

Teacher-Implemented AAC Intervention to Support Peer Interaction in an Inclusive Preschool

Classroom: A Pilot Study

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Abstract

Children with complex communication needs confront many barriers to peer interaction and, without intervention, are at risk for social isolation, even in inclusive classrooms. The aims of this pilot study were to determine the feasibility of training a preschool teacher to implement a peer interaction intervention and to measure the impact on the participating children. The teacher in this study was taught to program an AAC app and to implement a peer interaction intervention. The teacher's positive perception of the training and intervention, along with the social improvements seen in this pilot study are promising. More research is needed to increase confidence in the effectiveness of this training to support teacher-implemented intervention and peer interaction in inclusive classrooms.

Keywords: peer interaction, teacher-implemented intervention, augmentative and alternative communication, visual scene displays

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Social interaction between children paves the way for the development of robust friendships and social networks later in life. In addition, positive experiences with peers have cascading impacts, positively affecting language and cognitive development, mental and physical health, and academic success (Bukowski et al., 2009; Cohen, 2004; Hartup, 1989). Research on young children with complex communication needs (CCN) has identified many barriers to successful peer interaction, even in inclusive classrooms. These barriers include a lack of opportunities to interact with peers, a lack of support when social opportunities do exist, a mismatch of AAC systems to children who use them or to the communicative context (e.g. not having vocabulary to support social interaction), a lack of knowledge and skill of the classroom peers, and negative peer attitudes (Batorowicz et al., 2014; Chung et al., 2012). Teachers in these classrooms cite a lack of training or skill limitations as some of the main barriers to true inclusion for children who use AAC (Kent-Walsh & Light, 2003).

The best evidence interventions to support interaction between children with CCN and their peers frequently incorporate peer training with either (1) teaching skills and strategies to children with CCN, or (2) modifying the environment, or both (Author, 2016). One challenge for interventions including a peer training component is the establishment of relationships with a status differential, where the peer is a “special helper” and the child with CCN needs help. These interventions may promote improvement in use of AAC, academics and other areas, but are unlikely to contribute to the long-term goal of friendship development, and may, in fact be detrimental to it (Finke, 2016; Janney & Snell, 1996). Finke (2016) suggested that impactful peer

interventions must facilitate equal status between children and provide frequent motivating and authentic opportunities for interaction.

Authors (2016, 2018) developed a peer interaction intervention to increase communication between preschool children with CCN and their peers within a shared storybook context. This intervention included two components. The first was a dyadic training during which both children were taught conversational turn-taking skills. The second was the provision of an iPad with an app that allowed for embedding communication within the activity via visual scene displays (VSDs) of storybooks with built-in communicative hot spots. The iPad was presented as a universal support, and both children were encouraged to use it to support communicative interaction.

The intervention in Authors (2016, 2018) was designed to establish an equal-status relationship between the children and provide a motivating context for intervention and interaction. However, it was implemented by the research team outside of the preschool classroom. While this was necessary for experimental control and to evaluate the efficacy of the intervention, it limited the ecological validity. To test the effectiveness of any intervention in the “real world,” researchers must consider both the natural interventionists and the natural context for intervention (Olswang & Prelock, 2015).

Teachers are the natural interventionists in a preschool classroom, and research has shown that SLPs training caregivers to implement intervention has a positive impact on children who use AAC (Kent-Walsh et al., 2015). Therefore, the purpose of this study was to determine the feasibility of training preschool teachers to implement the peer interaction intervention within the classroom and to evaluate the impact of that teacher-implemented intervention on the participating children.

In this study, the researchers trained and supported the preschool teacher to deliver intervention in the natural environment of the classroom and measured the impact on peer interaction and communication between a child with CCN and her peers without disabilities. The primary research question was with what degree of fidelity will the teacher be able to program VSDs and implement the peer interaction intervention in the classroom after training? In addition to this primary question, this study explored the effect of the teacher's implementation on the communicative turn-taking and joint engagement of participating students. Finally, social validity data was gathered through a teacher interview to ascertain the teacher's perceptions of the training and the intervention.

Method

Research Design

IRB approval was granted by the Human Subjects Research Board at the author's institution. An A-B single-case design was used in this pilot investigation (Gast & Ledford, 2014). This design allowed for repeated measures of the target variables before and during intervention, which enabled a comparison of communicative interaction skills and joint engagement over time. Single case research design quality indicators were considered by ensuring at least five data points per phase and a stable baseline performance prior to beginning intervention (Kratochwill et al., 2010). Although it limits the conclusions that can be drawn related to student improvement, because prior intervention research (Authors, 2016; 2018) did not focus on teacher training, a pilot with one teacher was a necessary first step before training a larger group of teachers. The pilot allowed the research team to gather teacher input and

determine whether the teacher training component would require changes to be acceptable and effective.

Participants and Setting

One teacher, one child with Down syndrome and CCN (Ava), and one peer (Maddy) participated in this research. Recruitment emails were sent to directors of preschools that included children with and without disabilities in their classrooms. Once a center was chosen, the researcher explained that the participants were to be a classroom teacher, a child with complex communication needs, and a child with no identified disability. The director facilitated an introduction with a teacher whose classroom was appropriate for the study, and the teacher consented to participate. The participating teacher was a 22-year-old, Caucasian female with some college education. She had been working as lead teacher in her current position for one year and had been an assistant teacher at a different preschool for the four previous years. Students in her classroom were between the ages of four and five. Approximately 50% of students in her class received special education services.

