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RESEARCH ARTICLE

Evaluating an AAC training for special education teachers in Sri Lanka, a low- and middle-income country

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ABSTRACT

A majority of people with disabilities live in low- and middle-income countries where communication services for individuals with complex communication needs are scarce. It is essential that communication partners of individuals who have complex communication needs receive training to support communication. To address this issue, the current study evaluated an augmentative and alternative communication training for special education teachers living in a low- and middle-income country, Sri Lanka. The training was based on four key practices identified when training in low- and middle-income countries: investigate learner needs, provide contextually relevant instructional content, use engaging instructional activities, and assess the impact of instructional activities. This investigation implemented an interrupted time-series design with nine teacher–student dyads. Special education teachers were taught to provide evocative communication opportunities. Following the training, all nine special education teachers significantly increased the number of evocative communication opportunities provided to students with complex communication needs. Additionally, all nine students with complex communication needs significantly increased their number of communication turns.

Introduction

It is estimated that approximately one billion people in the world experience some form of disability (World Health Organization and The World Bank, 2011). Of these individuals, an estimated 1–2% have complex communication needs (Bunning, Gona, Newton, & Hartley, 2014) and a majority live in developing or low- and middle-income nations (Maloni et al., 2010). Individuals with complex communication needs are restricted in their participation in educational, social, and communication activities as a result of not being able to rely on speech for their daily communication needs. Augmentative and alternative communication (AAC) methods supplement or replace speech to benefit individuals with complex communication needs (Douglas, 2012).

Professionals such as teachers and teachers' assistants who work closely with individuals with complex communication needs often lack the knowledge and skills required to implement appropriate AAC interventions (Douglas, 2012). Like other communication partners, teachers and teachers' assistants may not know how to alter their communication behaviour to better support communication with people with complex communication needs (Binger & Kent-Walsh, 2012). However, providing training to communication partners can equip them with strategies to increase the frequency and quality of communication interactions with

children with complex communication needs. Positive outcomes of communication training have been reported for communication partners (e.g., Bornman, Alant, & Lloyd, 2007) and for individuals with complex communication needs (e.g., Douglas, McNaughton, & Light, 2014).

To date, most research on partner training in AAC has been conducted from an Anglo-European perspective (Huer & Soto, 1996) and findings from these studies may not be applicable in low- and middle-income countries, where there are several important differences in culture, economy, education, healthcare and technology. In addition, by definition, low- and middle-income countries have a largely rural population; limited health, education, and technology resources; and poorly performing economies (World Bank, 2012). In the more than two decades since the review by Huer and Soto (1996), there is still only limited AAC research conducted in low- and middle-income countries (Srinivasan, Mathew, & Lloyd, 2011).

In low- and middle-income countries, where there are few communication professionals, the number of skilled professionals specializing in AAC is extremely small (Bunning, Gona, Newton, & Hartley, 2014; Fuller, Gray, Warrick, Blackstone, & Pressman, 2009). Therefore, the responsibility of providing communication support often goes to communication partners such as parents, other family members, teachers, and teachers' assistants. Because there has been

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little research in this area, the field of AAC has only a limited understanding of how best to support the development of knowledge and skills of individuals who provide AAC support in low- and middle-income countries (e.g., Bunning et al., 2014).

Special education in Sri Lanka

Children with disabilities in Sri Lanka are, for the most part, educated in one of two ways: through mainstream schools, or through specialized schools (Yokotani, 2001). Both options are available in government-funded schools and privately-funded schools; however, Sri Lanka does not have a special education curriculum. Although special education teachers work in special education units in both mainstream and specialized schools, many have received only limited training. The two key barriers to providing special education services in the country have been reported to be the lack of systematic procedures and the lack of trained teachers (see United Nations Children's Fund Regional Office for South Asia, 2007).

Partner training in low- and middle-income countries

The critical need for communication partner training in contexts in which there are few trained AAC professionals highlights the importance of such training including consideration of evidence-based practice in relation to AAC. Recently, Muttiah, McNaughton, and Drager (2016) conducted a focus-group study exploring the experiences of eight AAC experts who conducted training in or trained professionals from low- and middle-income countries. The authors identified four key practices to be considered when training: (a) investigate learner needs; (i.e., the needs of the teacher being trained); (b) provide contextually relevant instructional content; (c) use engaging instructional activities; and (d) assess the impact of instructional activities (see Muttiah et al., 2016, for further details on these practices). To date, these four key practices have not been implemented or evaluated for efficacy.

As well as training being evidence-based, it is also necessary to identify training content that is feasible, and of high impact or powerful. The goal of many AAC communication partner programmes is to teach communication partners to offer increased communication opportunities in the hope that this may have a positive impact on the number of communication turns that students take (Light, Dattilo, English, Gutierrez, & Hartz, 1992). For example, asking "what", "where", "why" and other types of open-ended question places the individual using AAC in a more active role (Whitehurst et al., 1988) and facilitates turn taking. These types of communication opportunity, designed to elicit active involvement, will herein be called *evocative communication opportunities*. Evocative communication opportunities facilitate more involvement and learning for an individual with complex communication needs.

The objective of the current study was to investigate the effectiveness of an AAC training model for special education teachers living in Sri Lanka. Specifically, the following research questions were examined: (a) What is the effect of an AAC training for special education teachers in a low- and middle-income country on the number of evocative communication opportunities provided by teachers (i.e., opportunities that place the student in an active role)? and (b) What is the effect of an AAC training for special education teachers in a low- and middle-income country on the number of communication turns taken by students who have complex communication needs?

