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Empowering All Students to Participate: Utilizing AAC to Respond During Lessons

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Abstract

Previous research indicates that frequent and active participation of all students (including diverse student groups) improves student outcomes, as does using a variety of methods to respond during classroom instruction. Current research is limited in examining two key areas: 1) Increasing active participation of AAC users by encouraging engagement through frequent response opportunities during instruction and 2) Utilizing a variety of response methods to enable participation during instruction. Given the gaps that exist in the research, the purpose of this study is to examine whether incorporating a variety of opportunities to respond has an impact on AAC user's engagement and active participation during literacy instruction. This study followed an ABAB single-case design and examined the relationship between incorporating a variety of opportunities to respond and AAC users' engagement and active participation during literacy instruction. Results indicate that students who use AAC can use a variety of methods to respond to various question types and that having specified methods of response may have decreased instances of participants providing no response or partial responses. Results on whether having a variety of methods to respond to varying question types were mixed, but indicate there may have been slight increases in the number of complete responses given by some students.

Introduction

In school, children must actively participate in class to deeply internalize and learn a subject. Effective teachers design instruction that requires participation from students by asking them to say, write, and/or do something (Archer & Hughes, 2011; MacSuga-Gage & Simonson, 2015). Without the ability to respond and engage in lessons, students merely listen to information that is presented, and their chances of retaining important concepts are limited. Participation in lessons allows students to engage with new content by analyzing and processing it, finding successes, making mistakes, and finally, understanding the information.

Archer and Hughes (2011) compare effective lessons to good conversation— conversation is interactive, and each participant takes multiple turns to engage. Likewise, an effective lesson follows the format "Input → Question → Response. Input → Question → Response. Input → Question → Response. Input → Question → Response" (p. 132). Instruction is not "Input → Input → Input → Input → Input →See you tomorrow" (p. 132). As the number of opportunities to respond during a lesson increase, so does student engagement as well as the likelihood of positive student outcomes (Archer & Hughes, 2011; MacSuga-Gage & Simonson, 2015). This higher quantity of responses from students also gives teachers an increased amount of information to evaluate student understanding of a concept. Teachers can then use the collected information to adapt lessons and ensure student understanding.

Teachers generally require students to respond during a lesson using verbal speech or a physical action or gesture (i.e., thumbs up/down, raising hands, writing, etc.; Archer & Hughes, 2011). For most students, maintaining a frequent pace of response during a lesson is easy, and students can respond using both verbal speech and physical gestures. However, students with disabilities that impact verbal speech and/or physical movement will have significantly fewer

opportunities to participate in a lesson without accommodations. Opportunities for teachers to evaluate student knowledge is also limited without this frequent participation by students.

Many students with disabilities that impact verbal speech production use augmentative and alternative communication (AAC) to communicate with others. AAC includes many forms of alternative communication including signing, writing, typing, or using a low- or high-tech device with preprogrammed words that can be selected to create a message. These devices are referred to as communication devices, AAC devices, or speech-generating devices (SGD). AAC devices are also tailored to suit the physical needs of a user; adaptations can be used to enable access for persons with one or multiple visual, auditory, and/or physical impairments. Each communication device is individualized to suit the user's needs for language and physical access method (i.e., The way an AAC user physically operates a communication device.).

Lydia Dawley, the CEO of Click Speak Connect and an AAC user, shared her experience using her AAC device as well as other modalities of answering questions in her schooling in a status update on her company's Facebook page. She emphasizes the effectiveness her different modalities had in helping her participate in class while also saving time and energy. Dawley calls for individualized accommodations for all AAC users to help them participate in the classroom:

> "…we developed an unique and faster way for me to do my schoolwork. If there was a multiple choice question on my schoolwork or tests, she [Dawley's school aide] would write A. B. C. D. on a piece of paper and I'd point to the one I want or show my fingers like 1 for A, 2 for B, and so on. This saved so much time and my energy that I could get to the written/essay questions faster and take my time. I hear and observe AAC users in the classroom, see them using their devices when they are asked a multiple choice question, and it is taking longer. I can see they know the answer through their eyes, and I

feel like it's a no brainer for them to have an accommodation for answering questions. I know some people can't point or use their fingers, there are so many accommodations like head nodding, blinking, or even hitting an arm on the desk. It's ok for AAC users to not use their devices all day every day in school, we need a break sometimes" (Click Speak Connect, 2022.).

Lydia Dawley's Facebook post suggests multiple ways that AAC users can engage in frequent response opportunities in classroom settings. Both MacSuga-Gage & Simonson (2015) as well as Archer & Hughes (2011) have emphasized a teacher's need to require frequent opportunities to respond as well as the importance of utilizing a variety of participation methods for students to use to maintain their engagement in the learning process.

Literature Review

To find literature relevant to the research, the researcher used the EBSCO Host Database to search the following databases: Academic Search Ultimate, APA PsycInfo, Education Full Text (H.W. Wilson), Education Source, ERIC, Psychology and Behavioral Sciences Collection, Teacher Reference Center, and Vocational and Career Collection. Search terms included three combinations of the terms *opportunities to respond, questions, education, participation, accuracy, augmentative and alternative communication (AAC), AAC device, and speech generating device (SGD)*. In total, searches yielded 436 results (20, 409, and 7 respectively for the three individual searches) sorted by relevance.

Initially the titles and abstracts of up to 20 of the most relevant studies were reviewed to begin narrowing the literature. Selected studies focused on students that use AAC devices, the use of AAC devices in naturally occurring environments including the classroom, and/or teachers collecting responses from students. This refined the results to ten articles to examine in

greater detail. The abstracts of each article were assessed by considering central components of the research that was conducted. This includes a) increased opportunities for students to respond, b) principles of teaching AAC, c) communication partner perceptions, d) AAC user preferences, and e) AAC user participation in naturally occurring environments. Using these five categories, the literature was narrowed from ten articles to a final six to include in the literature review. Two doctoral dissertations were included because of the relevancy to the research.

Opportunities to Respond

MacSuga-Gage and Simonsen, 2015

MacSuga-Gage and Simonsen (2015) conducted a systematic review of existing literature examining the effects of teacher-directed opportunities to respond (TD-OTR) on student outcomes. Their initial review found 527 studies that were narrowed in a three-stage review procedure that produced 15 empirical studies for deeper analysis. The purpose of the review was to examine the characteristics of existing empirical literature regarding TD-OTRs, as well as to analyze the differential effects of varying the modality and the rate of TD-OTRs on student behavior and academic performance. Within the 15 studies reviewed, there was a total of 172 participants ranging from 1st to 11th grade. Most of the studies were set at the elementary level, but there were three set at the secondary level, and one study was unspecified in the age setting. The studies covered a range of school subjects and were equally dispersed between general education settings (7 studies) and special education settings (8 studies).

All but one of the studies reviewed by MacSuga-Gage and Simonsen (2015) were single-subject design studies. One was a group experimental design. The studies included two categories of independent variables: a) a comparison of class-wide TD-OTR modalities and b) increasing class-wide rates of TD-OTR presentation. There were several dependent variables

measured including student and teacher variables. Student variables were grouped into ten categories listed in the order of frequency: academic achievement, answering correctly, response rate, on-task behavior, disruptive behavior, off-task behavior, active student responding, test anxiety, incorrect responses, and no responses. Teacher variables were measured in less than half of the studies and included (in order of frequency) teacher rates of OTRs presented, praise statements, redirections, and instructional statements.

Based on the review of empirical research, increasing the rate of TD-OTRs as well as using a variety of response methods class-wide is associated with positive outcomes in both general education and special education settings (MacSuga-Gage & Simonsen, 2015). Research also suggests that class-wide, unison TD-OTRs result in more positive benefits for students with and without disabilities than individual TD-OTRs alone. One study found that a mix of choral (70%) to individual (30%) OTR's was more effective than one method independently. Finally, studies that researched the impact of increasing the rate of TD-OTRs demonstrated positive outcomes for students with and without disabilities. Results of the systematic review indicated teachers should provide TD-OTRS at a rate of 3–5 OTRs during drill instruction per minute based on the studies that were reviewed; however, the purpose of the review was not to establish an optimal rate of student response, so MacSuga-Gage and Simonsen cautiously made this recommendation. MacSuga-Gage and Simonsen's research may be somewhat limited because the literature base for the systematic review was small, however their "research suggests that by increasing the rate of TD-OTR presentation and varying the modality, teachers can support student gains regardless of disability status" (2015, p. 235). Future research is needed to examine the effects of TD-OTRs across classroom contexts and with different modalities.

