



Virtual Quality Improvement in Early Childhood: Virtual Observations, Goal Setting, and Text Messaging to Promote Adoption of Evidence-based Practices

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Abstract

Millions of young children attend childcare settings in the United States and the quality of these early childhood settings, such as the activities children engage in and how teachers interact with children, matter for children's development. This study was designed to test the impacts of a tech-enabled observation and feedback system focused on quality practices in early childcare. A randomized trial of 46 childcare professionals using items from a new observational quality tool outlining specific EBP, Brief Early Childhood Quality Inventory (BEQI), in Nebraska, was conducted. Treatment and control groups were observed virtually for 90 min by trained observers and received results from their observations on a set of evidence-based practices (EBP), such as engaging children in conversations about feelings and reading books. Treatment group participants then engaged in goal setting for EBP and received text-based messages for 12 weeks, while control group members only received observation results. Results indicated that treatment group members were significantly more likely to increase EBP that were targeted for change over the course of 12 weeks, with 62% showing improvement on two or more target EBP, whereas only 21% of the control group showed improvement on two or more target EBP. 70% of treatment group members agreed that the program was beneficial for the children in their care, and 73% would recommend the program to another childcare professional. Providing feedback to educators based on a simple observational tool can help promote adoption of EBP in childcare settings, with positive effects of an intervention focused on goal setting and support for specific practices through text messaging.

Keywords Early Childcare and Education · Professional Development · Tech-enabled Systems

Influencing Adoption of Evidence-based Practices in Childcare Using Feedback, Goal Setting, and Text Messaging

High-quality childcare — as measured by the degree of emotional support and environmental stimulation, safety, and protection and promotion of physical health — is associated with better child development outcomes (Burchinal

et al., 2010; Bustamante et al., 2022). Elements of high-quality care associated with children's school readiness and long-term development include structural elements, such as teacher/child ratios (NICHD, 2002) and teacher qualifications (Manning et al., 2019); and process elements (Ulferts et al., 2019), such as teacher/child interaction (Cash et al., 2019), focused attention to literacy and math (Jenkins et al., 2018), and children's access to materials (Mashburn et al., 2008) that ensure environments are stimulating and responsive to individual children's needs. High-quality childcare is especially important for young children who have experienced environmental risk factors such as growing up in poverty, experiencing migration, high levels of family stress, and exposure to community stressors like violence and racism (Bustamante et al., 2022). Yet in the United States, a large-scale study of early childhood settings found that less than 10% of childcare settings met standards for high-quality

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care (Griffin & Friedman, 2007) and more recently, analyses suggests that many early childhood settings meet slightly more than half of desired quality benchmarks (Slicker et al., 2023), underscoring the importance of focusing on quality in childcare settings.

Research has demonstrated that adopting evidence-based practices (EBP) in childcare can lead to positive impacts on observed childcare quality and child development (Egert et al., 2018). A key question facing the field of early childhood is how to promote reliance on EBP among all early childhood professionals, especially when access to professional development (PD) is uneven. Many early childhood professionals are highly dedicated to children and families. As a group, childcare professionals express motivation to stay in the field independent of compensation (Torquati et al., 2007), demonstrating the depth of commitment that many professionals feel towards children and families (Park et al., 2022). Therefore, the lack of reliance on EBP is perhaps most accurately viewed as the result of barriers such as lack of knowledge of what to do, inability to enact EBP based on lack of materials, time or other factors, and lack of belief that a particular EBP is important. Focused interventions specifically targeting barriers to adoption of EBP therefore may be effective. This study addresses the need for evaluation of scalable, cost-effective interventions to promote use of EBP in childcare settings, using mechanisms such as text messaging.

Data are limited on cost-effective approaches to encourage behavior change and increase the use of EBP. Most efforts to improve quality are delivered through PD programs which take several forms, including in-person training, coaching, and peer mentoring (Schachter, 2015). While PD varies in both form and impact, overall, research has found that targeting quality practices through PD leads to positive impacts on children's development (Egert et al., 2018). Provision of technical assistance and high-intensity PD positively affect childcare quality in family childcare homes (Han et al., 2021; Tang et al., 2020). Coaching, based on ongoing interactions between a coach and a childcare professional, has been documented as one of the most effective pathways towards childcare quality improvement (Yang et al., 2022). Meta-analyses showed that in-person, relationship-based coaching for 45–60 h total had the largest effect sizes on improving childcare quality, but such coaching interventions are expensive and difficult to scale (Ackerman, 2008).

Another key mechanism for supporting quality improvement is giving targeted, explicit feedback on specific changes to make in early education programs (Egert, 2018). Many childcare facilities experience observations of program quality by outside observers through state quality rating and improvement systems, childcare PD programs, and

other mechanisms. The purpose of these observations is to document strengths and areas for improvement, which in turn is hypothesized to lead to changes in childcare quality. Several studies have documented the value of video feedback for improvements in the sensitivity and responsiveness of childcare providers (Groeneveld, 2016; Werner et al., 2018). But there are at least two limitations to the present system of providing observational feedback that should be addressed: (1) observations are costly to scale, requiring trained observers and the willingness of early educators to allow them into early childhood settings; and (2) feedback from observations is not always provided to educators, and when it is it is not consistently provided in ways that are specific and immediately actionable, often focused on adherence to state standards rather than childcare providers' personal goals. For example, in K-12 school settings, observations conducted by principals do not consistently lead to sustained improvements in classroom quality (Stecher et al., 2018), in part due to the lack of specific, actionable feedback and the amount of time required for principals and other school leaders to document practices well. However, less work on the value and potential impact of specific, actionable observational feedback has been focused specifically on early childhood settings.