The teacher shared information about the study with parents of children who met the inclusion criteria, and interested parents met with the author to discuss consent and sign documentation of consent. Although all children in the class could theoretically benefit from the classroom-wide instruction, the impact of the intervention was specifically measured on one dyad of students. Two students from the teacher's classroom participated in this research. Ava was a 4;6 (year; month) Caucasian female diagnosed with Down syndrome who had complex communication needs, meaning that her speech was insufficient to meet her communication needs. Ava communicated with intention, using gestures, some speech and some sign to communicate (approximately 20 total words). The teacher reported that she was not using any

aided augmentative and alternative communication (e.g., picture symbols, speech-generating device). Her speech was highly unintelligible, and the teacher reported that peers rarely understood her when she tried to communicate. Ava smiled often and seemed to enjoy most classroom activities. At the time of the study, she was receiving speech therapy twice a week. Maddy was a classmate of Ava's who was a 4;3 (year; month) Caucasian female, with no diagnosed disability. She was invited to participate as the teacher identified her as a student with no disability and good communication skills who followed directions and played well with peers.

Materials

A laptop with a PowerPoint presentation was used to guide the teacher training. An iPad with the AAC app, SnapScene (Tobii Dynavox, n.d.), was provided to the teacher to program VSDs for each page of selected storybooks and was used during circle time instruction and intervention data collection sessions. During data collection sessions across sessions, a camcorder was used to capture the interaction between children. Classroom books were available in the reading center at all times.

Measures

Teacher Implementation

To evaluate the teacher's successful implementation of the intervention, the percentage correct was calculated for following the VSD creation protocol and implementing the steps of the instructional sequence during circle-time sessions.

Child Performance

The child dependent variable was the frequency of symbolic communicative turns taken by the child with CCN. Each symbolic communicative turn was coded as a discrete variable and was operationally defined as the use of spoken words, speech output from the AAC device, or

conventional signs and gestures (e.g., shaking head to say “no”). A turn was complete when either the other child began taking a turn, or when two seconds passed with no communication. For example, multiple hits of communication hot spots on the iPad would count as a single turn unless a hit was followed by a two second pause or the other child took a communicative turn in between hits.

Collateral variables included the frequency of symbolic communicative turns taken by the peer (using the same definition as above) and joint engagement. The percent of intervals of joint engagement was coded using momentary time sampling. Because the representativeness of estimates of behavior increases with shorter intervals (Sharp et al., 2015), 10 second intervals were chosen. To meet the operational definition for joint engagement, participants were considered jointly engaged if they were looking at each other, were looking at the same object, or one child was looking at the object and the other child was looking at the first child.

Procedures

The study was conducted over a three-month period, including recruitment and documentation of consent. Once baseline sessions began, data collection sessions occurred two or three times per week. Although three sessions per week was the goal, this study was implemented in the spring in a preschool classroom, and many special events made it difficult to complete three sessions per week.

Baseline

During baseline, the teacher provided no peer interaction instruction. The two child participants were asked to engage in data collection sessions simulating “business as usual” conditions, that is, without having been trained in interaction skills and without access to the

iPad and communication app. The two children looked at available picture books together in the reading center while being video recorded.

Teacher Training

While children were participating in baseline data collection sessions, the teacher was learning to program VSDs of storybooks to provide systematic instruction to increase communicative interaction between the two children (see Figure 1). For learning to program the app, she engaged in self-study using a researcher-developed programming guide that included short video tutorials. The teacher chose storybooks that were available in the classroom reading center as part of the typical curriculum. She was instructed to take a photograph of each page of a storybook and add between one and four communicative hot spots to each page. The teacher would draw a closed circle around portions of the photograph that would capture a child's attention or foster communication. Once programmed, the child could touch that portion of the image and a message would be spoken aloud. The teacher recorded communicative messages of between three and five words according to the guidelines for creating hot spots from Authors (2018). Each hot spot was to be fun and functional, meaning that it was motivating and engaging for the children, but also satisfied a communicative function. To be fun, hot spots had to incorporate either sound effects, exaggerated emotions (e.g., giggling), silly words (e.g., "uh-oh"), or character voices (recording something the character in the book might say). To be "functional," hot spots had to ask or answer a question (e.g., "what is that?"), call attention to a part of the picture (e.g., "look at that bug!"), or relate the picture to the child's experiences (e.g., "I love dogs!").

The teacher received feedback on the VSDs she created based on a pre-established checklist of required elements (see Appendix), then updated the book accordingly. Once two

books were created to the required standards (a score of over 80% on the checklist), the teacher was asked to create one additional book per week independently during the intervention phase to maintain student interest and provide novel stimuli. The teacher did not provide students with access to the iPad until intervention occurred.