Method

Research design

This study used an interrupted, time-series quasi-experimental design (Shadish, Cook, & Campbell, 2002) involving one treatment group with multiple observations before and after treatment (Shadish et al., 2002). The independent variable was the provision of AAC training to special education teachers. The primary dependent variable was the number of evocative communication opportunities provided by special education teachers during a naturalistic 10-min interaction. The secondary dependent variable was the number of communication turns taken by the students during a 10-min interaction. The study consisted of four phases: pre-training, training, post-training, and follow-up. Appropriate ethical approval was obtained from the Penn State institutional review board and the participating schools prior to commencement of the study.

Participants

The participants for this study were recruited from regular education and specialist schools in and around the Colombo area of Sri Lanka. A power analysis was completed using G*power (Faul, Erdfelder, Lang, & Buchner, 2007) with a mid-effect size of 0.5 (Cohen, 1992) to determine the appropriate sample size. An arbitrary mid-effect size was used to estimate the sample size because no other training studies were found that were similar enough to estimate more accurately effect size. The results of the power analysis indicated that seven participant dyads were required to obtain adequate power (0.95) if each dyad was measured repeatedly eight times: at three times pre-, three times post-, and twice during follow-up.

For this study, the participants were nine special education teachers and nine students with complex communication needs. Informed consent was obtained from students' parents. The parents were provided translated versions of informed consent in their preferred language of Sinhala to read and then sign. Because the students did not have a means of communication to indicate their approval or disapproval and had limited language comprehension skills, and because parental consent for their school-age child's participation was culturally acceptable, assent was not sought from students.

Informed consent was obtained from teacher participants. Inclusion criteria were: (a) had taught in a special education classroom in a regular or specialized school; (b) had a student with complex communication needs in his or her

Table 1. Demographic information for special education teachers (all names are pseudonyms).

Participant	Age	Type of school	Special education qualification	Special educator experience	Communication training received	Student diagnoses
Ms Thilini (T1)	46	Special	None	11 years	None	Down syndrome, autism spectrum disorder, hyperactivity
Ms Renuka (T2)	47	Special	6-month course	2 years	None	Down syndrome
Ms Bimali (T3)	33	Special	3-month certificate	1.5 years	Minimal: during certification course	Down syndrome, intellectual impairments
Ms Sonali (T4)	46	Special	None	3 months	Minimal: during nursing degree	Down syndrome, intellectual impairments, autism spectrum disorder
Ms Ramya (T5)	36	Special	Diploma (1 year)	3 years	Minimal: during special education diploma	Down syndrome, intellectual impairments, autism spectrum disorder
Ms Razna (T6)	43	Inclusive	Diploma (1 year)	5 years	Minimal: during special education diploma	Down syndrome, cerebral palsy, unknown genetic disorder
Ms Kamini (T7)	27	Inclusive	None	4 years	Minimal: during diploma course	Down syndrome, cerebral palsy, unknown genetic disorder
Ms Waruni (T8)	44	Special	None	5 years	None	Physical disabilities, multiple disabilities, cerebral palsy
Ms Chaturi (T9)	51	Special	Special education diploma (2 years)	20 years	Minimal: during special education diploma	Multiple disabilities

Inclusive education refers to children with special needs being educated in the same classroom with typically developing peers.

classroom; (c) was willing to be videotaped both pre- and post-intervention, attend a training, and complete pre- and post-questionnaires; (d) was fluent in English and/or Sinhala; and (e) was over the age of 18 years. Teachers completed a demographic questionnaire prior to the start of the study. Participant teachers' demographic information, including age, special education qualifications, years of experience, communication training received, and types of students in their classrooms are presented in Table 1.

Inclusion criteria for students participating in the study were: (a) had complex communication needs (i.e., no functional speech to meet current communication needs); (b) did not have a primary diagnosis of visual or hearing impairment; and (c) had a teacher who was willing to participate in the study. All of the student participants had limited functional speech and/or used only a few gestures. None of the students had been consistently using any form of low-tech or high-tech AAC prior to their participation in this study. Student participants who attended inclusive schools followed the general education curriculum; those who attended special schools did not follow a specific curriculum. Parents of the student participants completed a demographic information sheet for their children and the Communication Matrix (Rowland, 2011) was completed to assess students' communication. See Table 2 for students' demographic information, including age, gender, diagnosis, type of school, and information regarding communication.

Setting and materials

The study was conducted in the participants' own schools. Three types of material were used: (a) literacy-related activities (e.g., books, alphabet letters, and whiteboards with markers); (b) music-related activities (e.g., songs and instruments); and (c) arts and crafts-related activities (e.g., painting, colouring, pasting). All books and other materials were culturally appropriate, inexpensive, and readily available and used in local schools. These materials were used during all phases of the study. During the training phase, teachers developed and simulated through role play the use of basic AAC and other tools (e.g., hand-drawn visual schedules, hand-drawn pictures, pictures cut out from magazines and newspapers for use as removable pictures on a communication board, or words written on a whiteboard). The AAC tools developed in the training phase (see Figure 1) were used during the post-training and follow-up phases. A video camera mounted on a tripod was used to record all study sessions.