Further, we know little about the impacts of light-touch, technology-enabled approaches to PD in childcare settings. Integrating scientifically proven behavior change techniques to encourage EBP (i.e., providing feedback to providers using objective data and encouraging behavior change through setting goals and positive reinforcement) has the potential to transform childcare environments (Carey et al., 2019) but questions remain on how to effectively deliver these interventions at scale. While tech-based interventions have been shown to promote healthy behaviors among childcare professionals (Arandia et al., 2020) less work to date has focused on interventions using behavior change techniques to promote EBP for child development. A recent systematic review reported only 11 studies with adequate rigor for judging the impacts of tech-based PD on observed quality (Snell et al., 2019). Text messaging and emails can encourage childcare providers to adopt EBP (Barton et al., 2019), although effects indicated that individual approaches were needed to maximize impact.

Insights from behavioral science have demonstrated that exposure to brief early childhood interventions, or “nudges” can lead to positive changes over time. Nudges have been defined as a method for “influencing ... behavior through suggestions, positive reinforcement and other non-coercive means” (Karlsen et al., 2019; p.1). Specifically, nudge theory has posited that brief, focused messages on aspects of behavior change can lead to positive changes in reliance on EBP. Brunsek et al. (2023) recently reported positive changes in

response to a brief PD intervention relying on several forms of focused feedback and text messaging. Using a text-based approach to support teachers in a large-scale study, Hanno (2023) reported nudges on two goals: making transitions more efficient and promoting language development. The system was effective in encouraging teachers to speak more to children (although they listened less) and had no impact on changes to transitions. Hanno concluded that concrete messages that are feasible to implement could be a critical piece of effective use of text messaging. Given the potential value of inexpensive, tech-enabled PD techniques for scaling quality early childhood programs, more work is needed to examine the role that nudges delivered through text messaging can play.

This study was designed to examine the impacts of a virtual observation of routine childcare practices followed by providing childcare professionals feedback on target EBP, goal setting, and text-message nudges on the adoption of specific EBP in typical childcare settings in Nebraska. Rather than an emphasis on broad, comprehensive ratings of quality, we were interested in testing the impacts of a tech-enabled system on the adoption of specific practices. Based on previous work, we hypothesized that an observation coupled with goal setting and a focus on a small set of EBP, reinforced through text-message nudges, would lead to a greater uptake of EBP than an observation and feedback alone. We also hypothesized that educators' perceptions of the importance of specific EBP and their sense of personal efficacy would moderate results, with greater behavior change among educators who believed the EBP were important and who experienced high levels of personal self-efficacy.

Method

Participants

Prior to recruitment, the study design was approved by the Institutional Review Board. Childcare professionals were recruited to participate in the study through publicly available lists of childcare providers, childcare networks providing PD, social media, and through word of mouth among childcare providers between August 2022 and February 2023. Educators were recruited statewide, including rural areas, through childcare networks in Nebraska. Once an educator signaled interest, they were provided with materials outlining the purpose and process of the study for informed consent and were asked to complete an initial needs assessment survey.

A total of 81 educators initially responded to the study call, filled out the needs assessments survey, and agreed to

participate in the full study. The needs assessment survey included questions on educators' income, age, PD received in the past year, overall levels of stress, beliefs about the importance of quality practices, and feelings of self-efficacy. After completing the needs assessment survey, participants were contacted to schedule a 90-minute virtual observation of a typical morning in their early childhood setting. A total of 46 educators scheduled virtual observations. Prior to the observation, a pre-meeting was held to tour the program area and to ensure appropriate logistics, such as the device placement and connectivity, were in place for the virtual observation. After the observation was complete, participants were randomly assigned to treatment ($n=23$) and control ($n=23$) groups. At endline, there was no attrition in the treatment group versus seven of 23 participants in the control group who did not complete the final observation. Educators were compensated \$50 for completing initial needs assessment and observation, and \$50 for endline observations. Educators who completed the intervention received an additional \$50 for participating in the text message program.

Of the 46 participants, 37% were working in childcare centers, 58% were working in licensed family childcare homes, and 4% were in unlicensed family childcare homes. Educators had been working in childcare from 1 to 40 years (mean = 15.00 years; SD = 10.71); ranged in age from 22 to 63 years; and had formal education ranging from high school to advanced degrees. Participants' total household income ranged from less than \$25,000 per year to more than \$120,000 per year. Eighty-five percent of participants identified their race as white, 2% identified as Black, and 13% as another race/ethnicity. Eleven percent of participants reported that all children in their program identified as Black, Indigenous, and people of color (BIPOC), and 59% of participants reported that some of the children in their color identified as BIPOC. Family childcare home educators reported more PD hours (mean = 30 to 45 h) than childcare center educators (mean = 15 to 30 h) and were less likely to enroll children on subsidies.

There were no significant differences between treatment and control group participants on age, income, year of formal education, caring for children on subsidies, family childcare home vs. center, amount of PD received in the last year, overall stress levels or baseline quality observation scores. Treatment group participants were more likely to have received an observation of childcare quality within the past year (65% of treatment group participants vs. 35% of control group participants). Treatment group participants were evenly split between centers ($n=10$) and family childcare homes ($n=10$), with 2 unlicensed childcare providers. We therefore concluded that the randomization process was successful.

Measures

Needs Assessment Survey

Needs assessment survey questions included educators' ages, level of formal education, PD received, participation in the state quality improvement and rating system, whether an observation had been completed in the past year, their race/ethnicity as well as the children they were caring for, their views on the importance of specific quality practices in childcare settings, perceived self-efficacy and stress levels. Perceived self-efficacy was measured using a validated scale (Schwarzer et al., 1995). All other questions were generated by the research team to align with study goals. Stress was measured by asking educators to rate the extent to which they were stressed by a series of job-related stressors, including addressing children's behavior problems, dealing with administrative issues, communicating effectively with parents, enrolling children, and having enough resources for the program. Perceived importance of specific practices was measured by asking educators to rate each practice using a sliding scale of 0 to 100.