Principles of Teaching AAC

Mathis, Sutherland, and McAuliffe, 2011

Mathis, Sutherland, and McAuliffe's (2011) review of prior literature indicates that students who use AAC to communicate are generally presented with fewer opportunities to participate actively in communication, and as a result may have a limited ability to develop linguistic, operational, social, and strategic competencies. These limitations stem from poor communication partners who have low expectations of AAC users and who provide limited opportunities and time to respond to communication. Research indicated that including pause time as a strategy for communication partners when conversing with AAC users, can have a positive impact on the communication of the AAC user. The purpose of Mathis, Sutherland, and McAuliffe's study was to examine the effects of varying length of pause time on the expressive communication of young AAC users.

Eight participants aged 8;11–20;08, engaged in a 2-phase study in their home, school, or university campus clinic (Mathis et al., 2011). Each participant had used their AAC system for at least six months prior to the study. Phase one of the study included pre-testing and observation and phase two included the experimental procedure. During the study pause time was manipulated and participants were provided with 27 randomized turn opportunities of 2-, 10-, and 45-second pauses utilizing open questions, closed questions, and comments/statements. Researchers observed whether participants initiated or completed a response during the pause time (If a response was initiated within the pause time, the participant was allowed to finish their response regardless of how long it took). Researchers measured the (a) percentage of responses made to opportunities presented, (b) mean length of utterance (MLU) in words, (c) type of conversational act (active or passive), and (d) modes of communication used.

Results indicated that participants "exhibited a significantly greater number of conversational responses with increased pause time" (Mathis et al., 2011, p. 419). The percentage of responses increased as pause time increased, and this result was reflected in both individual and group analysis of the data. MLU's also increased with a longer pause time. Participants were more likely to respond to comments/statements and closed questions than open questions. This finding contrasted other previous research that suggested the use of open questions to facilitate interaction. Mathis, Sutherland, and McAuliffe cautioned that young persons who use AAC may need additional support and encouragement to respond to open questions. Increasing the length of pause time did not seem to affect the type of conversational act or the modes of communication of participants. Mathis, Sutherland, and McAuliffe state:

> "When the participants made a response, they employed other modes of communication (e.g., speech, gesture, and vocalizations) over 50% of the time. This means that therapists and communication partners must not view an AAC system as a sole or primary means of communication. It is important to be aware of, respond to, and encourage a multi-modal approach to communication . . ." (2011, p. 418).

Results of this study were limited in that a small number of diverse participants were used, so the ideal length of pause time in general cannot be stated. Optimal pause time duration should be assessed on an individual basis for AAC users. Future research is needed on the effects of other independent communication strategies suggested to communication partners that are designed to help teach interaction to AAC users.

Communication Partner Perceptions

Finke and Quinn, 2012

Finke and Quinn developed an online survey that they sent to 89 ASHA certified speech-language pathologists (SLPs) from 20 states who had experience working with children (ages 0–5) that used AAC systems to communicate seeking answers the following research questions: "(1) Do SLP perceptions of a child's communication style as active or passive affect intervention planning and decision making; and (2) Do SLPs target goals in intervention that promote and/or maintain an active communication style in young children who require AAC?" (Finke & Quinn, 2012, p. 119). An active communicator was defined as being able to more frequently initiate and regulate an interaction, have successful interactions (despite potential limitations), and initiate and extend topics in conversation while passive communicators were defined as initiating fewer interactions and taking on a respondent role in conversations.

The survey was designed using the Tailored Design Method and comprised three sections: (a) demographics, (b) general AAC information, and (c) perceptions of communication style and intervention practices. Participants received individualized surveys based on the answers they provided. The survey ended after the demographic and general AAC information sections for participants who did not have experience providing interventions for children under the age of five, or who had not utilized AAC within their practice. This left 57 SLPs that responded to the remainder of the survey, and the results are based on their responses. The results of the study may be limited by the small number of participants that completed the study.

Previous research suggests that interventions for students with a passive communication style should target increased initiation, turn-taking, and question asking (Finke & Quinn, 2012). For individuals with a more active communication style, the interventions should focus more on teaching new linguistic forms as well as increasing the range and frequency of these acquired forms. Results of the survey indicated that intervention planning and decision making of SLPs

does vary with the perception of an active or passive communication style and the targeted

intervention is also different for these groups in ways that align with positive supports of

previous research.

Responses to the survey also indicated differences in the vocabulary provided to AAC

users with active and passive communication styles. Vocabulary for children with a passive

communication style focused more on communicating about their wants and needs and these

children had more vocabulary excluded from their devices compared to children with an active

communication style. Previous research indicates that "if the majority of the vocabulary

available is intended to allow the child to respond and request, then it may be the vocabulary that

is limiting the child's ability to communicate and participate in more active ways" (Finke &

Quinn, 2012, p. 123). Finke and Quinn stated that the vocabulary chosen by SLPs is significant

and could be an important limiting factor in developing an active communication style among

their students if the vocabulary over-represents requests and does not facilitate communication

for other purposes. Future research is needed to determine whether the nature of passive

communication is due to the communication style alone or if intervention priorities and targeted

communication goals contribute to passive communication.

AAC User Preference

Genç Tosun, Köse, and Okatan, 2022

Genç Tosun, Köse, and Okatan (2022) conducted a study reviewing existing studies to

determine preferences of individuals with autism spectrum disorder (ASD). Specifically, they

researched how preference assessments were conducted and which type of AAC system

participants preferred among sign language, speech generating devices, and picture exchange-

based systems. The initial review found 129 articles that were narrowed to 13 through the review

process. Two additional articles were found after the review process but also met the inclusion

requirements. There were 48 total participants from the 15 studies reviewed, ranging in age from

3–17. Forty-one of the participants were male and 7 of the participants were female; 8 of the 15

studies included males only. All participants had ASD, and each had either no speech, some

vocalizations, echolalic speech, or a limited vocabulary. Nine studies reported the participants

had experience using AAC prior to the study. The studies were conducted in one of four settings:

(a) school, (b) clinical, (c) home, or (d) unspecified.

The studies reviewed by Genç Tosun, Köse, and Okatan (2022) utilized one or multiple

of the following single-case research designs: alternating treatment, adapted alternating

treatment, multiple-baseline, or multiple probe. Independent variables were not reported;

however, 14 studies had a common dependent variable: a single-step requesting skill. The 15th

study researched a multi-step requesting skill. Studies were analyzed based on the following

variables: "(a) participant characteristics, (b) AAC types that were compared, (c) preference

assessment methods, (d) preference assessment process, (e) findings, and (f) methodological

characteristics" (Genç Tosun et al., 2022, p. 148).

Of the 48 participants from the studies reviewed by Genç Tosun, Köse, and Okatan,

(2022), 36 preferred to use a speech-generating device, 11 preferred a picture-based exchange

system, and 1 preferred sign language. These findings aligned with previous research that found

most individuals with ASD prefer speech-generating devices over other AAC systems. Most

participants also preferred the system they learned the fastest, however some preferred other

methods. The studies reviewed were only conducted in school or clinical settings and did not

assess individuals' preferences in different settings or with other communication partners. This is

a limitation of Genç Tosun, Köse, and Okatan's study as participants' preferences may change in

different settings and with different partners. While Genç Tosun, Köse, and Okatan determined

that it is important for individuals with ASD to have a voice in determining which type of AAC

system they want to use, further research is needed to examine individuals' preferences in other

settings including home and social environments and with other communication partners.

Research is also needed to examine AAC system preference when individuals are demonstrating

different communication skills.