Dependent measures

Data were collected on two dependent variables. The primary dependent measure was the number of evocative communication opportunities provided by special education teachers to students with complex communication needs. This was measured for each 10-min interaction session between the teacher–student dyad. The definition of an evocative communication opportunity was adapted from Light, Collier, and Parnes (1985), Douglas et al. (2014), and Whitehurst et al. (1988): (a) an open-ended question (excluding yes/no questions), comment, or choice directed towards the student by the teacher; (b) provision of a means for the student to respond; and (c) wait time of 5 s or more. An evocative communication opportunity was counted only if all three of these criteria were met. Past research has documented the importance of including all of these components when interacting with children who have complex communication needs (e.g., Light et al., 1985). Teachers were given credit for an evocative communication opportunity if they:

Table 2. Demographics and language levels for participants (all names are pseudonyms).

Participant	Age/gender	Diagnosis	Type of school	Language in school	Communication Matrix level[a] (Rowland, 2011) and communication modes
Binara (S1)	14/M	Down syndrome with hyperactivity	Special	Sinhala	Level IV: Single words (approx. 10), vocalizations, gestures, facial expressions, able to make choices, request, reject, greet people, and answer questions with yes and no
Mohan (S2)	21/M	Down syndrome	Special	Sinhala	Level III: Single words (approx. 10), gestures, facial expressions, requests more, rejects, greets people, answers questions with yes and no
Nelum (S3)	18/F	Down syndrome	Special	Sinhala	Level III: Single words (fewer than 5), vocalizations, gestures, and facial expressions
Piyal (S4)	22/M	Down syndrome with cerebral palsy	Special	Sinhala	Level III: No words, only vocalizations and gestures
Samanmali (S5)	19/F	Cerebral palsy	Special	Sinhala	Level I: Single words (10–12 words), will occasionally name things and people, gestures, and facial expressions
Namali (S6)	16/F	Unknown degenerative genetic disorder	Inclusive	English	Level IV: Single words (2–3), few gestures, facial expressions, able to make choices, request, reject, and greet people
Tisara (S7)	14/M	Unknown degenerative genetic disorder	Inclusive	English	Level IV: Single words (approx. 10), few gestures, facial expressions, answers simple questions, requests more, rejects, greets people
Malini (S8)	10/F	Cerebral palsy	Special	Sinhala	Level IV: Single words (5–6), gestures, vocalizations, facial expressions, shows affection to others, offers things, requests, rejects, directs attention
Shehan (S9)	15/M	Cerebral palsy	Special	Sinhala	Level IV: No words, only gestures, vocalizations, and facial expressions

[a]Communication Matrix: Level I: Behaviour is not under the individual's own control but reflects general state (e.g., comfortable, uncomfortable, hungry, or sleepy); Level III: Primarily uses unconventional communication using pre-symbolic behaviours (e.g., body movements, actions on people and objects, vocalizations); Level IV: Primarily uses conventional communication using pre-symbolic behaviours (e.g., conventional gestures, and vocalizations).

(a) directed an open-ended question, comment, or choice towards the student; (b) provided a form of aided means of communication (e.g., whiteboard or pictures) or the student responded via unaided means (e.g., speech, sign, gestures); and (c) waited at least 5 s or the student responded within the 5 s wait time (making it unnecessary to wait a full 5 s).

The secondary dependent measure was the number of communication turns taken by the student participants during a 10-min interaction. The operational definition of a communication turn was adapted from Bruce and Vargas (2007) and Carter (2003). A communication turn was defined as an intentional communicative behaviour that transmitted a message and was directed towards a partner. Intentionality was indicated by the student attempting to initiate or respond to a communication partner by attending to the partner and/or system through eye gaze, gesture, leaning towards, touching, or vocalizations. A communicative behaviour was defined as a behaviour that transmitted a message in a conventional form (speech, signs, gestures, pointing to pictures, pointing to words, use of AAC system) or non-conventional form (vocalizations or gestures). A turn was required to be both intentional and communicative to be counted. A communication partner speaking, or a 2 s interval between the end of one communication turn and the beginning of the next turn, signalled the end of a student's communication turn.

Procedures

As noted previously, this study consisted of four phases: pre-training, training, post-training, and follow-up. Each session

within the pre-training, post-training, and follow-up phases lasted approximately 10 min and was videotaped. Sessions took place two to three times per week. Prior to participating in the training, teachers completed a pre-training questionnaire as part of the needs analysis to investigate learners' needs as suggested by experts (Muttiah et al., 2016). The questionnaire explored each teacher's current knowledge and experiences with AAC, learning priorities and needs with regards to AAC, and information on the student's communication. The results of the questionnaire indicated that none of the teachers had any prior knowledge of AAC and no experience with using any type of AAC. The content of the training was based on the learning priorities and needs identified by the teachers completing the questionnaire. Many of the teachers listed the following as their highest learning priorities when working with children with communication needs: helping students who use AAC to answer questions, enabling students to participate in literacy activities, increasing student participation in leisure activities such as music, and developing materials that would support effective communication.

Pre-training phase. The dyads were observed and video-recorded for three pre-training sessions, each of which consisted of a 10-min naturalistic interaction between teacher and student. All dyads had access to literacy, music, and play materials, and the dyads chose the activities in which they wanted to engage. No feedback was provided by the researcher to any of the dyads during this phase of the investigation.