Brief Early Childhood Quality Inventory (BEQI) Observation

The BEQI tool is an observational measure of early childhood quality that is primarily comprised of binary yes/no items indexing specific EBP; use of materials is indexed using a 3-point scale (not available; available but children not observed using materials; and material available and at least one child observed using). BEQI was developed based on available literature on specific practices that promote child development followed by expert review of the items, rated for importance for child development outcomes. After this process, a total of 44 observational items were retained for the final tool. Scores are created by summing across items, with higher scores indicating that more desired behaviors are observed. Because the focus of this study was on the ability of text messaging to support changes in a small set of EBP, we selected eight BEQI items for this study. We refer to these eight selected practices as "targeted EBPs" in this paper. These practices included (1) creating the time and space for children to read books on their own; (2) educator reading story books to children; (3) talking with children about emotions; (4) working one-on-one with children; (5) connecting activities to children's lives; (6) integrating math concepts into activities and conversation; (7) integrating literacy concepts into activities and conversation; and (8) integrating science concepts into activities and conversation. These items were identified because of their significance for child development and because preliminary data (not reported here) showed a variability in how frequently

these practices were observed within another sample from the same population. See Table 1 for a summary of the literature supporting each of the selected eight practices.

Observers were highly trained early childhood experts with experience conducting observations of childcare quality using several different tools. Seven observers participated in a four-hour virtual BEQI reliability training. At the end of the training, observers completed two BEQI Reliability Assignments which included a written quiz, made up of 20 multiple choice items related to the BEQI. Following the written quiz, observers watched a 30-minute video from a family childcare program and scored the video using the full BEQI Observation tool. Scores were then compared to the master coded scores. To become reliable on the BEQI, observers had to score above 85% on both assignments. At the end of the training, all seven observers passed both quizzes.

A 90-minute virtual program observation was performed for all educators. Observers completed the BEQI observation scorecard immediately after the observation was complete. To minimize bias, observers were blind to whether educators were in control or treatment group and were not aware which EBP practices were targeted or set as goals. Once the observation was complete, all participants were sent feedback, described in greater detail below.

Weekly Progress Reports Via Text Messaging

Educators in the treatment group were asked to respond to weekly surveys sent via text message with questions regarding their progress towards their selected goals for quality improvement and the barriers that stood in the way (more information on the goal setting can be found below, "Treatment Group Intervention"). They were also asked to report on how happy they were feeling in their jobs. As outlined below, text message surveys were sent to educators weekly during the intervention period. Control group participants did not receive text messages.

Feedback on Program Participation and Impacts

At the end of the intervention period, we asked treatment group participants how likely they would be to recommend the program to other educators and how much or little they believed the program impacted children in their program, along with questions about which programmatic activities were helpful to them.

Procedure

After completing the needs assessment and observation, educators received observation feedback. To minimize

Table 1 Rationale for 8 potential target practices

Practice from BEQI Observation	Evidence
Children read or look at books on their own	Book reading and other oral language and preliteracy practices need to be given priority within the ECE setting, with a particularly strong focus on supporting the young child's oral language development (Dockrell, 2019), adopting a playful approach to emergent literacy (Nicolopoulou et al., 2015), and providing a literacy-rich environment (books, labels, signs, and so on). Children need spaces and time to read on their own, for example, book corners where children can "read" picture books either alone or in small groups (Reese, 2015).
Educator reads a storybook to children	Shared and interactive book reading with young children significantly enhances the rate of their vocabulary growth and their overall oral language development. It is consistently ranked as the most impactful activity on preschoolers' literacy development both at home and at school (Dennis & Horn, 2011).
Educator talks about feelings or emotions	Emotional competence – expressing, understanding, and regulating emotions in an adaptive manner – is crucial for young children's social and preacademic development (Denham & Liverette, 2019). Children become better skilled at describing emotions when adults provide appropriate information about what people are feeling and why, rather than expecting children to know these things automatically (Thompson & Twibell, 2009).
Educator works one-on-one with children	Individual educator-student interactions- characterized by educator' sensitivity to individual needs, individualized support for positive behavior, and stimulation of language and cognitive development- are a key element of classroom experience that appears to benefit all children across the pre-K-3 span (Burchinal et al., 2000; Pianta et al., 2005). Explicit teaching and one-on-one support allow educators to scaffold or work specifically with children who may be struggling with a task (Hall et al., 2015).
Educator connects a lesson to real-life or every-day experiences	Making links and connection to a child's world (i.e., asking questions or making comments that help the child make connections between the text and their experiences) emphasizes critical language and vocabulary skills (Roberts et al., 2005). Conversations that center on topics in which children are absorbed or can directly relate to are more likely to produce spontaneous and lengthier discussions than those focused on adult-directed or selected topics (Jalongo, 2007).
Educator integrates math concepts into activities and conversation; Educator integrates literacy concepts into activities and conversation; Educator integrates science concepts into activities and conversation	Intentional time spent on learning activities in ECCE, particularly literacy, mathematics, and science, leads to greater learning gains at the start of primary school (Burchinal, 2018). Playful learning can be enhanced by the involvement of adults, sometimes referred to as "guided play." Setting tasks in a playful context has been shown to enhance children's ability to focus their attention and resist distraction (White et al., 2017), to support their working memory (Mistry et al., 2001), and to enhance their oral language development (Quinn et al., 2018). Making an activity meaningful can help a child learn through play (Zosh et al., 2017) and facilitate "sense-making" for children (Fisher et al., 2013).

cognitive overload and in line with principles of behavioral science, educators only received feedback on a small number of practices. In the treatment group, educators received feedback on three "areas of goalsetting" (i.e. EBP they were not observed doing) and six "strengths" (i.e. EBP they were observed doing); in the control group, educators received feedback on a maximum of four EBP they were not observed doing and four EBP they were observed doing (with the goal of balanced feedback on observed strengths and weaknesses).