(insert Figure 1 here)

Following the fourth baseline session, the teacher also participated in a face-to-face training on implementing the peer interaction instructional sequence during circle time. The instructional sequence included six steps: (1) introduce with enthusiasm, (2) model the expected behaviors, (3) provide assisted practice, (4) provide feedback, (5) announce availability of iPad, (6) let them know the rules. A handout and video model of each step were provided. The 30-min in-person training was led by the research team and followed modified strategy instruction steps from Kent-Walsh & McNaughton (2005). First, the goals of the study were explained. Then, the instructional sequence (see Table 1) was introduced and described. A mnemonic, I'M A PAL, was introduced to aid memory of the instructional sequence. The teacher was asked to repeat the steps and descriptions orally back to the researchers. The teacher was then shown video examples of each of the six steps and given the opportunity to ask clarifying questions. Finally, the teacher had an opportunity for practice, during which she engaged in role play with the research team and was provided with in-the-moment feedback. The teacher did not implement this instructional sequence during circle time until baseline data collection was complete, and she was instructed to begin intervention.

(insert Table 1 here)

Intervention

Once a stable pattern for frequency of symbolic communication was established, the intervention phase began. During each intervention day, the teacher provided a short lesson following the I'M A PAL sequence using the VSDs during circle time. First, she described the expected behavior, "I take one turn and then I wait for my friend to take a turn." Then, she modeled the behavior by taking turns with a student buddy and provided an opportunity for all children in the class (in pairs) to practice taking a turn. As part of the assisted practice step, when children struggled either to take a turn or to wait for their friend to take a turn, the teacher provided least-to-most prompting support. Least-to-most prompting began with the least intrusive prompt, a visual cue such as a point, and increased to include spoken cues and modeling only when necessary. Once children successfully contributed a communicative turn, she provided feedback that naturally reinforced that communication. After all children had an opportunity, she announced that the iPad would be available in the reading center for the remainder of the day. The final step was to let the children know that they could use the iPad only if they were sitting in the reading center and reading with a friend. The teacher then continued with other class circle time activities. Following circle time, children were sent in groups of two or three and to specific centers, or spaces in the classroom. On training days, Ava and Maddy were assigned to the reading center and their intervention data collection probe session began. Although a maintenance phase following intervention was planned, time constraints related to the end of the school year and student attendance resulted in the study coming to an end after session 13.

Teacher coaching

Each week during the intervention phase (three total weeks), the teacher participated in a 15-min informal coaching session on a day that was convenient for her. At least one data

collection day had to have taken place between scheduled coaching sessions. The researcher shared the teacher's quantitative performance in providing the instruction based on the fidelity checklist. This was followed by a reflection on performance using the following prompts: a) what has been going well, b) what has been challenging, c) what is unclear, and d) what are your goals for the next week?

Teacher Social Validity Interview

After the final intervention session, the teacher participated in a semi-structured interview. Questions were developed to investigate the teacher's perceptions of the importance of peer interaction, the degree to which a peer interaction intervention was valued, and the feasibility and effectiveness of this specific peer interaction intervention.

Data Collection and Analysis

Teacher Implementation

The primary investigator (author) used the VSD checklist to grade the quality of each book VSD based on the presence or absence of required elements. During teacher-implemented instruction at circle time, a member of the research team used an implementation checklist to evaluate the teacher's execution of the instructional sequence. Each of the six steps was marked with a plus for correct or a minus for incorrect. Percentage of correct steps was calculated by dividing the number of correctly implemented steps by the total steps and multiplying by 100.

Child Performance

All data collection sessions were recorded to increase accuracy of measurement; a camcorder was arranged on a tripod in front of the two students to capture both children and the books. The 10-min sessions were used to assess the impact of the multicomponent intervention. Ava and Maddy were instructed to sit in the reading center, choose a book, and read together.

During baseline, they only had access to hard copies of the books. During intervention sessions, they had access to both the hard copies of the books and the iPad with VSDs. After providing instructions, the adult walked away to attend to other work in the classroom and did not intervene unless required for health and safety reasons, (e.g., bathroom breaks).

Child Data Coding

StudioCode software (Vosaic, 2017) was used to code videos for all data collection sessions. Two graduate students in communication science and disorders used operational definitions of the child dependent variables and trained on practice videos of children reading books together until reliability of coding turns was 100% and reliability of coding engagement reached a kappa value of 1 across two consecutive videos. Once reliability was established in training, the students began coding videos from the current study. During the coding process, coders reviewed each 10-min session a minimum of two times. Coders paused the video every 10 seconds to document the presence or absence of joint engagement. The percent of intervals jointly engaged was calculated by dividing the total number of times when the children demonstrated joint engagement by the total opportunities. Data for all child measures were graphed across all phases for visual analysis. Visual analysis of graphed data both within and across phases in regard to level (average performance), trend, and variability was used to examine the effect of the intervention across all variables (Gast & Ledford, 2014).

Interobserver Reliability for Child Data

A second trained coder viewed a random selection of 20% of the videos from both the baseline and intervention conditions. Percent agreement was used to calculate reliability for turns for each participant. Reliability was calculated by dividing the number of agreements by the total number of agreements plus disagreements, then multiplying by 100. For Ava's communicative

turns average reliability across phases was 96% (range = 84%–100%). For Maddy, average reliability for frequency of turns across phases was 93% (range = 85%–100%).