Training phase. The training phase consisted of group training for the teachers and three individual follow-ups with
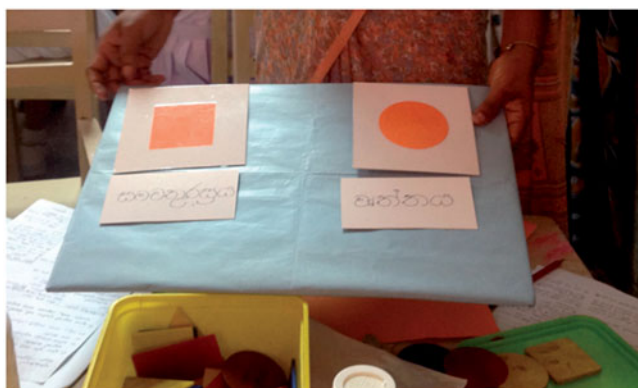
Figure 1. Top: examples of AAC materials prepared during the training. Bottom: teachers role-playing with the developed materials.

each teacher–student dyad. The duration of the group training was between 3.5 and 4 h, and the three individual follow-ups were each between 20 and 30 min. The group training was completed in one day and the three follow-ups were completed across three separate days. The entire training phase was completed for all dyads between 4.5 and 5.5 h across four days. All teacher participants at the same school attended the same group training, which included other educators working at the school who were not involved in the study. Two of the training sessions were conducted in Sinhala and one was in English. The language of the training was determined by the language used in the school and spoken by the teachers. The training was conducted by the researcher from Sri Lanka who was not only fluent in both English and Sinhala but was also familiar with the culture and context.

The training content was based on a number of factors; a primary factor being needs of the learners who were identified by teachers who completed the pre-training questionnaires. The training format incorporated recommendations for principles of adult learning by Muttiah et al. (2016) and an adapted strategy instruction model developed by Kent-Walsh and McNaughton (2005). As identified in the pre-training questionnaire, none of the special education

teachers who participated in the current study had prior knowledge regarding communication interventions and AAC. Their training involved six steps. All six steps and the format of training in classroom settings are presented in Table 3.

Step 1. The first step focused on providing foundational knowledge on communication and AAC. The first activity demonstrated the power and importance of communication, in that teachers were placed into groups of two to three participants and instructed that one person in each group was to play the role of a person who was not able to rely on natural speech to communicate. This person was handed a message and asked to convey it to the rest of the group without using natural speech and only using AAC. Following this activity, the following concepts were discussed: the definition of AAC, examples of AAC tools, details of diagnoses that would benefit from using AAC, and dispelling myths regarding AAC (e.g., impact of AAC on verbal speech output).

Step 2. The second step involved strategy description, where evocative communication opportunities were defined and described.

Step 3. The third step involved strategy demonstration, in which teachers were shown videos from a pilot study completed previously that involved training two Sri Lankan special education teachers on provision of evocative communication opportunities with their students with complex communication needs. In addition, the instructor engaged the teachers in role-playing to further facilitate understanding of how evocative communication opportunities could be provided.

Step 4. In the fourth step, teachers watched videos of their own students and completed a training worksheet to identify contexts during the school day where communication opportunities could be provided. Teachers identified three specific evocative communication opportunities they might be able to provide for each context, and also prepared a script on how to implement these opportunities (see supplemental material for the training worksheet). Teachers also developed appropriate AAC tools based on the communication opportunities identified on the training worksheet. Because this study was focused on AAC options that could be implemented in low- and middle-income countries, particular care was taken that the AAC tools teachers developed were all constructed using low-cost materials already available to them in the school. This was important, because although some free software options are available in certain countries, many schools, including two of the schools in the current study, do not have access to computers.

Step 5. The fifth step involved teachers following the script on the training worksheet and role-playing with each other using the AAC tools they had developed (see Figure 1). During this step, teachers were required to provide a minimum of three evocative communication opportunities while role-playing. The instructor verified this by using a checklist.

Step 6. The sixth and final step involved three follow-up sessions that were conducted two to three days after the training where the instructor provided feedback to the teachers while they practised using evocative communication

Table 3. Training content and format.

Strategy instruction model	Training format
Step 1: Communication and AAC	Conducting a role-play activity showing teacher participants the power of communication; providing basic knowledge of AAC
Step 2: Strategy description	Providing information on evocative communication opportunities: (a) asking open-ended question, providing a choice, and making a comment; (b) providing the student with a means to respond; and (c) waiting 5 s for a response
Step 3: Strategy demonstration	Showing videos from the pilot study to demonstrate use of AAC tools and partner communication strategies; instructor role-playing with teacher participants to model communication partner strategies
Step 4: Verbal practice	Watching videos of students with complex communication needs familiar to the learners and using these students as case studies to complete the training worksheet
Step 5: Controlled practice and feedback (guided practice)	Developing own AAC using material available in their environment; teacher participants role-playing with each other using AAC materials and implementing partner strategies that were learned; instructor evaluates learners' demonstration of a minimum of three evocative communication opportunities
Step 6: Follow-up sessions (advanced practice and feedback)	Conducting three one-on-one follow-ups with each teacher–student dyad in their classrooms over 3 days; providing feedback to learners as they practice AAC strategies in the natural setting with students with complex communication needs

opportunities and AAC tools with their individual students in the classroom setting.

Post-training phase (independent practice). Data were collected for three post-training sessions two to three days after the training. No feedback was provided to any of the dyads during this phase. All of the same literacy, music, and play activities that were available during the pre-training phase were also available during this phase. In addition, teachers had access to the AAC tools they had developed during the training phase.

Follow-up phase. Two follow-up probe measures were collected for each dyad approximately three weeks following the training. These two sessions were the same duration and followed the same format as the pre-training and post-training sessions. No feedback was provided to any of the dyads during this phase.