Treatment Group Intervention


First, educators received a strengths-based summary of their BEQI observation. The summary first validated the educator's strengths (six EBP observed during the BEQI observation) and then focused on three target practices (based on non-observed EBP), which were framed to educators as "Areas for Goalsetting". We randomized which practices we gave feedback on, prioritizing the eight target practices as mentioned above. See Fig. 1 as an example of the Observation Summary provided to the treatment group. BEQI

observation summaries were sent to the educators in the treatment group via text message.

Upon receipt of the observation summaries, educators were asked to select one goal from their three identified "Areas for Goalsetting" for an EBP they wanted to address. The intervention was implemented in two rounds of six-weeks (12 weeks in total.) From the "Areas for Goalsetting," educators chose a first goal of an EBP to focus on in the first six weeks (weeks 1–6). At the end of the first six weeks, educators selected a second goal (from the same list) to focus on for the second six weeks (weeks 7–12).


Educators in the treatment group received "Together in Practice" Kits via mail. These kits included Together In Practice ("TIP") cards based on the specific goals they selected. The TIP cards outlined why their selected EBP was important, suggestions and examples of how to implement it, along with simple materials to support them in implementing the EBP. See Fig. 2 for an example of a TIP card. Educators received two TIP Kits: one per each selected goal for each of the six-week text goal setting program.

Educators in the treatment group also received and responded to weekly text message "nudges" to support them with their goals. Educators received two text messages per



BEQI • Brief Early Childhood Quality Inventory

Observation Summary



Provider Name _____ **Date of Observation:** _____












Your Strengths	
<i>Congratulations! We observed you doing some great things to support your children learn and develop.</i>	
	<p>1. You read storybooks to children By reading aloud, you are helping foster a joy of reading as it presents books as sources of exciting experiences and helps to develop language and literacy skills.</p>
	<p>2. You talk about feelings with children You are helping children learn to manage their feelings and impulses during their early years and to put names to their emotions to help better express themselves.</p>
	<p>3. You integrate science concepts into your program Incorporating early science activities such as plants, seasons, color mixing, cause-effect helps children with higher level-learning by asking questions, making predictions, and exploring properties.</p>
	<p>4. You connect activities to children's daily lives When you connect learning to children's everyday life, you are helping them practice higher order thinking.</p>
	<p>5. You give children choice in how to carry out activities By giving children choice in how they do activities, you are helping them learn by creating their own understanding of how things work.</p>
	<p>6. Children in your program interact positively with each other Through promoting a community of positive relationships, you are helping children to connect with others, build healthy friendships, and support self-regulation of their emotions.</p>
Areas for Goalsetting	
We recognize that in a 90-minute observation, we may not see everything, but here are some areas we didn't see during the observation, which could be areas for setting goals in your daily program.	Why is this important?
	<p>1. You could help children read or look at books on their own When children read or look at books on their own, you help them set the foundation for early literacy and a love for reading.</p>
	<p>2. You could incorporate literacy concepts into your daily practice. Working with kids on letter identification, phonics, writing, rhyming, etc. can help get children become ready for learning to read and write.</p>
	<p>3. You could work one-on-one with children By giving one-on-one time and feedback to children, you are helping to stimulate the child's thinking, problem-solving and overall learning.</p>
What's next?	
We appreciate you participating in the observation.	
Over the next few months, we will be working with you through text messages. We'll be helping you think about strategies and ways to regularly incorporate these practices into your daily work to support the children in your program. As a token of appreciation for responding to our texts, we will be providing an additional \$50 gift card at the end of the program.	
Please reach out to info@scdmmeasure.org with any questions.	

Fig. 1 Treatment group observation summary sample




Help Children Read or Look at Books On Their Own



TIP Card

Together In Practice



This boy is relaxed and comfortable while he explores a book by himself.

Why should children look at books on their own?

The foundation for literacy begins early for children that regularly explore books. Throughout early childhood, children need to have multiple opportunities to look at books on their own. Children that can read the pictures or recall a story that has been read to them are beginning to show a love for reading. If a child reads for pleasure, they are on the way to becoming a reader for life. When children have access to and can choose books to “read” or look at independently, they will want to read.

How can I put this into practice?

The first step in promoting independent book exploration is to set up access in a cozy place:

- ✓ **Create comfortable and inviting spaces in different parts of your program for children to cozy up with a book.**
- ✓ **Make the book reading area inviting with comfortable furniture. Add homelike touches such as: pillows, rugs, low lighting, plants, stuffed animals, or dolls.**
- ✓ **Put books that go with your current theme or topic in a special display or basket.**
- ✓ **Make sure books are in good condition, right for your age range of children and of interest to all.**
- ✓ **Rotate books in this area so that they are fresh.**

STRATEGIES TO TRY

Easy access:
Place books down low and visible so that children have access. Think about putting books or magazines in other play areas.

Theme-based books:
Put books that go with your current topic in an inviting and seen place.

Set aside time:
Make time to invite children to choose books on their own. Notice out loud to them as they are reading.

Inviting:
Make the book area inviting and cozy. Think of soft and beautiful places that say, “Come curl up with a book!”

Variety of books:
Offer a variety of books, including fiction and non-fiction.