For joint engagement, Cohen's kappa was used for calculating reliability, as it factors in chance agreement when used to calculate reliability on categorical data (i.e., data with two or more categories with no intrinsic ordering)(McHugh, 2012). Cohen's kappa values range from -1 to 1, with zero representing the agreement expected by chance. Kappa values over 0.8 demonstrate a strong effect (McHugh, 2012). In this study, average kappa for engagement across phases was 0.9 (range = .85-1) showing strong reliability in coding joint engagement.

Teacher Social Validity Interview

A transcript of the teacher interview was created, and responses were summarized by members of the research team.

Results

Results from this pilot study suggest that preschool teachers can be trained to implement this peer interaction intervention, and that children with complex communication needs can learn skills to help them interact more frequently with their peers in inclusive classrooms.

Teacher Implementation

VSD Creation

The teacher created two books during training. For her first independently created book VSD, the teacher scored 77% (37/48 points) (see Appendix for sample feedback form). She was able to complete the tasks that required operational skills including taking pictures of the book pages and programming hot spots with voice output consistently from her first book through the end of the study. Initially, the content of the hot spots did not meet the fun and functional criteria. Her created hot spots frequently produced voice output from the perspective of the

characters rather than from the perspective of children commenting on the book. In addition, for one page, the hot spots had to be selected in a particular order to make sense. Feedback was provided, and the teacher was able to create several new hot spots that satisfied the requirements. Her second independently created book scored 81% (43/53 points). For this book, the teacher had added sound effects to hotspots without linguistic content, which she corrected after feedback. During the remaining time in the study, the teacher created three additional book VSDs.

Peer Interaction Instructional Sequence

The teacher used the instructional sequence during circle time six times within a 3-week period. In three of the six circle time sessions, the teacher skipped the modeling step. In one, the teacher did not provide least-to-most prompting during the assisted practice step, and in another, she did not let the children know the rules for use of the iPad (see Table 2). Average percentage of correctly completed steps across all sessions was 86%. In two of the six sessions, the teacher correctly implemented all steps of the instructional sequence.

(Insert Table 2 here)

Child Performance

Communicative Turn-taking

Average performance of both participating children was higher during intervention than during baseline (See Figure 2). Frequency of turns in baseline was stable for both Ava and Maddy, with neither child taking many turns. The exception was during session 6, when Ava took six communicative turns. This session was an outlier as in all other baseline sessions, Ava took either zero or one turn, and in this particular session, all turns included the same single word. Ava increased from an average of one turn during baseline to an average of 14.5 turns

during intervention (+13.5 turns). Maddy increased from an average of 0.7 turns to an average of 22.5 turns (+21.8 turns). During one session in the intervention phase (session 9), Ava took four turns, which was fewer than her baseline maximum. Despite this one session, Ava's intervention data shows an increasing trend overall, with large increases in turn-taking during session 10 and session 13, but a decrease at session 11. Maddy's intervention data is more variable, with an increasing trend for the first half of the intervention sessions, and a decreasing trend for the second half.

(Insert Figure 2 here)

Joint Engagement

Engagement with each other and the activity increased from an average of 7% (range: 0%-10%) in baseline to 46% (range: 20%-58%) during intervention (See Figure 3). Engagement during baseline was consistently below 10%, while during intervention, the lowest engagement was 20%.

(Insert Figure 3 here)

Teacher Perspectives

During the post-intervention interview, the participating teacher shared her perspectives related to peer interaction for children with disabilities, the teacher training, and the effectiveness of the intervention in her classroom.

Importance of Peer Interaction and Peer Interaction Interventions

The teacher noted that children with disabilities need supports, such as adult facilitation or provision of AAC, to interact with peers without disabilities in the classroom. She specifically noted that without those supports children rarely interact, saying, "from what I've seen, peers choose not to go play with a child with disabilities very often." Prior to participation in this

study, the teacher reported using strategies to support interaction, including grouping students with and without disabilities for activities, assigning peer helpers, and suggesting interaction during less structured activities by saying things like “It looks like Sarah wants to play too!”

Feasibility of the Intervention

When asked about the self-study videos to learn to program the app, the teacher remarked that video pacing was just right, and the videos aligned with her expectations for how-to videos. She noted that she watched the videos a few times, which was typical for her when learning new things. The teacher rated her confidence on the app as 8 out of 10, saying the challenge was meeting hot spot criteria to be fun and functional.

Regarding the in-person training in the instructional sequence, the teacher noted that the most helpful element was the video examples, particularly retaining access to the videos so that she could review. The face-to-face aspect (vs. an online webinar) was appreciated because she could ask questions in the moment. She suggested that future training occur with a group of teachers to allow them to ask each other questions and share ideas during and after the training.

When asked about the ease of implementing the intervention, the teacher noted that creating one book per week was time-consuming and was difficult due to the time of the year when the study was being conducted (late spring). She noted that the circle time instruction easily fit within typical circle-time activities, and that providing the instruction was not difficult. She noted that the most difficult part was providing least-to-most prompting, as she initially wanted to provide a higher level of support. She recommended a visual aid, like a poster on the wall, reminding the teacher about the prompting hierarchy.