Procedural reliability

To ensure that the researcher consistently provided the same instructional content and followed the same format for all the group trainings, an administrator (from each of the schools) attending the training and completed a checklist. The checklist identified the content and format the instructor should have followed during training (e.g., instructor provided information on AAC, role-played evocative communication opportunities). The administrators noted that 100% of the planned activities were presented, indicating that the training content and format were equivalent for all training sessions across the three schools.

Coding

All sessions were videotaped. The videos were then viewed and coded for the two dependent variables by the researcher based on the definitions of an evocative communication opportunity and communication turn. A count was obtained for the number of evocative communication opportunities provided by teachers per 10-min session. In addition, a count was obtained on the number of communication turns expressed by students per 10-min session.

Communication turns were counted if they met the definition of a communication turn regardless of whether it followed an evocative communication opportunity or not.

Data reliability

To establish the integrity of the data that were collected, point-by-point reliability was completed by a second coder on approximately 20% (3 min of each video) of the data. These data were randomly selected from the videos and coded. The second coder was an undergraduate speech-language pathology student who was also a fluent bilingual speaker of English and Sinhala. She was trained on the data coding procedures using the pilot videos until a reliability of 80% or better was achieved for both dependent measures. An opportunity or a turn needed to be coded within a time-frame of 3 s to be counted as an agreement. Inter-rater agreement was calculated for the two dependent variables by dividing the number of agreements by the sum of the agreements, disagreements, and omissions, and multiplying this value by 100 to obtain a percentage. The average reliability score for teachers' evocative communication opportunities was 97% (range: 94–100%) and for students' communication turns was 93.75% (range: 90–97.5%).

Data analysis

The data were graphed and visually inspected for changes between the pre-, post- and follow-up phase sessions. In addition, statistical analysis was completed using a repeated measures analysis of variance (ANOVA) mixed effects model on Statistical Analysis Software (SAS). An ANOVA was used to analyse differences in the number of evocative communication opportunities provided by special education teachers before and after the training. A similar analysis was completed to analyse differences in the number of communication turns taken by students with complex communication needs before and after their teachers participated in the training.
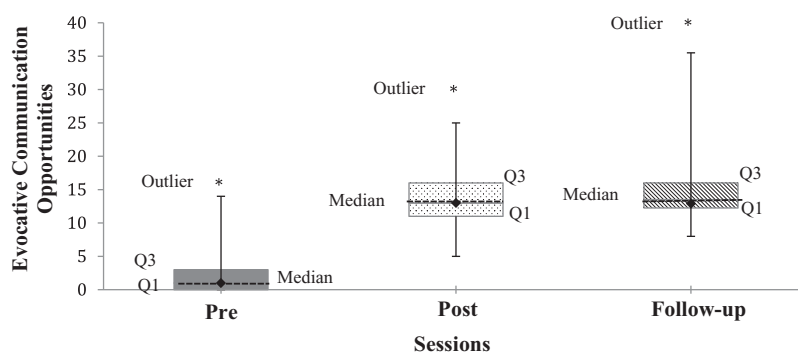
Figure 2. Evocative communication opportunities by pre-post-follow-up predictor variable. The box goes from the first quartile Q_1 to the third quartile Q_3. The horizontal line within the box is the median, the two vertical lines are the whiskers that show the spread of the data, and the asterisk represents outliers.

Social validity

The teacher participants completed a satisfaction survey at the end of the study as a social validity measure to determine how the teachers perceived the AAC training and strategies. The social validity questionnaire enquired about the teachers' experience with the AAC training, such as the strengths and suggestions for further improving the training programme, any changes they noticed in the student they were working with, and suggestion of one AAC strategy or tool they would continue to use in their context.

Results

Evocative communication opportunities provided by teachers

Data were explored visually using boxplots to examine the possible relationship between the variables. Figure 2 shows the relationship between the predictor variable, pre-post-follow-up, and the response variable evocative communication opportunities provided by teachers. Teachers increased their provision of evocative communication opportunities from pre-training to post-training. Additionally, these increases appear to have been maintained during the two follow-up sessions. During the three pre-training sessions teachers provided a mean of 2.07 evocative communication opportunities per 10-min session (range: 0–16). During the post-training sessions this increased to a mean of 13.85 (range: 5–28) evocative communication opportunities, and a mean of 15.05 (range: 8–38) during the follow-up sessions. The asterisks indicate the outliers, meaning a teacher who was presenting more evocative communication opportunities relative to the rest of the group.

A repeated measures ANOVA mixed effects model was used to evaluate differences between the number of teacher-provided communication opportunities during the pre-training, post-training, and follow-up phases. The random effect in the model was the teacher subjects, and the fixed effect was the pre-post-follow-up variable. Prior to running the analysis, the assumptions of independence, normality, and homogeneity of variance were evaluated. The residual plot violated the homogeneity of variance. Therefore, a square root transformation was completed that resulted in

improving the homogeneity of variance. The model was rerun using the transformed data.

The main effect for the pre-post-follow-up variable was statistically significant, $F(2,56) = 174.94$, $p < .001$. The number of evocative communication opportunities provided by teachers was different across the pre-, post- and follow-up conditions. Partial eta squared was calculated to determine effect size, $\eta_p^2 = 0.86$ (Lakens, 2013). Follow-up analyses of group differences for the pre-post-follow-up variable were accomplished with pairwise t-tests. Type 1 (alpha) error rate was adjusted using the Bonferroni correction to create a family-wise error rate of 0.0167 ($\alpha = 0.05/3$). Teachers provided a statistically significant higher number of evocative communication opportunities in the post-training and follow-up conditions than in the pre-training condition. The calculated effect size for the pre–post comparison was $d_z = -3.78$, while the effect size for pre–follow-up comparison was $d_z = -4.22$. Both these effect sizes are considered very large. There was no statistical difference in the number of evocative communication opportunities provided during the post-training and follow-up conditions.