Home languages:
Make sure that there are books in every child’s home language. If not available, ask parents for help.

Share read aloud books:
After reading storybooks to the group, make those books available for choice.

Fig. 2 Together in practice “TIP” card example

week. Text messages included (a) weekly brief surveys to answer questions about how the educators were feeling, how often they implemented their goal in their childcare over the previous week, and any barriers towards implementing the goal; (b) weekly light PD in the form of a text message, including some basic information about why their goal was important, suggestions of how to do the goal and materials that could be used to support the goal, and video examples of other educators doing the goal.

At the end of each of the six-week goalsetting program, participants were sent a final survey via text message to reflect on their overall change in practices, their perceptions of the program in terms of helping improve general practices, and to provide feedback on the individual components of the goal setting program (i.e. receiving observation summaries, making goals, receiving text messages, receiving the TIP kit, etc.). Educators in the treatment group participated in two rounds of this six-week text messaging program; each round focused on a different selected goal.

See Fig. 3 for a summary of the full 12-week text message goal setting program.

Control Group

Educators in the control group received a simple summary of eight practices following their initial observation. We focused on the same eight target EBP as the treatment group and randomized what feedback we provided. Educators received feedback on up to four practices they were not observed doing and at least four practices they were observed doing. If there were less than four of the target practices observed, we provided feedback on practices they did from other preselected items from BEQI observation. These basic summaries were sent via mail and no additional feedback was provided. See Fig. 4 as an example of the Observation Summary provided to the control group. The control group did not participate in a text messaging program or receive any additional support.

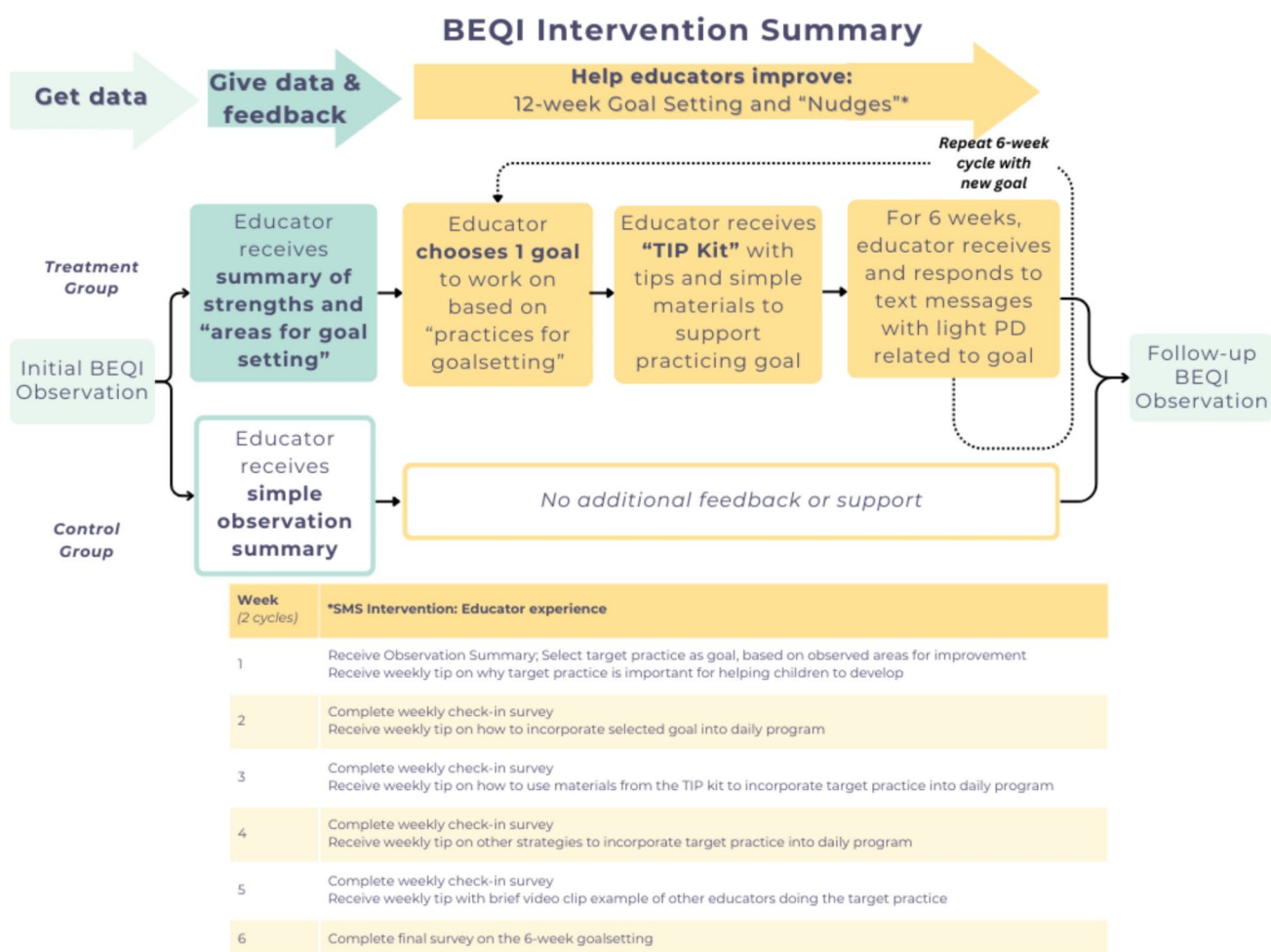


Fig. 3 BEQI intervention summary



BEQI • Brief Early Childhood Quality Inventory

Observation Summary



Thank you for participating in an observation last week. We appreciate your willingness to contribute.