Effectiveness and Perceived Benefit Outside of the Reading Center

Finally, the teacher discussed the effectiveness of the intervention. She said that during baseline she noticed that the two children primarily looked at books independently, even after being instructed to read together. During intervention, they looked at the book on the iPad together.

Outside of the specific data collection sessions, the teacher noted that more interaction around classroom books occurred, even when the students were using hard copies of the books. She noted an increase in looking at books together, pointing to pictures, commenting, and laughing among all students. The availability of the iPad in the reading center caused some arguments, primarily among children without disabilities, and she recommended limiting the amount of time a particular dyad could use the iPad and use of a visual timer.

Discussion

The purpose of this study was to investigate the feasibility of training teachers to implement social interaction intervention within the preschool classroom and to evaluate the impact of the teacher-implemented intervention on the participating children.

Teacher Implementation

The results of this pilot study suggest that preschool teachers may be able to learn to program VSDs to support the social communication of their students at the reading center with limited training time and feedback. The teacher in this study was able to program the app, SnapScene, after participating in a self-study program with minimal feedback. This extends the research of Caron et al. (2017), who found that apps with fewer programming steps enabled professionals to create more VSDs, with more hotspots, than apps with more programming steps. The challenges faced by the teacher were not the technical programming steps, but choosing the phrases and ideas that would motivate children to communicate with each other. This suggests

that programming hot spots to support social communication may not be intuitive, and that more research is needed to understand what hot spot content allows children the best functional communication within a variety of contexts.

The teacher in this study was able to follow the intervention procedures with an average performance over 80% and found the instructional content and format to fit into typical circle time activities. Her feedback as well as her performance suggest that it was feasible to learn the instructional sequence, but that minor changes may improve implementation. The two steps that the teacher performed incorrectly were modeling and assisted practice. In coaching sessions, after missing the modeling step, the teacher verbalized that she thought the modeling step was unnecessary because the children seemed to know what to do. Emphasizing the relationship between increases in modeling and growth in children's expressive language skills (Allen et al., 2017) during the initial training may be warranted. In her interview, the teacher noted that remembering the least-to-most prompting hierarchy was a challenge. Research suggests that least-to-most prompting expedites the learning of skills (Libby et al., 2008), so strategies to help teachers utilize prompting hierarchies should be investigated. The teacher's suggestion of a visual cue for the teacher may be a place to start. Additionally, given that the child data from this project is similar to the results in studies where a researcher implemented the intervention, it is possible that some of the components of the instructional sequence are not essential for student learning (Author 2016; 2018). Future research should investigate whether each step in the sequence is required to promote social interaction among students.

Child Performance

In this study, Ava, the child with CCN, increased frequency of communicative turns by an average of 1.35 turns per min. In Authors (2018), the average increases for the participating

children in cohort 1 ranged from 1.3-2.5 turns per min, and for cohort 2, where one child did not complete training, they ranged from 0.4-1.9 turns per min. In Authors (2016), gains for children with CCN ranged from 1.1-4.6 turns per min. While the improvements seen in this study can't be causally linked to the intervention, they were similar to those seen in previous studies where the researcher served as interventionist, and children were taught skills in a separate room, which suggests that this more natural implementation may also be effective.

The two participating children in this study showed different patterns of participation during intervention. The peer increased communication immediately, while the child with Down syndrome did not increase until the third intervention session. This delayed response was expected, as the complexity of using aided AAC effectively means that the provision of AAC alone is not enough for children to effectively communicate using AAC without intervention (Light & Drager, 2007; Smith, 2015) In this case, at the time of the third session, the child with Down syndrome had been exposed to the circle time teaching instruction three times and had participated in sessions with a peer during which the peer modeled the use of AAC for communication twice. Combined, this included approximately 30 minutes of instruction and modeling in the use of AAC. In the final sessions, the peer's frequency of communication decreased as Ava's increased. It is possible that the addition of one book per week did not provide enough novel stimuli to keep the peer engaged in the activity, and it is also possible that as Ava communicated more, the peer spent more time listening.

Engagement was initially measured in Authors (2018), but average gain was not reported. In that study, engagement was variable across baseline and intervention conditions, although average engagement was higher during intervention for all participants. In this study, engagement between Ava and Maddy was stable during baseline and increased during

intervention. While this is promising, further investigation into the decreased engagement on the final day of the study is required to determine whether the increases in engagement would maintain once the use of iPad at the reading center was less novel.

Limitations

The primary limitation of this study was the number of participants. Before training many teachers, the research team determined that it was important to gather information related to the feasibility of training a single teacher and the perspectives of that teacher related to that training to allow the research team to modify the training and intervention steps to account for “real world” challenges faced by preschool teachers. Even so, soliciting the input of only a single teacher does limit understanding of whether teachers in general are receptive to this type of training and whether the training would be effective. This teacher, for example, found it easy to learn to program the iPad app. At age 22, she was more likely to be accustomed to using mobile technology for many tasks, whereas teachers who are less accustomed to mobile technology use may need additional instruction or feedback. Further, in this study, the fidelity of the teacher’s implementation, both for creating VSDs of storybooks and for using the instructional sequence during circle time, was evaluated only by the primary investigator, the author. As this was preliminary work, entered into in order to determine the feasibility and make changes prior to implementing with a larger group of teachers, there was incentive to accurately gauge teacher performance. Despite this, it is possible that bias influenced measures of fidelity, and in future work, two independent observers should evaluate the teacher’s fidelity in implementing the instructional sequence.