Communication turns of students with complex communication needs

Students' communication turns in pre-training, post-training, and follow-up sessions are shown in Figure 3. There is an increase in the number of communication turns during the post-training and follow-up phases compared with the pre-training phase. During the three pre-training sessions students with complex communication needs took a mean of 10.07 communication turns per session (range: 0–26). During the post-training sessions, turns increased to a mean of 28.11 (range: 12–53); during follow-up sessions, the mean was 28.16 (range: 14–47). The asterisk in the figure indicates an outlier: a student with complex communication needs who was taking more communication turns relative to the rest of the group during the post-training phase.

A repeated measures ANOVA mixed effects model was used to evaluate differences between the number of communication turns taken by students during the pre-training, post-training, and follow-up phases. The random effect in the model was the teacher subjects, and the fixed effect was the pre-post-follow-up variable. Prior to running the analysis,
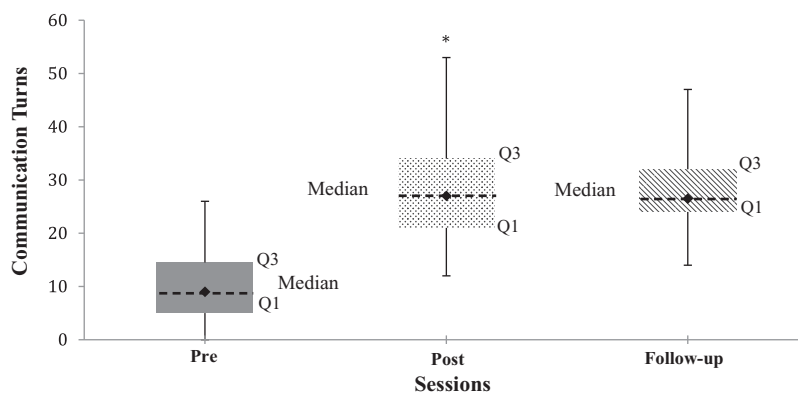
Figure 3. Communication turns by the pre-post-follow-up predictor variable. The box goes from the first quartile Q_1 to the third quartile Q_3. The horizontal line within the box is the median, the two vertical lines are the whiskers that show the spread of the data, and the asterisk represents outliers.

the assumptions of independence, normality, and homogeneity of variance were evaluated. The residual plot violated the homogeneity of variance; therefore, a square root transformation was completed that resulted in improving the homogeneity of variance. The model was rerun using the transformed data. The main effect for the pre-post-follow-up variable was statistically significant, $F(2,56) = 54.8$, $p < .001$. The number of communication turns taken by students was different across the pre-, post- and follow-up conditions. Partial eta squared was calculated to determine effect size, $\eta_p^2 = 0.66$ (Lakens, 2013).

Follow-up analyses of group differences for the pre-post-follow-up variable were accomplished with pairwise t-tests. Type 1 (alpha) error rate was adjusted using the Bonferroni correction to create a family-wise error rate of 0.0167 ($\alpha = 0.05/3$). The students took a statistically significant higher number of communication turns in the post-training and follow-up conditions than in the pre-training condition. The calculated effect size for the pre–post comparison was $d_z = -1.82$, while the effect size for pre–follow-up comparison was $d_z = -2.26$. Both these effect sizes are considered very large. There was no statistical difference in the number of communication turns taken during the post-training and follow-up conditions.

Social validity

All of the teachers stated that they would participate in a similar training programme if given another opportunity to do so, and all said that they would recommend this training programme to other teachers. All teachers reported a noticeable change in the students they worked with and shared aspects they felt were strengths of the programme, including: (a) learning about more effective ways to communicate with the student, (b) utilizing strategies to communicate and teach, (c) engaging in activities the students enjoyed, and (d) allowing the students to communicate more independently (e.g., expressing their needs). They also discussed aspects of the training that should be changed to improve it further in the future, such as: (a) creating more materials (i.e., picture cards), (b) using picture cards and strategies in a greater variety of activities, (c) involving parents in the training, and (d) building further on these strategies. Teachers also shared at

least one strategy they hoped to continue using with their students with complex communication needs. These included: (a) continuing to use the picture/word cards, (b) continuing to use the AAC tools developed with the students (e.g., communication board), (c) using AAC tools in similar activities as those in the training (e.g., singing), and (d) continuing to implement the strategies learned during the training (e.g., providing wait time, not answering questions on behalf of the student).

Discussion

The results of the group training demonstrated positive results for both teachers and students. The training resulted in increases in the number of evocative communication opportunities provided by teachers and the number of communication turns taken by students. A short training programme of four instructional sessions, which consisted of one group training and three individual sessions (approximately 6 h in total), was successful in teaching special education teachers evocative communication strategies that enabled the students with complex communication needs to communicate in their classrooms. In addition, following the teacher training, all of the students increased their number of communication turns.

Evocative communication opportunities provided by teachers

All of the teachers participating in this study showed an increase in the number of evocative communication opportunities provided to students, with some individual variability. The increases ranged from a mean of 9.42 to 16 opportunities during a 10-min session. The four key practices identified by Muttiah et al. (2016) as being essential when providing AAC training in low- and middle-income countries probably played a pivotal role in the successful outcomes seen in this investigation, as described in the sections that follow.