AAC User Participation

Gormley, 2019

For her doctoral dissertation, Gormley (2019) designed a pretest-posttest control group

study to determine the effect of AAC training on medical providers' behavior when interacting

with children who had complex communication needs. The purpose of the study was to assess

the effectiveness of the training and understand the effects it had on providers' and children's

communicative interactions in real-world contexts. Thirty healthcare professionals and three

children participated in the study. The healthcare professionals ranged in age from 29–74 and

had a range of one month of experience to 9 years of experience working with children in in-

patient settings. Professionals included nurses, certified nursing assistants, respiratory therapists,

occupational therapists, physical therapists, physical therapy assistants, recreational therapists,

and speech-language pathologists. Of these professionals 66% had no prior AAC training. The

three children, Jacinta, Gerome, and Adriana (pseudonyms), each had complex communication

needs, and were 1:5-, 16:7-, and 16:11-years-old respectively. The study was conducted in an in-

patient rehabilitation hospital during regular child-provider interactions.

During the 7-week study period each provider was randomly assigned to the treatment

group or to the control group (Gormley, 2019). Each provider completed a pretest and a posttest.

Providers in the treatment group, also completed an AAC training and were instructed to follow

a communication procedure with children that included three primary steps: "(a) offer a choice,

(b) wait for a response, and (c) respond to the child" (Gormley, 2019, p. 59). The independent

variable was the mobile AAC training and checklist. Several dependent variables were measured,

including the percentage of providers who offered children a choice, the level of accuracy that

providers followed the procedure, and the percentage of interactions that the children responded

and/or made a choice during a routine interaction.

The study was both benefitted and limited by being conducted in a real-world

environment and naturally occurring contexts. It was limited in that the researcher was unable to

control multiple variables across participants and time; however, the study demonstrated the

effectiveness of a real-world application of this type of AAC training. Overall, 71% of providers

in the treatment group offered a choice(s) to children compared to 0% prior to the intervention

and compared to the 7% in the posttest of the control group. The results of the study indicate that

a brief (less than 15-minute) procedural AAC training that included a checklist for the procedure

was an effective way to deliver training and that providers were able to generalize the use of the

training procedure. Results also indicated that if the procedure was implemented by providers

over time, children and other patients would have "more opportunities to make meaningful

decisions related to their care and potentially increase valuable self-efficacy skills to contribute

to their own care" (Gormley, 2019, p. 123). While offering a choice to children and AAC users is

an important element in promoting communication during health care procedures, the study

encouraged other types of communication opportunities be researched in these types of provider-

child interactions in future studies.

Westover, 2010

The purpose of Westover's (2010) dissertation study was to determine the effects of modified direct instruction as well as the effects of performance feedback given to instructors on the number of opportunities to respond and correct academic responses from students who are AAC users. A total of four dyad teams were used to complete the study. The classroom instructional assistants served as primary participants and the students served as secondary participants. Instructional assistants were selected based on direct service in the classroom, having limited experience facilitating and supporting communication needs of AAC users, and being responsible for providing daily literacy instruction. Students, between the ages of 5 and 12, who were enrolled in a self-contained special education classroom were selected by the following criteria: (a) have IEP goals that address literacy and be receiving literacy instruction, (b) parent and teacher agreement that student would benefit from an increase in planned AAC and literacy instruction, and (c) could point or use partner-assisted scanning to make choices between 2+ visual options.

Two independent variables were manipulated in the study: modified direct instruction and modified direct instruction with performance feedback. Three dependent variables were measured: opportunities to respond, correct responses, and increased literacy skills (Westover, 2010). To measure these variables, Westover utilized a single subject multiple baseline study across participants and involved four phases including baseline, modified direct instruction, modified direct instruction plus performance feedback, and maintenance. A pre- and post-test literacy assessment was delivered to students. Instructional assistants were given individualized training prior to the modified direct instruction phase, and then received performance feedback in phase three. Data sessions occurred with real-time observation and lasted 10 minutes during literacy instruction. The frequency of communication opportunities, correct responses to

opportunities, no-response occurrences, praise and redirect occurrences, and error corrections were tracked.

For all variables measured, data increased during the modified direct instruction phase (Phase 2) from baseline, and during the modified direct instruction with performance feedback phase (Phase 3) from modified direct instruction (Phase 2; Westover, 2010). Results from phase three were maintained during the maintenance phase. Both the rate of opportunities to respond as well as the accuracy of students' responses increased throughout the study. Results also indicated that students with significant disabilities who require AAC can increase their literacy skills through modified direct instruction with performance feedback for instructional assistants. Generalization was one limitation of this study; the narrow range of instructional assistants, students, and diversity among the forms of AAC used by students limited the results of this study and indicate a need for further research. Including students who use other forms of communication such as eye gaze or switch-scanning as well as utilizing AAC for more forms of participation in literacy tasks are important directions in future research. The results of this study indicated that students with limited verbal skills and significant disabilities can increase their literacy skills, even after failed attempts. Westover calls for further research connected to literacy and AAC use. She states, "We must discontinue the use of prerequisites to the access of literacy instruction for this population and work at ways to bypass the need for vocal speech in instruction" (Westover, 2010, p. 115).

Problem Statement

Current research is limited in utilizing AAC to require frequent responses from students using a variety of response methods including vocal output and physical actions. Most of the research has focused on effective practices for teaching students to communicate using AAC

(Light, 1996; Mathis et. al, 2011; Subihi, 2013) or analyzing the effects of the perceptions communication partners have of AAC users and how these perceptions impact the quality of a communication exchange (Finke & Quinn, 2012; Brodhead et. al, 2020; Ivy et. al, 2020). Genç Tosun, Köse, and Okatan (2022) examined the importance of AAC users' preferences in selecting a communication method.

Two studies have emphasized the importance of AAC users' ability to actively participate in their environments. Gormley (2019) examined an AAC user's ability to be an active participant in their own health care routines, and Westover (2010) examined the number of opportunities AAC users had to respond during literacy instruction as well as the number of correct academic responses. While some research exists emphasizing the importance of frequent and active participation for all students, including AAC users, further research is needed to study methods of participation and response for diverse students.

Statement of Purpose

Given the gaps that exist in the research, the purpose of this study was to examine whether incorporating a variety of opportunities to respond has an impact on AAC user's engagement and active participation during literacy instruction. The research questions that guide this study are:

1. To what extent is there a functional relationship between incorporating a variety of opportunities to respond to differing question types (dichotomous, multiple-choice, close-ended, and open-ended) and AAC user's engagement and active participation during literacy instruction?

2. To what extent are students that use AAC to communicate able to provide responses using a variety of different response methods (i.e., gestural, multiple choice, AAC device)?

Methods

Participants and Setting

This study took place in a special school environment within a public school district in Utah. In Special Education, there is a continuum of placements for students to receive their education and support. These settings include (from least restrictive to most restrictive) general education classrooms, resource classrooms, self-contained classes (often called special classes or life skills classes), special education schools, and home or residential facility placements. The goal is for all students to be placed in the least restrictive environment that still meets a student's needs. Students are placed in a special education school when a typical school with a self-contained classroom does not support a student's needs. Special education schools typically serve students with significant disabilities and do not typically have same-age general education peers. This is true of the participants' school setting.

Primary participants for this study were selected from a group of elementary students in grades 2, 4, 5, & 6 that were students in the researcher's classroom. The parents of 9 students from the researcher's classroom consented for their child to participate in the research study. Classroom paraeducators assisted the researcher in instructing and collecting data from students. Each student had significant disabilities and communication needs, and each required the use of AAC to communicate with others. Participants were also medically fragile, used wheelchairs, and all but one participant were non-speaking (the participant who used verbal speech also used a communication device to supplement speech production). Each participant qualified for special

education under the Multiple Disabilities eligibility on their IEP; however, this was not an inclusion criterion in the study.

Participants generally used one of three methods to access their AAC devices, though some students communicated using more than one method. The methods included direct selection, eye gaze, and visual/auditory scanning. Students with enough arm mobility and hand dexterity used the method of direct selection to make a choice or otherwise communicate using their AAC device. Eye gaze was similar, except users made selections and communicated by looking at an item(s) for a specific duration. Visual/auditory scanning was done in one of two methods: one-switch scanning or two-switch scanning. In one-switch scanning, users had one button that they used to make choices. Choices were displayed visually and/or read aloud on a timed interval depending on the user's access needs, and the user pressed a button when they saw or heard the message they wanted to communicate. Two-switch scanning enabled the user to move throughout their communication device at their own pace; one of the switches moved from item to item and the other switch made selections. Choices using two-switch scanning could also be displayed visually and/or read aloud depending on the user's needs.