Below you will find a brief summary of our new observation measure. We are still testing this measure and we are grateful for your partnership. We understand that you may not do every activity on this list every day and we appreciate all of the good things you do every day with children!

We're sending along a gift card as a token of our appreciation. Our research team will be reaching out in a couple of months.

Provider Name:

Date of Observation:

<i>Below is a summary of what we observed. Each of these activities can support children's learning and development.</i>	Yes	No
1. Children work one-on-one with you	X	
2. You talk about feelings with children	X	
3. You read storybooks to children	X	
4. You lead a science activity with children		X
5. Children read books on their own		X
6. You connect activities to children's daily lives		X
7. You give children choice in how to carry out activities	X	
8. You lead a literacy activity with children		X

Fig. 4 Control group observation example

End of Intervention for Both Groups

After an average of 15 weeks (minimum 79 days- maximum 216 days elapsed for all participants; mean 108 days elapsed for treatment group and mean 104 days elapsed for control group participants), participants in both the treatment and

control group participated in another 90-minute virtual BEQI observation using the same tool as in the beginning of the intervention. A full summary of the intervention can be seen in Fig. 3.

Analytic Plan

Our main hypothesis was that educators in the treatment group would show a greater degree of improvement in use of target quality practices (e.g. specific not-observed EBP that participants received feedback on) than educators in the control group. As such, our analytic strategy was focused on comparing the control and treatment groups on use of target practices. We constructed two outcome variables as proxies for quality. First, we constructed a variable to summarize changes in EBP that were designated as “target practices” from Time 1 to Time 2 for the treatment group. This variable identifies whether unobserved practices that educators received specific feedback on were observed in the Time 2 observation, summarized as a percentage. Given that participants did not necessarily receive feedback on the same number of EBP, we calculated individual scores as a percentage (i.e., if an educator received feedback on three EBP and showed changes in two, they would receive 0.66 as their score for this variable). Second, we report on the total scores for the eight target practices at Time 1 and Time 2.

Results

Time 1 Needs Assessment Results

The goal of our analyses of Time 1 survey responses were to identify associations between educators’ education, PD, feelings of self-efficacy, and perceived importance of EBP, and Time 1 observations of the eight practices, as a first step in defining how these factors were related to intervention effects. Educators gave high ratings to the importance of EBP, with means of 85 or higher on all items. Science and math activities were given lower ratings overall than the other practices, with an average of 87 on math activities and 85 on science activities compared with averages of 97 on reading books to children and talking about feelings,

which may reflect lack of support for early math and science among childcare professionals (e.g., Geist, 2015; Piasta et al., 2015). But contrary to our hypothesis, there were no significant associations between the degree to which educators rated each practice as important and whether they were observed as engaging in that practice during the observation. We also found no associations between engagement in the eight practices at Time 1 or overall BEQI scores, ratings of importance of target behaviors, and educators’ feelings of self-efficacy and stress.

Time 1 Initial Observations and Goal Setting

Total children present during the initial observation ranged from 2 to 22 (mean = 7.83; SD = 3.88); total number of educators ranged from 1 to 3 (mean = 1.15; SD = 0.42). Table 2 displays the frequency of observed target practices for both groups of educators. Of the eight target practices, the most frequently observed practice at Time 1 was educators working one-on-one with children (87%); least frequent was educator incorporating science activities (13%). Mean number of practices observed among the eight was 4.95, ranging from 1 to 8; the treatment group mean was 5.17 and the control group mean was 4.74 and the difference was not statistically significant. Educators who had received more PD in the past year were observed as having a higher mean score on the eight practices at Time 1 ($F(3, 45) = 2.99, p < .05$). We observed no other significant associations between educator characteristics measured in the needs assessment survey and overall scores on the eight practices.

Educators in the treatment group identified two goals based on observational feedback as described above. Selected goals were relatively evenly distributed across the eight. See Table 3 for the percentage of goals selected by educators.

Table 2 Frequency of practices observed at time 1 and time 2

Observed potential target practice	Frequency of practice observed ($n = 39$)			
	Time 1		Time 2	
	Control Group	Treatment Group	Control Group	Treatment Group
Work 1-on-1	13	21	13	19
Read storybooks aloud	12	17	11	16
Talk about feelings	12	15	12	15
Connect to daily lives	9	17	10	13
Incorporate math concepts	3	5	2	3
Help children read/look at books	2	6	4	5
Incorporate literacy concepts	2	5	3	6
Incorporate science concepts	1	4	2	4

Note. Given the randomization of feedback to prioritize strengths-based feedback, not all educators received feedback on all eight practices. Table 3 below shows whether educators received feedback on specific practices.

Table 3 Feedback on target practices and rate of addressing feedback

Potential target practice	Frequency of feedback provided on this practice at Time 1 ^a		Goal Selection Rate for Treatment Group ^e	Rate of addressing feedback ^b		
	Control Group ^c	Treatment Group ^d		All Educators	Control group Educators ^f	Treatment group Educators ^g
Work 1-on-1	6	1	100%	100%	100%	100%
Read storybooks aloud	3	5	40%	44%	15%	75%
Talk about feelings	3	5	80%	71%	100%	60%
Connect to daily lives	4	5	40%	70%	80%	60%
Incorporating math concepts	10	11	64%	50%	0%	91%
Help children read/look at books	12	15	67%	23%	18%	27%
Incorporating science concepts	11	14	71%	44%	15%	75%
Incorporating literacy concepts	13	13	77%	39%	18%	58%

Note.

^a Unobserved practices that educators received feedback on in their observation summaries.

^b Percent who showed improvement on target practice at Time 2.