Investigate learner needs. Identifying learners' needs by conducting a needs analysis is an aspect that has been deemed important by other researchers (e.g., Bornman et al., 2007). Decisions on the content to be taught in Step 1 of

the training was based on the needs analysis conducted prior to the training. This also aligns with two of the major principles of adult learning: matching learning to adults' backgrounds and building upon their previous experiences and knowledge (Bryan, Kreuter, & Brownson, 2009).

Provide contextually relevant instructional content. Providing contextually relevant instructional content and materials included equipping the trainees with strategies that facilitated the use of AAC to support everyday communication with the students with complex communication needs. For example, locally available, inexpensive items such as paper, cardboard, hand-drawn pictures, pictures cut out from magazines and newspapers, and a whiteboard and marker were used as AAC tools. The decision to implement the evocative communication opportunities during music, arts and crafts, and literacy was based on the types of activity that teachers were already doing with the students. In addition, using case studies of students from the teachers' own classrooms enhanced the applicability of the training because seeing videos of themselves interacting with students in their classrooms made the training more personal. This was an effective way of addressing the "why" component of adult learning (Bryan et al., 2009). These were incorporated in Steps 3 and 4 of the training.

In this study, the trainees were equipped with strategies to support everyday communication with the students in their classrooms, and the primary focus of the training targeted the provision of evocative communication opportunities. Creating evocative communication opportunities is an important skill, as communication partners of individuals who have complex communication needs have reportedly provided fewer communication opportunities for individuals who use AAC to participate (Blackstone, 1999). In addition, teaching communication partners to provide individuals with a means to participate, and waiting an appropriate amount of time for a response, are known to be important skills to target when training communication partners of individuals who have complex communication needs (e.g., Kent-Walsh, Binger, & Hasham, 2010). Positive outcomes seen in the current investigation are consistent with the findings of other studies (e.g., Binger et al., 2010; Douglas et al., 2014).

Use engaging instructional activities. Using engaging instructional activities was also essential to ensure success. This training was based on steps of the strategy instruction model introduced by Kent-Walsh and McNaughton (2005). Modelling communication partner strategies, providing opportunities for controlled practice and feedback, providing opportunities for advanced practice and feedback, and independent practice in the learners' own settings are all steps of this strategy instruction model. Teachers developing their own AAC materials and then using the materials to role-play situations during the training is an example of adults being active participants in their own learning process (Bryan et al., 2009). Furthermore, using case studies of students from the teachers' own classrooms effectively addressed the need for adult learners to develop solutions for regularly observed challenges, and these were incorporated in the final four steps of the training.

Assess the impact of instructional activities. Assessing the impacts of instructional activities was also deemed to be an important component of training in this study. To ensure they met minimum criteria, the short-term impacts of the training were evaluated by observing learners demonstrating evocative communication strategies during Step 5 of the training to ensure they met the minimum criteria. Additionally, learners (i.e., teachers being trained) completed a satisfaction survey that encouraged them to self-reflect on content they had learned during the training. Sustainability was promoted by asking learners to reflect on one specific strategy or aspect of the training they hoped to continue to use with the students in their classrooms.

Increase in communication turns taken by students with complex communication needs

All students with complex communication needs in the study showed an increase in their communication participation following the training for their teachers. This provides evidence that training teachers to offer more evocative communication opportunities resulted in positive changes in students' communication. This finding is consistent with other studies training partners to provide communication opportunities (e.g., Kent-Walsh et al., 2010).

Provision of evocative communication opportunities. During baseline, a majority of the teachers in the current study provided the students with frequent directives, such as pointing to pictures in a book in response to instructions such as "Show me … " or "Where is the … .?" These types of communicative behaviour are common among caregivers of individuals with developmental delays (Tannock, Girolametto, & Siegel, 1992). Communication partners may not intuitively know how to alter their behaviour to support better the communication of individuals with complex communication needs (Binger & Kent-Walsh, 2012). Although these types of directive allowed the students to participate, their contributions to the communication interactions were largely passive. By contrast, evocative communication opportunities such as asking individuals with complex communication needs open-ended questions, commenting, and providing choices allow them an opportunity to take more responsibility and actively participate in the communication interaction. This may have supported students in taking an active role in communication, which may have facilitated their increase in communication turns. In addition to the evocative communication opportunities offered there may have been other factors that contributed to the increase in students' communication participation. These are described in the following sections.

Provision of AAC. Providing students with complex communication needs with opportunities to communicate will not be productive unless they are also provided with some means to respond (Douglas et al., 2014). None of the students in the current study were consistently using any form of aided AAC prior to participating. During the pre-training sessions many of the students were observed to make attempts to communicate but were unsuccessful, probably because teachers were not able to understand them due

to poor speech intelligibility and not having any form of AAC to support their speech. Following the training, teachers provided the students with a variety of low-tech AAC options, including picture cards, word cards, pictures drawn on a whiteboard, and written word choices on a whiteboard.

Adequate wait time. Many studies have documented how crucial it is for communication partners to wait, providing individuals with the time needed to respond (Douglas et al., 2014; Kent-Walsh et al., 2010). Prior to participating in the training, many of the teachers either did not wait for or did not provide enough time for a response after providing an opportunity to communicate. Most often, it was observed that teachers would repeatedly ask the students questions without waiting for the student to respond. After the training, teachers were observed to wait longer for a response from the students. The additional wait time may have contributed to students producing more communication turns during the post-training and follow-up sessions.