Because each participant had an IEP, they each worked on individualized academic goals in reading, writing, math, and a functional skill area. Participants also received related services according to their needs in the areas of occupational, physical, speech-language, vision, and hearing therapies provided by a related service provider at the school. In addition to IEP goals, the participants received general Tier 1 instruction in literacy (reading and writing), math, science, and various specialties. The curriculum was designed around and based on the Dynamic Learning Maps (DLM) Essential Elements (EEs) which were derived from Utah's Common Core State Standards. This study took place during a specific component of literacy instruction

focused on developing knowledge and skills in phonological awareness—specifically rhyming and alliteration. Because of this, a more detailed discussion of the participant's literacy instruction is discussed next.

The literacy curriculum used in the researcher's classroom stemmed from the EEs and used principles from the science of reading taught in the LETRS® (https://www.lexialearning.com/letrs) program and the practices described in *Comprehensive Literacy for All: Teaching Students with Significant Disabilities to Read and Write* by Dr. Karen Erickson and Dr. David Koppenhaver (2020). Erickson and Koppenhaver (2020) divided comprehensive literacy instruction into two parts: emergent and conventional. Emergent literacy included "all reading and writing behaviors and understandings that precede and develop into conventional reading and writing" (Erickson & Koppenhaver, 2020, p. 7). Instruction in emergent literacy prepares students for more traditional instruction known as conventional literacy. Emergent readers and writers receive literacy instruction utilizing the instructional practices/areas of shared reading, shared writing, independent reading, independent writing, and alphabet knowledge and phonological awareness. Students in the researcher's class received between 90 and 120 minutes of literacy instruction daily in addition to the other areas of their curriculum. Most participants were transitioning from emergent literacy instruction to conventional literacy instruction. Conventional literacy maintains the practice of independent reading and independent writing, but exchanges shared reading, shared writing, and alphabet knowledge and phonological awareness for the areas of reading comprehension and word study (Erickson & Koppenhaver, 2020). During the study, the instructional routine used targeted phonological awareness and included concepts from the reading comprehension and word study areas of conventional literacy.

Inclusion criteria to participate in the study included (a) parental consent to participate, (b) being assigned to the researcher's class before baseline data collection began, and (c) having the need to use AAC to communicate as determined by the student's IEP team ("Communication needs addressed in IEP" and "Assistive Technology addressed in IEP" are both checked under the special factors section of the service and placement page on participants' IEPs). Students who did not receive parental consent were excluded from data collection as part of the study, but still participated in instruction.

A more detailed description of each of the participants follows. Student participants were allowed to create their own pseudonym for the study. Students used vocabulary from their communication device to select a pseudonym or they used the alphabet page on their communication device or another alternative pencil to spell their own pseudonym.

Bubbles

Bubbles is an 8-year-old white female in second grade. She is medically fragile and uses a wheelchair. Bubbles has both a hearing and a visual impairment that impact how she accesses instruction and materials in the classroom. Because she is deafblind, Bubbles has a 1-on-1 aide called an intervener to help her access instructional materials and communicate with others in the classroom. Because of Bubble's deafblindness and because of her physical impairments that impact how she uses her hands, Bubbles first started learning to communicate via visual-auditory scanning with one switch using a visually adapted version of an auditory Pragmatic Organization Dynamic Display© (PODD©) scan (https://podd.dk/eu-wp/). Bubbles uses this scan book to communicate and is also learning to use a speech generating device to give her further independence and additional vocabulary when communicating. The device she is currently learning to use in addition to the physical scan book is called an Accent® 1400

(https://www.prc-saltillo.com/). Bubbles is learning to access her new AAC system with two access methods—visual/auditory scanning and eye gaze. When scanning, Bubbles presses a button/switch, it activates the device, which then reads options of things she could say as well as visually shows the possible messages on the screen. When she hears what she wants to say, Bubbles selects the message using her button and the device reads her message aloud. Bubbles can also use eye gaze to access this communication system. Using this method, she can look at the screen and highlight potential items for her to say. When she looks at an item for long enough, the computer will read aloud her message. Bubbles uses both access methods interchangeably to communicate in the classroom. In addition to using a switch, Bubbles also makes vocalizations or moves her body (e.g., kicks her feet, straightens her back, etc.) to make choices during instruction.

In literacy, Bubbles has learned to identify the names of letters as well as the most common sound represented by each letter of the alphabet using highly contrasted letters. She can identify the sounds of a given letter of the alphabet from a field of at least three options. Bubbles also participates frequently during shared reading activities by making comments, answering questions, and sometimes asking questions of her own. She is working to answer more questions during shared reading and is ready to start building her knowledge in phonological awareness. Bubbles can sleep intermittently throughout the day, which affects how she is able to participate in instruction.

N

N is also a white female student in second grade. She turned eight years old during the study. N uses a wheelchair and is medically fragile; she often has seizures during the school day, which affects how she engages in learning. When she has a seizure, she will typically sleep

afterward. N has a visual impairment that affects how she accesses materials. She needs items presented in high contrast and benefits from tactile objects. She has difficulty manipulating objects independently and needs physical assistance to engage in instruction. N has a communication device she uses to communicate at school (an Accent® 800); because of her visual impairment, she uses auditory scanning with two switches to access her device (https://www.prc-saltillo.com/). N uses one switch to navigate around her communication device and one switch to select items. Some items open new pages of vocabulary, and some items are words that are said aloud when selected. N has used this communication device for about 1 year. She also sometimes still uses her previous AAC system which was an auditory PODD© scan that she accessed using a single-switch auditory scan (https://podd.dk/eu-wp/). N also communicates and makes choices using the switches in addition to putting her hand to her mouth as a tell that she is making a selection.

N is learning to identify the sounds represented by letters of the alphabet. She is currently identifying a letter sound from a field of three after being given the name of a letter. She is also beginning to identify words that start with a given letter sound. N has been working to identify the number of syllables within words and is ready to learn about rhyming and alliteration. She is also working to engage more frequently in shared reading by making comments and answering questions.

S323

S323 is a white male student in fourth grade. He is 9 years old. S323 uses a wheelchair and is considered medically fragile. Because of the way he tolerates his feeding, S323 is fed incrementally via a g-tube throughout the school day. This can impact the way he receives instruction as there are sometimes small interrupts to feed him, which impacts his focus on a

task. S323 uses his head to activate a switch, which runs his communication device—a ChatFusion™ running WordPower® (https://saltillo.com/). He has used the device for about 4 years. The device reads options to S323 and visually scans across the page so S323 can track where he is going and select what he would like to say. The device has multiple pages of vocabulary and reads messages aloud when S323 selects words. S323 has limited other movements of his body, but can look at items, turn his head both directions, and can lift his arms off his wheelchair armrests or lap. He uses these methods to help him make choices in addition to using his communication device.

S323 regularly identifies the names and sounds represented by each of the letters of the alphabet from a field of at least three. He also makes comments during shared reading and answers CROWD questions (Comprehension, Recall, Open-Ended, Wh-, and Distancing; Erickson & Koppenhaver, 2020). He is working to develop his reading comprehension by participating in Anchor, Read, Apply activities in which he engages in shared reading of a text for a specific purpose and completes an activity related to that purpose (Erickson & Koppenhaver, 2020). S323 can also identify the number of words within a sentence of five or fewer words and the number of syllables within a word for words of four or fewer syllables. He has been working on identifying the odd word out in a field of three rhyming words and one non-rhyming word. S323 has also started to spell two- and three-letter words following the Making Words lesson format from *Comprehensive Literacy for All* (Erickson & Koppenhaver, 2020).