In true single case design, it is essential to have multiple replications of the between phases effect to determine that the intervention alone is responsible for the change in the

dependent variable. In this pilot study, only one triad participated and therefore the impact on the student behaviors must be interpreted with extreme caution. With only one dyad of participating students, this study does not experimentally control for maturation of participants, or the impact of other instruction and therapy these students might be receiving. The fact that their data shows a similar pattern to two previous investigations of this intervention increases confidence in the likelihood that the teacher-implemented intervention played at least some role in the changes seen across phases, however, a study with multiple dyads participating is the only way to determine the existence of a functional relation between the independent variable (teacher-implemented intervention) and the dependent variable (symbolic communicative turns).

A second limitation is that the intervention itself is a multicomponent intervention, including the circle-time training and the provision of the iPad, programmed to support peer interaction at the preschool reading center. Determining the relative contribution of each component was not possible given the design of this study.

Future Research

This study leads immediately into future research with greater experimental control in order to investigate whether a causal relationship exists between the teacher-implemented intervention and the changes in social communication and engagement of participating children. In addition, future research should investigate whether the training in instructional strategies could be provided as an online course with synchronous online coaching meetings. This completely web-based format would speed the transition from research to practice, as receiving training wouldn't be dependent on geographical location. Finally, future research is needed to specifically measure the impact of the intervention on peer relationships outside of the intervention context.

Conclusion

Preschool teachers are the natural facilitators of social relationship development for young children. This pilot study suggests that preschool teachers can learn to program AAC and provide instruction to support increased social interaction between children with CCN and their classmates. More research is needed to determine the relationship between teacher strategies and child outcomes.

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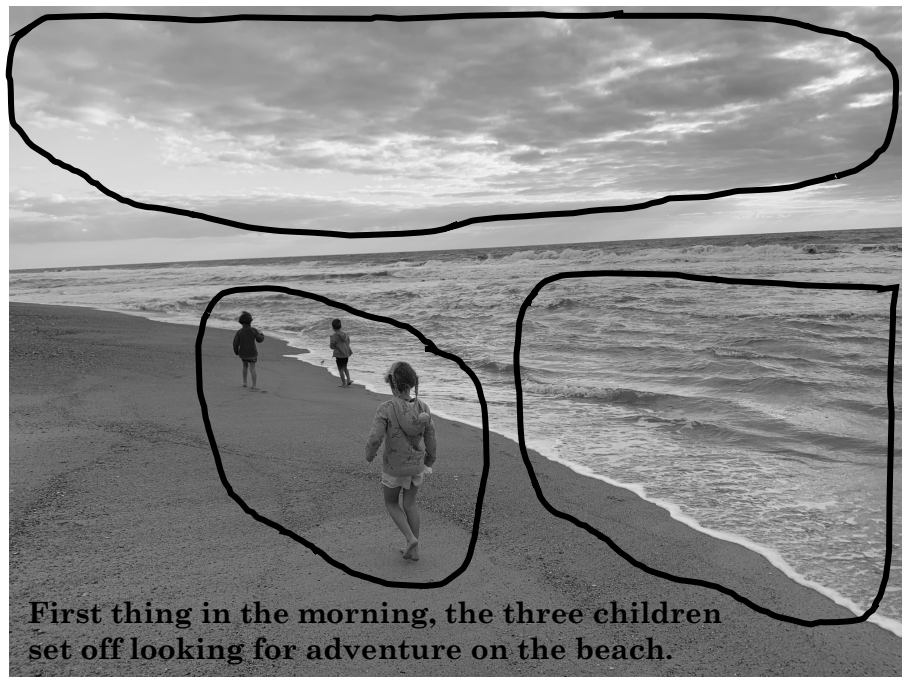
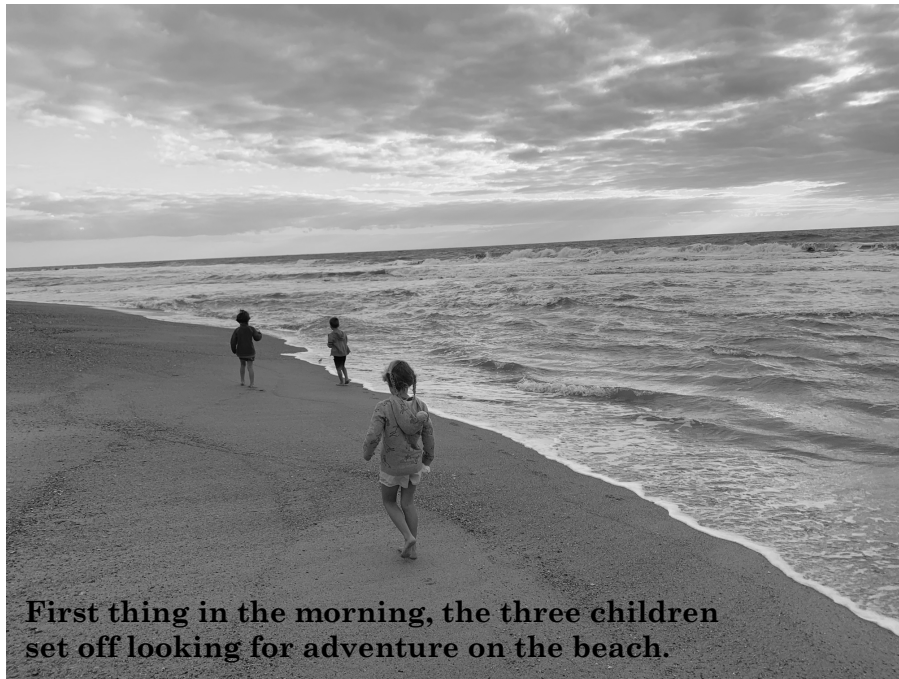
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Figure 1