Clinical implications

The positive results emerging from this investigation were the outcome of a relatively short-term training that resulted in teachers providing more evocative communication opportunities to students with complex communication needs. As a result of the teacher training, their students increased their communication participation during naturalistic interactions in the classroom. Teachers observed these positive changes in the students as reported in their social validity questionnaires. These findings are promising, given that the intervention did not directly target the students with complex communication needs. Additionally, the training utilized locally available educational tools and inexpensive materials, adding to the ecological validity of the study. Furthermore, teachers who participated in the study reported that they would continue to use the AAC tools they developed and strategies they learned.

Based on these results it appears that this training programme could be effective for a range of different teachers and students with complex communication needs. The special educators in the study had a wide range of ages (27–51 years), no or minimal experience with communication training, a range of educational backgrounds (from completion of high school to completion of a college-level degree), and a range of classroom experiences (3 months–20 years). Similarly, student participants in the study encompassed a wide age range (10–22 years), a range of diagnoses (Down syndrome, cerebral palsy, and genetic disorder), and a wide range of language abilities (from Level I to Level IV on the Communication Matrix).

Limitations and directions for future research

This study was a group design with a relatively small sample size, limiting the generalizability of these findings. Replicating this study with a larger sample size would be an important next step. This study utilized a quasi-experimental design, and threats to internal validity that are associated with these types of design need to be considered as limitations. The major threat to validity in this investigation is history. There were no significant or consistent external events that occurred during the course of this study that may have accounted for the changes seen in either the teachers' and/ or students' behaviours following the training. A second threat to validity in this study was that the primary researcher coded the videos for both the dependent variables. This could have introduced an additional bias, given that the researcher was not blinded to the hypotheses of the study and was aware of the pre- versus post-training sessions. In addition, although each of the student participants was assessed using the Communication Matrix (Rowland, 2011), none received a comprehensive AAC assessment prior to initiating intervention.

Although all teachers increased the number of evocative communication opportunities provided to students, there were differences in the amount of increases seen for individual teachers. Some showed more increases than others following the training. Some of the differences may have been due to the range of experiences in teachers' educational experiences and backgrounds. Despite not having specialized training in special education or AAC, it is possible that the many years of experience some teachers had with working with children with complex communication needs contributed towards them intuitively providing communication opportunities. Future investigations should include greater homogeneity in participants' groups resulting in findings that are more representative of all of the participants in the group, or alternatively, attempt to identify differential teacher characteristics that have an impact on outcomes. A further limitation is that an evocative communication opportunity was defined as requiring a number of components: (a) an open-ended question (excluding yes/no questions), comment, or choice; (b) a means to respond; and (c) a wait time of 5 s or more; however, the effect of each of these individual components was not investigated. Further research is needed to tease out each of these components and identify their individual effects.

In this study, only teachers' evocative communication opportunities were coded as opportunities because these allowed the students to be more active communicators during communication interactions. Other types of communication opportunities, such as asking yes/no questions and directives, were not coded because the purpose of the training was to prompt teachers to engage in providing students with evocative or more active communication opportunities. Therefore, teachers probably presented students with more opportunities to communicate than are shown in the results. Although this study documented that teachers could learn to use certain supportive strategies (e.g., strategies that were taught), more research is required to move to optimal communication systems for individual student participants. Additionally, although teachers' pre-training questionnaires enquired about their pre-training knowledge of AAC, an assessment of their AAC knowledge post-training was not completed.

The current study collected follow-up data, but this was limited to a short-term follow-up of only three weeks. Future studies should look at exploring longer-term effects of this training by measuring follow-up over a time period of three months and longer to determine whether teachers continued to use the strategies they learned during the training. Another important aspect for future research would be to replicate this training model in other low- and middle-income countries, to determine its viability in especially those countries with similar contexts. It would also be useful to determine whether this training is useful in developed countries. Additionally, as suggested by the teachers in the social validity questionnaire, expanding the training to include other communication partners such as parents, peers, siblings, speech-language pathologists, and other professionals is essential. Teachers also suggested expanding the training to providing communication opportunities for activities other than literacy, music, and leisure.

Conclusion

This study adds to the current research base on AAC partner communication training. Specifically, it adds to the scarce research base on AAC training in low- and middle-income countries. The positive results of this study are preliminary evidence that the training model developed by Muttiah et al. (2016) based on four key practices for conducting AAC training in low- and middle-income countries may be an effective model for training in these countries. These findings are noteworthy, as the literature documents how inadequate communication services are for individuals with complex communication needs living in low- and middle-income countries (Hartley, 1998). Effective training for communication partners of individuals with complex communication needs can help bridge the gap in communication service provision in these countries and serve as a more immediate solution to the grossly inadequate number of trained AAC professionals (Blackstone, 1990).

The current study contributes valuable information on evaluating the effectiveness of an AAC training programme for special education teachers living in low- and middle-income countries on increasing the number of evocative communication opportunities provided to students with complex communication needs. Results of this investigation provided preliminary evidence that training special education teachers was effective in increasing the number of evocative communication opportunities they offered their students with complex communication needs. In addition, the training positively benefited the students with complex communication needs by resulting in an increase in their communication participation during naturalistic interactions with teachers. These results are indicative that this training model may be beneficial for other low- and middle-income countries with similar contexts and for use in other communicative contexts.

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