Gomo

Gomo is a 9-year-old white male student in fourth grade. He is medically fragile and has a tracheotomy (trach). Gomo also uses a wheelchair. He has a private-duty nurse who provides oral and trach suction as needed; the nurse also takes care of any other medical needs. Gomo is

also deafblind—he has both visual and hearing impairment. Because of this he has an intervener to help him access instructional materials and communicate with others. Gomo uses a communication device that scans both visually and auditorily (an Accent® 1400) he has used the device for about 2 years (https://www.prc-saltillo.com/). He uses two switches to navigate the device—one switch moves around the device and one switch select items. Gomo also uses eye gaze to look at options to make choices and can use his hands to make choices in addition to using his communication device.

Gomo knows all the uppercase and lowercase letters and the sounds that the letters of the alphabet represent. He uses eye gaze to demonstrate this knowledge from fields of at least three letters. He can also identify the number of words in a sentence for sentences of five or fewer words and can identify the number of syllables in a word for words that are four or fewer syllables. Gomo can also identify the odd word out from a set of three rhyming words and one non-rhyming word. He is working to identify another word that rhymes with a given word from a set of three words. Additionally, Gomo engages frequently during shared reading by making comments using his communication device and answering CROWD questions (Erickson & Koppenhaver, 2020). He is working to complete activities connected to a specific purpose for reading a text following the Anchor, Read, Apply model (Erickson & Koppenhaver, 2020). Gomo is also spelling two- and three-letter words using the Making Words lesson format. (Erickson & Koppenhaver, 2020)

Big

Big is a White/Hispanic male student in fifth grade. He turned 11 years old during the study. Big has a tracheotomy and has a private-duty nurse that attends school with him to take care of his suctioning and other medical needs. Big uses a wheelchair and has Cortical Vision

Impairment (CVI); he needs simplified and highly contrasted materials in order to see

instructional materials. Big is not able to manipulate objects using his hands, so he activates his

communication device and typically makes choices by turning his head to the right. When Big

gets close to and/or presses the proximity switch positioned to the right of his head, his

communication device (an Accent® 800) will read him choices to navigate around the device as

well as to select words for Big to say (https://www.prc-saltillo.com/). The options are read at an

interval of about 2.5 seconds between each option. Because of Big's visual impairment, he

accesses his communication device auditorily. Big has used this device for about 1 year.

Big is working to learn the letter sounds for all letters of the alphabet. He is able to

identify most of the letter sounds most of the time from fields of at least three and has begun

identifying the initial letter sound of a given word from fields of at least three. Big is also

working on building early phonological awareness skills; currently he is working to identify the

number of syllables within a word of four or fewer syllables. Big does well making comments

using his communication device during a shared reading activity. Big is working to develop his

reading comprehension by answering CROWD questions (Erickson & Koppenhaver, 2020).

GN?

GN? is a 10-year-old female Hispanic student. She is in fifth grade. GN? uses a

wheelchair and has physical impairments which prevent her from using her hands to access

instruction and AAC. GN? also has a visual impairment and needs high-contrasted materials to

assist her in seeing objects. Because of her visual impairment, GN? accesses her communication

device auditorily using two switches. Her device is an Accent® 800, and she has had this device

for about 1 year (https://www.prc-saltillo.com/). GN? is able to lift her right wrist and/or forearm

to trigger one of the two switches. She uses her right foot to access the other switch. When

navigating the communication device, one switch moves the selector from item to item, and the other switch selects items which navigate to an additional page of vocabulary or say a word aloud. GN? sometimes has seizures which also impact her access to education. Her seizures can be triggered by being startled. Typically, they are 15–30 seconds, and she is able to recover quickly. However, she will sometimes sleep after having a seizure.

GN? is working toward mastery identifying letter sounds from fields of at least three. She is also working to identify the initial sounds of given words as well as identifying an additional word that starts with the same initial sound from fields of three. GN? is also working to build early phonological awareness skills. She is currently working to identify the number of syllables within words of four or fewer syllables from fields of at least three. GN? does well making comments during shared reading. She is building her reading comprehension by answering CROWD questions during shared reading activities (Erickson & Koppenhaver, 2020).

Uno

Uno is a white 10-year-old male student. He is in fifth grade. Uno does not have a visual impairment, but has Cerebral Palsy, which impacts his ability to use his hands. Because of this, Uno uses an eye gaze communication device called a Tobii (https://www.tobii.com/). He uses two vocabulary sets on his device—a smaller vocabulary platform that he first learned when receiving the device several years ago, and a larger vocabulary platform he is learning to use. Uno has used both vocabulary platforms together for 1–2 years but has had the older vocabulary set for 4–5 years. He can navigate back and forth between the vocabularies to best suit his communication needs in the moment.

Uno can identify all the uppercase letters, lowercase letters, and letter sounds of the letters of the alphabet from fields of at least three. He can also identify the number of words

within a sentence of five or fewer words and identify the number of syllables for words of four or fewer words, also from fields of three. He can identify the odd word out from a field of three rhyming words and one non-rhyming word. He is currently working to identify a word that rhymes with a given word from a field of at least three words. Uno engages in shared reading by making comments and answering questions. He has begun completing activities after reading for a specific purpose using the Anchor, Read, Apply lesson format (Erickson & Koppenhaver, 2020). Uno is also beginning to spell two- and three-letter words following the Making Words lesson format (Erickson & Koppenhaver, 2020).

Dance Festival

Dance Festival is a white female student in sixth grade. She is 12 years old. Dance Festival can speak vocally in complete sentences. She does often echo other individuals or repeats memorized phrases. In addition to vocal speech, she uses a communication application called CoughDrop on an iPad (https://www.mycoughdrop.com/). The vocabulary set has 60 buttons on the home page, and most of the buttons navigate to additional pages of vocabulary with similar amounts of words per page. Dance Festival accesses her iPad using her hands and has used this application for 3–4 years.

Dance Festival does well with reading comprehension and letter-sound knowledge when she is able speak about what she knows (vocally or using AAC). She also does well discussing pictures and using picture symbols to make choices. She has a harder time identifying letters and letter sounds when she needs to use written letters to answer questions about them. During shared reading, she initiates comments and answers questions about the text. Dance Festival can identify the number of words in a sentence of five or fewer words and identify the number of syllables within a word for words for four or fewer syllables. She has started completing reading

comprehension activities when reading a text for a specific purpose following the Anchor, Read, Apply model (Erickson & Koppenhaver, 2020). She also is using the Making Words lesson format to help her better identify the letters of the alphabet as well as gain exposure to spelling two- and three-letter words (Erickson & Koppenhaver, 2020).

Elephant

Elephant is a sixth-grade student who is 12 years old, white, and female. Elephant has physical impairments which impact the use of her hands. She also frequently keeps them in her mouth or above her head. Because of this, the most reliable method of access for her to communicate is via eye gaze as she does not have a visual impairment. She uses an eye gaze computer (Tobii), which will say messages aloud when she looks at an item for a few seconds. She uses a vocabulary set with multiple pages of about 25 options per page (https://www.tobii.com/). Elephant uses eye gaze to both navigate between pages as well as saying words aloud. She will sometimes use an older vocabulary set in addition to her current vocabulary (PODD©; https://podd.dk/eu-wp/). She has used her current vocabulary for about 1 year.

Elephant can identify the letter sounds represented by the letters of the alphabet from fields of at least three. She can also select and write about a topic using a keyboard on her communication device and then read her writing aloud again using her communication device. Her writing is unconventional at this point, but she is able to give context to her writing by reading it aloud after she has written. Elephant initiates comments during shared reading and is beginning to answer CROWD questions during shared reading (Erickson & Koppenhaver, 2020).

Experimental Design

The experimental design of this study followed an ABAB single-case design. Throughout the study, students were given opportunities to answer four types of questions using various response methods. In both baseline phases (Phase A), baseline data were collected about how students use different methods of communication to answer questions and participate in classroom lessons. Students were given opportunities to answer questions using methods they had used prior to the study without specification. In the targeted intervention phases (Phase B), students were presented with opportunities to answer questions using a specified response method.