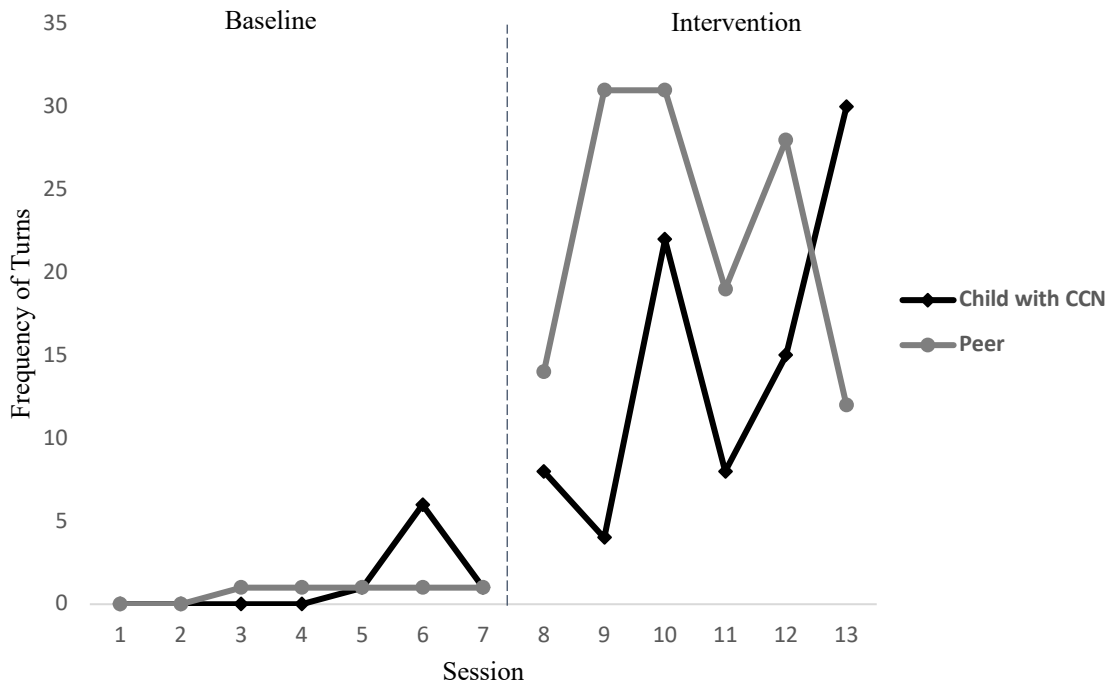
Sample Visual Scene Displays



Note. Each VSD was a digital photograph of a page from a story book. The top picture shows the VSD as the children saw it. The bottom picture identifies the teacher's chosen communicative hotspots. The hotspots for this page could say "It's a cloudy day," "The kids are on the beach," and "I love the ocean!"

Figure 2

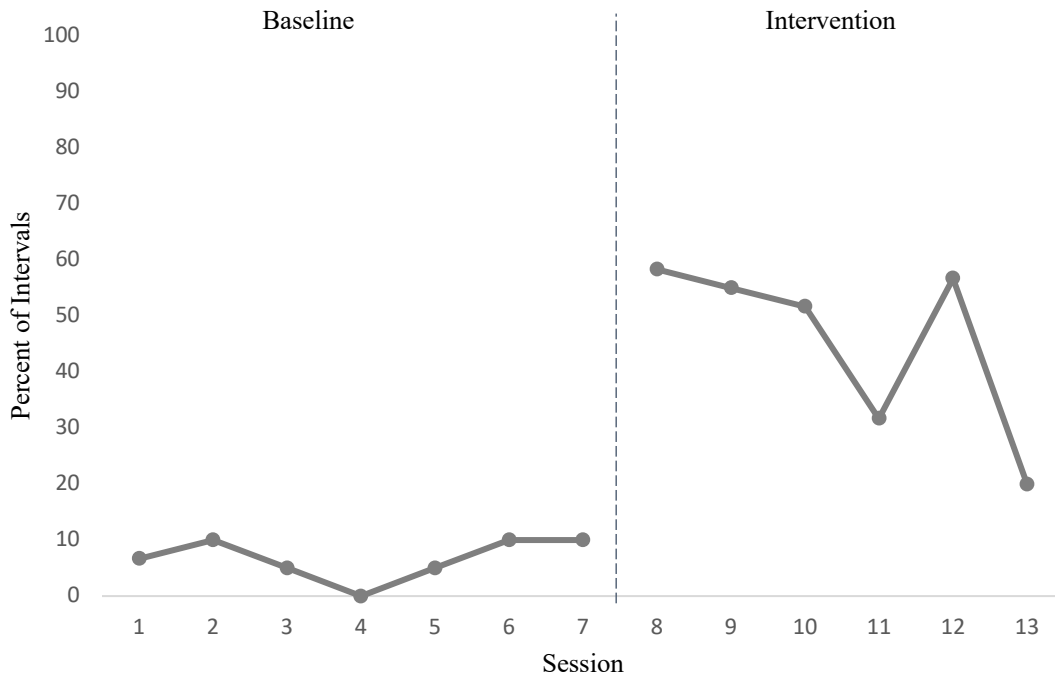
Frequency of Symbolic Communicative Turns for Participating Children