^c Control group educators were provided feedback on eight practices, including at least four strengths. If there were not four strengths within the eight potential practices, other strengths from BEQI items were provided. If there were more than four target practices were not observed (e.g. unobserved practices), maximum of four practices were randomly selected for feedback. In our analysis, to make comparable number of target practices between CX and TX, three target practices were randomly selected for control group.

^d Treatment group educators were provided feedback on nine practices, including no more than three practices they were not doing, (e.g. target practices). If there were more than three of the eight potential practices not observed, practices were randomly selected for feedback.

^e Educators were asked to select one goal to work on for six weeks, then a second goal to work on for another six weeks. This is likelihood of educator selecting specific target practice to work on as a daily practice.

^f Rate of addressing feedback for control group educators describes whether at Time 2, they were doing the four target practices they were told they were not observed doing at Time 1.

^g Rate of addressing feedback for treatment educators looks at whether the three target practices changed between Time 1 and Time 2 (regardless of whether educator selected it as a goal).

Time 2 Observations

Total children present during the Time 2 observation ranged from 3 to 24 (mean = 8.77; SD = 3.78); total number of educators ranged from 1 to 3 (mean = 1.03; SD = 0.40). Consistent with Time 1, the most frequently observed activities were educators working one-on-one with children (82%) and the least frequent was educators incorporating science activities (15%).

Intervention Effects

Our primary hypothesis was that treatment group members would demonstrate greater improvements in target practices from Time 1 to Time 2 than control group members. Table 3 illustrates the rate of changes on the specific areas of feedback that educators received in their observation feedback summaries. In both groups, educators were most likely to improve the practice of working one-on-one with children (100% of treatment and control groups improved this EBP after receiving feedback on it). Across groups, educators were less likely to improve the practice of helping children read or look at books on their own (27% of treatment groups and 18% of control group improved this EBP after receiving feedback on it).

When we focused on changes in the two specific target practices that were selected as goals, significant differences between the treatment and control groups were noted (treatment mean = 0.62; control mean = 0.21; $F(1, 37) = 19.48$, $p < .001$; eta squared = 0.32). Treatment group members were three times more likely to demonstrate changes in the targeted EBP than control group members, with an average of 62% of EBP improved in the treatment group versus an average of 21% of EBP changed in the control group.

We found that 91% of educators in the treatment group who received feedback and participated in the goal setting text message program showed improvement in at least one of the targeted EBP, compared with 56% of educators from the control group who received feedback on areas for improvement but no further support. Said another way, members of the treatment group were more likely to improve on the targeted EBP identified in the observation through receiving feedback, texting, and TIP cards than members of the control group, who received information on the weaknesses with no additional support or nudging.

Notably, even in the absence of continued support, some educators from the control did show improvement on some of the EBP that were targeted for improvement solely by being informed they were not observed implementing an EBP. Educators in the control group were most likely to

change their practices at Time 2 around working one-on-one with children and talking about feelings (100% improved between Time 1 and Time 2) and were least likely to change practices to incorporate math activities (0% improved) or science concepts (15% improved.) (Table 3).

Overall Changes in The Eight Targeted Ebp and Beqi Scores from Time 1 to Time 2

When looking across all educators with complete observational data in both treatment and control groups, however, there were no statistically significant changes in the eight practices between Time 1 and Time 2, although overall means declined in both groups, from 4.74 to 4.56 in the control group and from 5.17 to 4.69 in the treatment group. Additional analyses on the participants whose scores improved from Time 1 to Time 2 indicated that participants with the least amount of PD in the past year, who also had lower scores at Time 1 ($r = -.71, p < .001$), were more likely to improve rather than decline over the 12 weeks, regardless of membership in the treatment or control group. Educators with more experience were marginally less likely to improve their practices over the 12 weeks ($r = -.31, p < .10$). There were no changes in overall BEQI scores on target practices from Time 1 to Time 2. (Table 2).