Independent Variable

The independent variable of this study was the type of response method participants used to answer different types of questions. (For this study, response method refers to the specified method for answering a question—e.g., using an AAC device with navigational assistance.) Each response method participants used could be accessed via multiple access methods (i.e., eye gaze, auditory scanning, direct selection, etc.) Participants were asked one of the following types of questions: dichotomous questions (i.e., true/false, yes/no, positive/negative, etc.), multiple choice questions (A, B, C, D), close-ended questions (questions with a specific correct answer(s) without options presented), or open-ended questions (questions that required no correct response with no options presented). Participants used multiple forms of AAC to answer questions depending on the type of question asked. For dichotomous questions, a gestural response (or another way of indicating between two choices) was used. Multiple-choice questions were answered using an individualized way of selecting between a limited number of options, and close- and open-ended questions were answered using an AAC communication device.

Dependent Variable

The frequency with which students participated by answering each type of question using the corresponding response method described above (accessed by direct selection, eye gaze, or visual/auditory scanning according to individualized need) was measured as the primary dependent variable. Data were collected individually as well as collectively. Participation was assessed based on whether students responded independently after being asked a question and were given 45 seconds of wait (pause) time.

Measures

To measure the dependent variable, the researcher and paraeducators tracked whether students answered a question fully, partially, or did not give a response after 45 seconds of wait time (Mathis et al., 2011). They also marked when a student participated with prompting/assistance. If a student initiated a response within the 45 seconds of wait time, students were allowed to finish their response regardless of how long the response took. A complete response included the student initiating their response and completing it by make a choice/communicating their answer. A partial response began with the student initiating a response, but the student did not then make a choice/communicate an answer. When students did not initiate any answer within the 45-second wait time, the response was recorded as, "No Response." The response method used was recorded as well as the response the student gave. Data sheets were created by the researcher using Google Sheets (https://www.google.com/sheets/about/), and data collection occurred by the researcher and paraeducators using an online copy of the data sheet (See Appendix A for a sample of the data sheet).

Procedures

Recruitment and Consent

Parents and guardians received a parental consent form sent home by the researcher outlining the purpose of the study, participant expectations, procedures, potential risks, and hypothesized benefits. Upon returning a signed consent form, students were enrolled into the study. If a parental consent form was not received from a potential participant in the researcher's classroom, the participant was excluded from the study. However, since this study occurred as part of regular instruction practices in the classroom, students whose parents did not provide consent to participate in the study still participated in the classroom instruction, but no data were collected for these students.

Lesson Procedures (Baseline and Intervention Phases)

The instructional lesson in which the procedures took place targeted the early phonological awareness skills of rhyme and alliteration. Lessons followed a routinized protocol but were not fully scripted. The researcher wrote the questions for each lesson and routinized the lessons to help minimize differences in implementation between different lesson days.

In both baseline and intervention phases, students participated during the lessons using their communication devices and other individualized response tools that enabled them to answer questions. Students accessed these tools using their preferred access method (direct selection, eye gaze, and/or visual/auditory scanning). Some participants may have had multiple access methods they used to engage in the classroom. Utilizing multiple access methods was allowable during the study. Specific types of response methods were prescribed during the intervention phase— described later—but these response tools could be accessed via multiple access methods.

During instruction, students were taught material and were primed to answer questions during the lesson. Students may not have known the correct answer to a question, which could have impacted participation rates. To help alleviate this potential limitation, an "I Don't Know"

response was included in multiple choice questions. This response allowed students to participate without having to know the correct answer. There were also questions included that did not have a specific correct answer. All students received up to 45 seconds of wait time when they were asked a question to allow students to think about the question, decide their response, and then initiate a response (Mathis et al., 2011). When questions had options listed as part of the question (i.e., Which word does not rhyme with ball? Wall, Cat, Fall, Tall, or I don't know), options were presented ahead of the wait time to allow students to consider the options, select one, and initiate a response.

During both the baseline and intervention phases dichotomous questions, multiple-choice questions, close-ended questions, and open-ended questions were used. The question types and examples of each question are described in Table 1. The researcher intended for participants to answer eight questions—two of each type—during each lesson. However, because of time constraints, participants may not have answered all eight questions every day. To avoid creating participant biases toward or against certain question types or a specific order of the question, the order of the questions was randomized. This also helped to ensure that each question type was answered in relatively equal proportions. The questions were randomized in two sets so that a random set of the four question types were presented first followed by another randomized grouping of question types (i.e., A, D, C, B | C, A, B, D). A sample lesson is included in Appendix B.

Table 1

Question Types and Response Methods Used in Intervention Phases (Phase B)

Question Type	Response Method	Example Question
Dichotomous Questions	Gestural response (or other individualized way to indicate between two choices)	Do the words hat and cat rhyme? *Yes/No*
Multiple-Choice Questions	Multiple options presented in an accessible way	Give me another word that rhymes with the word cat. *Toy, Girl, Bat, I Don't Know*
Close-Ended Questions	Participant AAC device (participant can receive assistance to navigate to a specific area of the device)	Tell me another letter that we could put in front of -at to make a word that rhymes with cat. *(Student given help navigating to keyboard on AAC Device)*
Open-Ended Questions	Participant AAC device (No navigational assistance will be given as this question type does not require a specific correct answer.)	What do you think of cats? *(Student not given any navigational assistance. There is no specific correct response.)*

Baseline-Specific Procedures

In the two baseline phases (Phase A), students were presented with the four question types using methods they had typically used to answer questions in the classroom. No specific instruction or guidance was given to paraeducators on how to solicit responses from students (other than waiting during the wait time for a student to indicate they were ready to answer a question), nor did participants receive instruction on how to answer a given question. Data were collected using the data collection sheets described in the measures section (Also see Appendix A). The first baseline phase spanned five lessons and the second baseline phase spanned three lessons.

Intervention-Specific Procedures

During the two intervention phases (Phase B), the researcher systematically incorporated the use of specific response tools to participate in the lesson using the four question types: dichotomous, multiple-choice, close-ended, and open-ended questions. To respond to questions,

participants answered each question type utilizing direct selection, eye gaze, or visual/auditory

scanning according to their individualized needs and personalized access methods. Question

types, response methods, and example questions are outlined in Table 1. Both intervention

phases spanned five days each.

After the completion of the first baseline phase (Phase A) and prior to the first

intervention phase (Phase B), paraeducators were trained together during a regularly scheduled

45–60-minute paraeducator training meeting on the four question types and how to facilitate

student responses using the corresponding response method for each question type. The

researcher-guided training included both direct instruction on question types and response

methods as well as modeling and practice of question types and response methods. Paraeducators

were allowed to ask questions during the training to ensure they understood each question type

and how to assist students in communicating their answers. The intent of this training was to

ensure that paraeducators were providing as much independence to students as possible as the

students answered questions and participated in instruction. It also ensured that paras did not

over-assist students or give an answer for a participant. Feedback was provided to paraeducators

by the researcher while practicing during the training session. A shorter reminder training session

was given to paraeducators between the second baseline phase (Phase A) and the second

intervention phase (Phase B). The same principles were reviewed and paraeducators had the

opportunity to ask questions about the procedures returning to intervention.

During a student training phase that occurred after the paraeducator training and between

the first baseline and first intervention phase, students also received instruction on how to

respond to each type of question listed in Table 1. Direct instruction on each question type and

response method were used, as well as modeling a response using each access method (direct

selection, eye gaze, and visual/auditory scanning). Students practiced answering each question type with the corresponding response method. Paraeducators assisted students in answering questions during this training phase to gain practice using each type of question and response before intervention data collection began. Feedback was provided to both paraeducators and students while practicing during the training lessons. The training phase spanned five days. As students and paraeducators became familiar with the intervention procedures, training and scaffolding were faded. Data were collected using the data collection sheets described in the measures section (See Appendix A).

Results

Out of the nine students who enrolled in the study, results are provided for six students. Data were not collected for one student, Big, because he was absent for the entire baseline phase of the study. Graphs of two other students are included in the results, but their data are not fully analyzed because each student had many absences across multiple phases of the study. These students are N and Elephant. Results for both research questions are included below.

Results for Research Question 1

Research question 1 asked: To what extent is there a functional relationship between incorporating a variety of opportunities to respond to differing question types (dichotomous, multiple-choice, close-ended, and open-ended) and AAC user's engagement and active participation during literacy instruction? Results are provided below for six participants; graphs are included for two additional participants. Results are separated into three sections based on measured variables: no response results, partial response results, and complete response results. Figures are presented for all participants at the end of each section.