Note. Graphs show the frequency of symbolic communicative turns during a 10-minute dyadic interaction at the book center. During the session, no adult prompts, support, or feedback were provided.

Figure 3

Joint Engagement of Participating Children



Note. The graph shows joint engagement across phases during a 10-minute dyadic interaction in the literacy center. Percent engagement was calculated as number of intervals engaged divided by total intervals.

Table 1

Teacher-implemented Intervention Steps – I’M A PAL

Step	Description
I – Introduce with enthusiasm	<ul style="list-style-type: none"> • Draw attention to the book on iPad using an excited & enthusiastic tone (e.g., “Look! Today, we have our story book on the iPad!!”) • Explain how the hot-spots work (ex. “When we look at stories on the iPad with our friends, we can touch the screen to talk about the story & the pictures.”) • Identify the child behaviors we’re teaching: turn-taking & waiting (e.g., “We’re going to share the iPad with friends when we look at books together. First you take a turn, then you wait for your friend to take a turn!”)
M – Model the expected behaviors	<ul style="list-style-type: none"> • The teacher says: “Let me show you!” or “Watch me!” • Teacher presses a hot spot, models making eye contact with students and repeats the phrase that was spoken when the hot spot was pressed. • Then, to model waiting, the teacher passes the iPad to an aide or student buddy saying “Now I’ll wait for you to take a turn!” <ul style="list-style-type: none"> ○ Aide or student buddy takes a turn ○ Teacher responds contingently
A – Assisted practice	<ul style="list-style-type: none"> • Teacher announces that it’s time for the children to try. “Now you all can try it!” • For each pair of children, teacher announces that they are buddies. (e.g., “Sarah, your buddy is Eric.”)

	<ul style="list-style-type: none"> • Teacher reminds children about the behaviors she expects to see: (e.g., “Remember, first you take a turn, and then you wait for your friend to take a turn!”) • Teacher hands the iPad to the first child. • If necessary, teacher uses least-to-most prompting to encourage turn-taking and waiting (gesture only, gesture + oral prompt, model)
P – Provide feedback	<ul style="list-style-type: none"> • Teacher provides feedback either to the waiting or turn-taking child for each turn taken. <ul style="list-style-type: none"> ○ e.g., “I like how you waited for <child’s name> to take a turn!” ○ e.g., a contingent response to what was communicated (example: if the hot spot says “Look at that dog!” teacher could say “that dog is so silly!” or “yeah, I like that dog too!”)
A - Announce availability	<ul style="list-style-type: none"> • Teacher makes a statement about how fun it is to look at books together (ex. “Isn’t it fun to look at books together?”) • Teacher announces that the iPad will be available in the literacy center (e.g., “Today, when you go to the literacy center, the iPad will be there for you to use)
L – Let them know the rules	<ul style="list-style-type: none"> • Teacher shows children the visual aide listing the rules for using the iPad in the literacy center, and reads the rules out loud: <ul style="list-style-type: none"> ○ You must be with a friend ○ You must stay in the literacy center ○ Remember to share!

Table 2

Teacher implementation of Instructional Sequence

	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6
Step 1 – Introduce with enthusiasm	X	X	X	X	X	X
Step 2 – Model expected behavior	X	-	-	X	X	-
Step 3 – Assisted practice	X	-	X	X	X	X
Step 4 – Provide feedback	X	X	X	X	X	X
Step 5 – Available iPad	X	X	X	X	X	X
Step 6 – Let them know the rules	-	X	X	X	X	X
Percentage correct	83	67	83	100	100	83

Note. Sessions occurred 2-3 times each week during circle time teacher-led instruction. Correct steps are marked with an (X) and incorrect steps with a (-).

Appendix

Sample Teacher VSD Feedback Form

Scoring instructions: In each cell, Yes = 1, No = 0						Row Score
Is the book fun & engaging for children to look at together?						
Is the book complete with pages in order?						
Is the VSD book created correctly (home page with cover image, jumps to first page of book)?						
Page	Is picture clear?	Correct # of hotspots (1-4)	Are messages between 1-5 words?	Are messages fun?	Are messages functional?	Row Score
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Note. Additional rows can be added as needed depending on the length of the picture book.
Total possible score = (Total number of pages * 5) + 3.