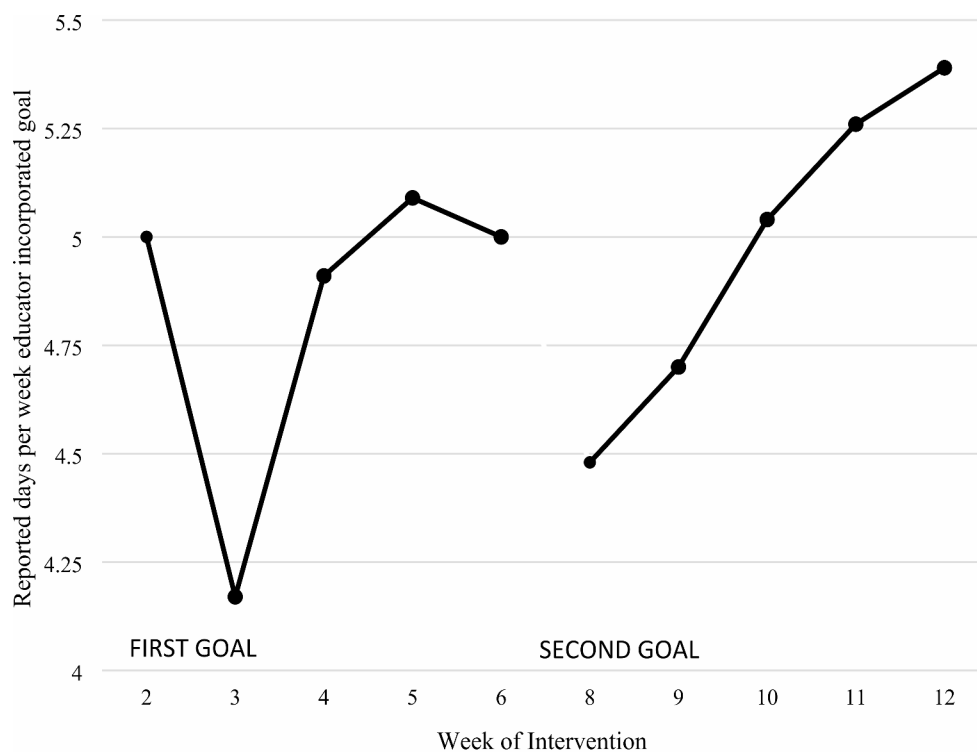
Self-reported Adherence to Goal Setting

At weekly intervals ten times over the intervention period, we asked educators to report on the number of days per week they had implemented their goal. Using a repeated measures ANOVA ($F(1, 22) = 620.21, p < .001$), we found statistically significant differences in the number of reported goal days over the course of the intervention. Reported goal days were lowest towards the start of the intervention and were greatest during the mid-point of the intervention for Goal 1 and at the end of the intervention for Goal 2. However, we did not find an association between the number of days educators reported achieving their goals and observed practices at Time 2. See Fig. 5.

Evaluation of Program

Treatment group participants were asked to provide an evaluation of the program after completing the final survey. We asked whether they felt that the program helped them better support the children in their program, and whether they would recommend it to other educators. Ninety-six percent thought it was helpful to receive immediate and strengths-based observation feedback; 91% thought it was helpful to reflect weekly on their practices; 73% would recommend the BEQI goalsetting and text message nudge intervention

Fig. 5 Self-Reported Goal Days over the course of the interventionss



Note. Educators set goals on Weeks 1 and 7 of intervention and reported on goals

to other educators; and 70% believed it was beneficial for the children in their care.

Discussion

This study offers initial experimental evidence that a tech-based intervention integrating virtual observation with goal setting and text-message nudges on specific EBP practices that promote child development can be effective. Combining an observational tool that focuses on specific EBP with 12 weeks of feedback, follow up, and support for improvement, our results demonstrate that goal setting and follow up text messaging can encourage the adoption of EBP in childcare settings. We found strong evidence that goal setting and follow-up text messaging is more effective in encouraging adoption of specific practices than observation and feedback alone. This study confirms results from Hanno (2023) demonstrating that text-message nudges may be one important element of scalable, impactful PD for childcare educators. Our study also differs from Hanno (2023) in that the list of potential goals to choose from were identified by researchers rather than by educators. Future work should compare the degree of buy-in for behavior change when goals are selected by educators themselves.

Most importantly, we found effect sizes that are only slightly smaller than effect sizes noted for more intensive interventions lasting for months and/or requiring several hours of training for educators (e.g., Werner et al., 2016; effect sizes ranging from 0.35 to 0.44 for effects on classrooms and caregivers). From this perspective, our results bode well for adding low-cost, easily scalable interventions to the mix of supports available for childcare educators. This may especially be the case for educators who are new to the field, or in low-resource or other types of settings where PD for early childhood educators is not readily available, as we found that changes were greatest among educators with the least amount of experience and training. Given the present shortage of qualified childcare educators, identifying how to begin engaging these educators in PD is an important task. Interventions such as the one we described here thus may provide an important first step towards sustained quality, especially given the positive feedback we received from treatment group participants about their perceived value of our intervention.

However, we also found that observation of EBP at Time 1 did not guarantee continued observation of the same EBP at Time 2. Like conclusions drawn by Hanno (2023), text messaging alone may not be sufficient for sustained reliance on EBP. In our trial, even when educators were affirmed for their reliance on EBP at Time 1, we did not consistently observe the same practices 12 weeks later. Clear focus and

goal setting may be essential for maintaining practices over time. We also were able to document educators' self-reported achievement of goals over the 12 weeks, which demonstrated the great variability in adherence to goals over the intervention period. While this study does not provide insight into why goal adherence went up and down, understanding what helps educators integrate new goals into routine practices is a central question for more deeply understanding how and why this type of intervention might work.

There were several limitations to this study, notably the small sample size and the subsequent inability to adequately test moderating effects. More research with larger samples is needed to build on the findings reported here. Further, we did not repeat the initial needs assessment survey at the end of the study, so we were not able to examine a comparison of Time 1 and Time 2 in all variables across the sample, which may have precluded our ability to detect changes in self-efficacy, ratings of the importance of specific activities and stress levels, as well as the role that knowledge and beliefs may have played in influencing adoption of EBP.

However, even with these limitations, the results from this study point to several conclusions to inform future work in this area. First, observations followed by goal setting and text messaging around specific practices is a viable route towards promoting adoption of quality practices, particularly for educators who have not had much PD and less experience in early childhood. Because many quality improvement programs offer more support to educators with higher quality levels and deeper investment in the field of early childhood, this type of intervention helps fill the gap for educators who are new to early childhood, who have invested less in PD, and/or have less opportunities for or access to PD. Second, experimentation with tech-enabled approaches to quality measurement and improvement is critical to ensure that the early childhood field is maximizing the potential of innovations.

In conclusion, this study breaks new ground by using virtual quality measures to focus on clearly defined, specific EBP, followed by nudge theory to encourage behavior change among childcare professionals. Given the millions of young children in childcare and the shortage of high-quality settings, the field of early childhood is ripe for innovations in training and professional development, especially those that rely on virtual, tech-based approaches that are inexpensive and scalable. Our study demonstrates that using virtual observations and text messaging to deliver nudges holds promise as an impactful and cost-effective intervention to promote quality. Future work should aim to replicate and expand this study, as a way of improving access to quality childcare for all children.

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Declarations

Competing Interests Authors Raikes, Mojgani, and Alvarenga Lima are compensated by ECD Measure, which has a financial interest in the Brief Early Childhood Quality Inventory tool.

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