No Response Results by Participant

Bubbles. Bubbles began the study with a mean of 22.5% of no responses during Baseline 1. There was no change in level between Baseline 1 and Training, though her average decreased to 13.57%. There was a decrease in the number of no responses as Intervention 1 began. Bubbles averaged 29.47% no responses during Intervention 1. In Baseline 2, Bubbles averaged 25% no responses, and there was a slight decrease in no responses between Intervention 1 and Baseline 2. There was no change in Bubbles' no responses between Baseline 2 and Intervention 2. Bubbles averaged 10% no responses during Intervention 2.

During Baseline 1 and Baseline 2, Bubbles had a decreasing trend of no responses. In Training and Intervention 1, the trend of Bubbles not responding to a question was increasing. In Intervention 2, her trend was level. Mostly, Bubbles had some or moderate levels of variability. Her variability increased slightly from Baseline 1 to Intervention 1, but her lowest amount of variability happened in Intervention 2.

S323. S323 had relatively low levels of no response throughout the study. In Baseline 1, S323 averaged 10% no response. This decreased to 5% in Training and there was a slight immediate decrease in his level of no response. There was no change between Training and Intervention 1, though his average continued to decrease to 3.57%. S323 had an immediate increase in his level of no response as Baseline 2 began. In this phase, he averaged 45.83% no response. There was an immediate decrease in not responding as Intervention 2 began. During this phase, S323 averaged 12.86% no response.

In Baseline 1, S323 had an increasing trend of no response. This trend leveled some as he only had a slightly increasing trend during Training and Intervention 1. During Baseline 2, S323 had an increasing trend of no response, and finally in Intervention 2, S323 had a decreasing trend of no response. There were low amounts of variability in S323 not responding to a question.

Intervention 1 had minimal amounts of variability, followed by Baseline 1, Training, and
Intervention 2 with low levels of variability. Baseline 2 had the most amount of variability in no
response for S323.

Gomo. Gomo started the study with an average of 12.5% no response during Baseline 1.
There was no change in level between Baseline 1 and Training, however, his average of no
response increased to 29.47% during Training. There was a large and immediate decrease in the
level of no response for Gomo between Training and Intervention 1. During Intervention 1,
Gomo's average decreased to 5.36% no responses. This average increased slightly to 8.33% in
Baseline 2, though there was no immediate change in the level of response between Intervention
1 and Baseline 2. There was also no change between Baseline 2 and Intervention 2. Gomo's
average of no response in Intervention 2 was 17.86%.

Through most of the phases, Gomo had an increasing trend of no response. He had an
increasing trend in both Baseline 1 and Training. During Intervention 1 and Baseline 2, Gomo
only had a slightly increasing trend. Gomo had a slightly decreasing trend of no response in the
final intervention phase. Gomo began Baseline 1 with moderate variability in his levels of no
response. This decreased some in Training and then remained at low levels of variability
throughout Intervention 1, Baseline 2, and Intervention 2.

GN?. GN? averaged 25% no responses during Baseline 1. There was an immediate
decrease in the level of her no responses between Baseline 1 and Training, as well as between
Training and Intervention 1. Her average of no responses also decreased through these two
phases; GN? averaged 18.57% no responses in Training 1 and 8.33% no responses in
Intervention 1. GN? had an immediate increase of no responses as the study transitioned to
Baseline 2. Her average of no responses also increased to 37.50%. In Intervention 2, GN?'s

average decreased to 23.22% and there was an immediate decrease in the level of no response from her as Intervention 2 began.

GN? began the study with a level trend in Baseline 1. In training, the number of no responses was trending upward, but reversed and decreased in Intervention 1. GN? again had a level trend in Baseline 2 and finished the study with an increasing trend of no response in Intervention 2. GN? had no to some variability in the study. She had no variability in both baseline phases, low variability in Intervention 1, and some variability in Training and Intervention 2.

Uno. In Baseline 1, Uno averaged 32.5% no response of the questions that were asked of him. There was an immediate decrease in level of no response as Training began, and his average decreased to 20%. During Intervention 1, Uno averaged 31.43% no response, and there was an increase in no responses as the phase began. There was an immediate large increase in no response as the study transitioned from Intervention 1 to Baseline 2. During Baseline 2, Uno averaged 29.17% no response. There was no change in level of no response between Baseline 2 and Intervention 2. However, Uno's average of no response decreased to 15%—his lowest average of no response during the study.

Mostly, Uno had a decreasing trend of No Response. In Baseline 1, Training, and Baseline 2, Uno had a decreasing trend. In Intervention 1, Uno had only a slightly decreasing trend. Intervention 2 resulted in an increasing trend because of the last data session, in which Uno had a larger percentage of no response compared to the levels of the rest of the phase. In each of the phases throughout the study, Uno had some level of variability in not responding to the questions asked him.

Dance Festival. Dance Festival began the study with an average of 50% no response during Baseline 1. She had an immediate decrease in no responses when Training began, and her average of no responses during Training decreased to 9.82%. There was another decrease in no responses when Intervention 1 began, though her average of no response increased to 28.93% during that phase. There was a slight decrease in no responses between Intervention 1 and Baseline 2. During Baseline 2, Dance Festival's average was 18.75% of no responses. When Intervention 2 began, Dance Festival had an increase of no responses. Her average of no responses for the phase was 37.14%.

In Baseline 1, Dance Festival had a decreasing trend of no responses. In both Training and Intervention 1, she had an increasing trend of no response. In Baseline 2, the trend was slightly increasing, and reversed to slightly decreasing in Intervention 2. Dance Festival had varying levels of variability of no response during the study. She began with a high level of variability in Baseline 1. In Training, she had a low level of variability, which increased to moderate during Intervention 1. In Baseline 2, Dance Festival had minimal levels of variability. She finished the study with moderate levels of variability in Intervention 2.

Summary of No Response Results. Out of the six students' results described above, overall, three students had a decreasing trend in no responses (Bubbles, Uno, and Dance Festival). One student had a level trend (Gomo), and two students had increasing trends (S323 and GN?). For four of the students—Bubbles, GN?, Uno, Dance Festival—each had a lower mean of no responses in Intervention 2 compared to Baseline 1. S323 and Gomo had slightly higher means of no response, though both had a decreasing trend of no response in the final intervention phase. For S323, the mean in Intervention 2 was slightly higher, but his Baseline 2 mean was significantly higher than any other phase. Two students, Bubbles, and Gomo had less

variability in the levels of no response in the final intervention phase. Gomo's variability

decreased throughout the study. Four students (Bubbles, GN?, Dance Festival, and Elephant) had

responses that were recorded as no responses because they did not initiate an answer within the

45 seconds of wait time; there were 12 total questions that these students answered after the wait

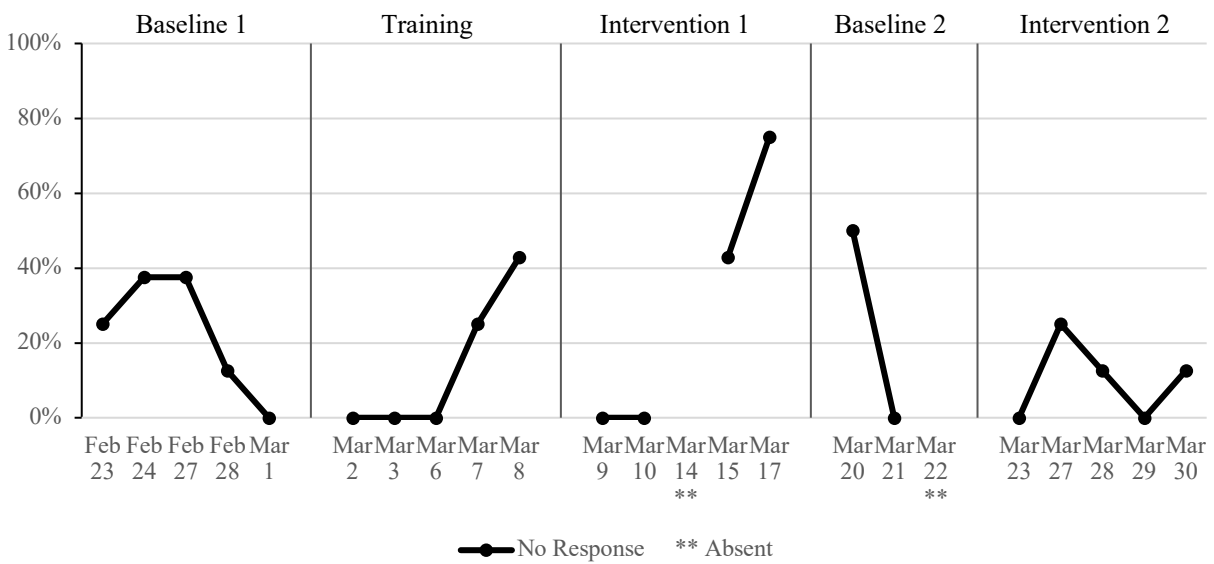time ended (Bubbles: 7, GN?: 2, Dance Festival: 2, Elephant: 1).

Figure 1

Bubbles – No Response Results

Figure 2

S323 – No Response Results
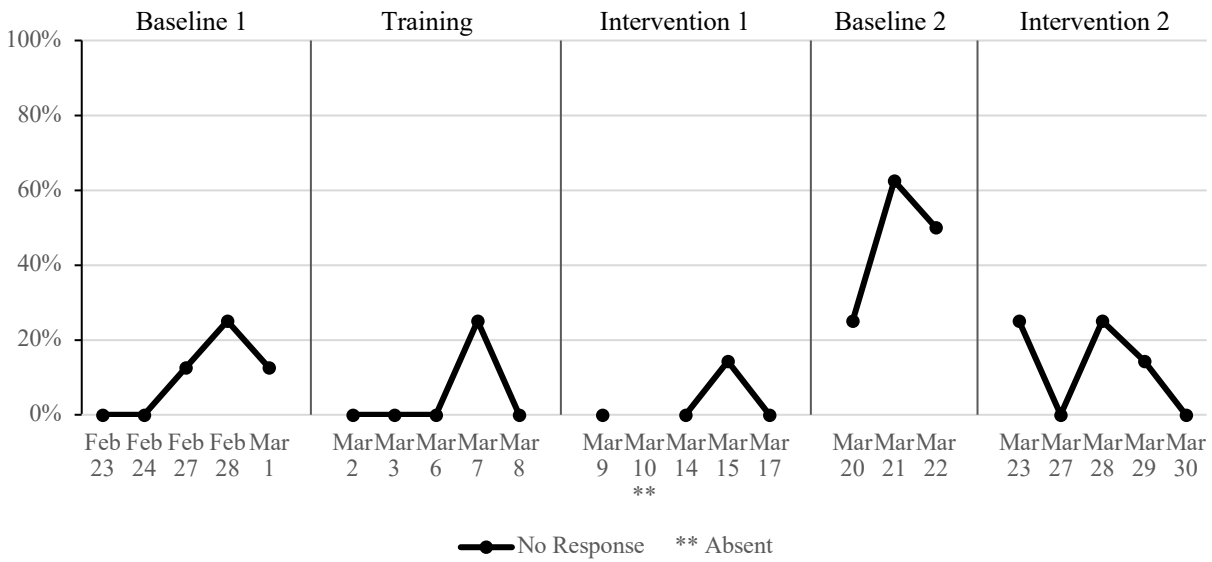
Figure 3

Gomo – No Response Results
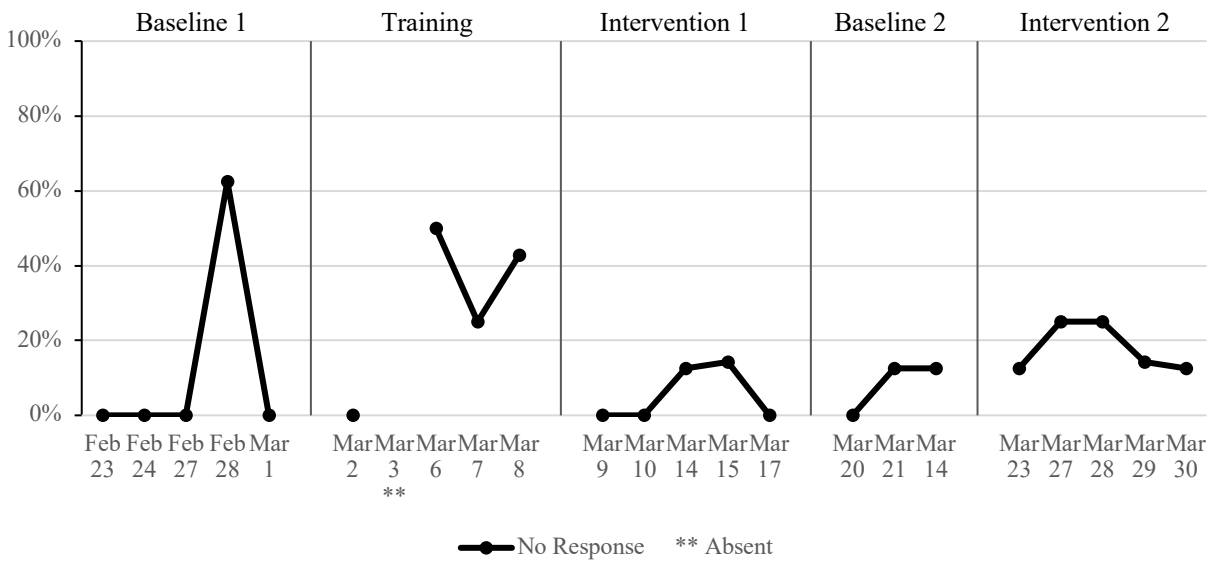
Figure 4

GN? – No Response Results
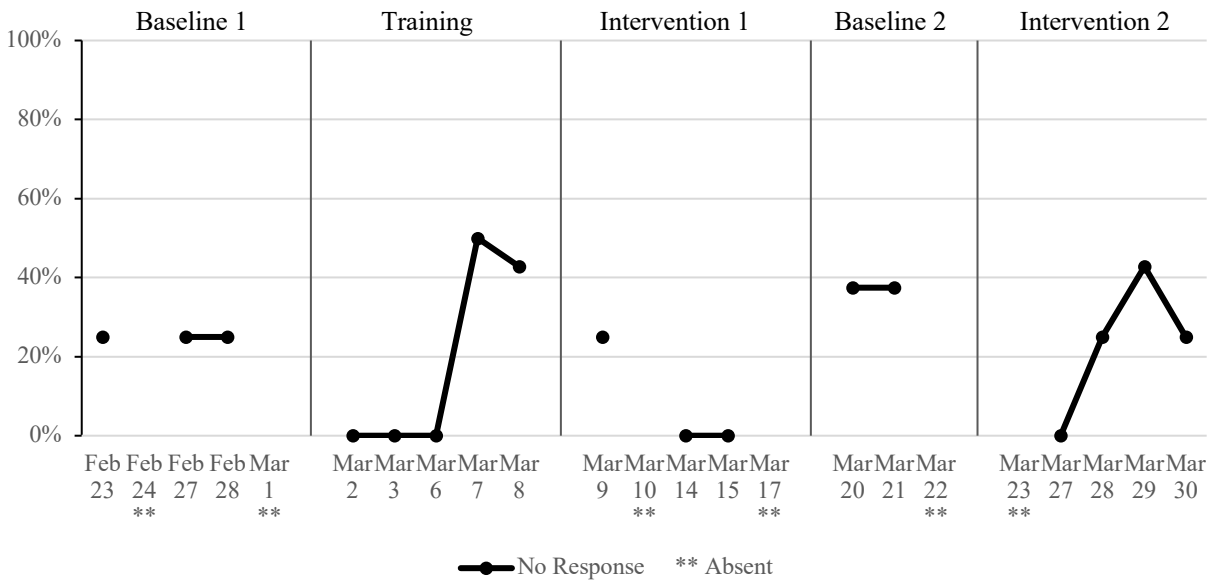
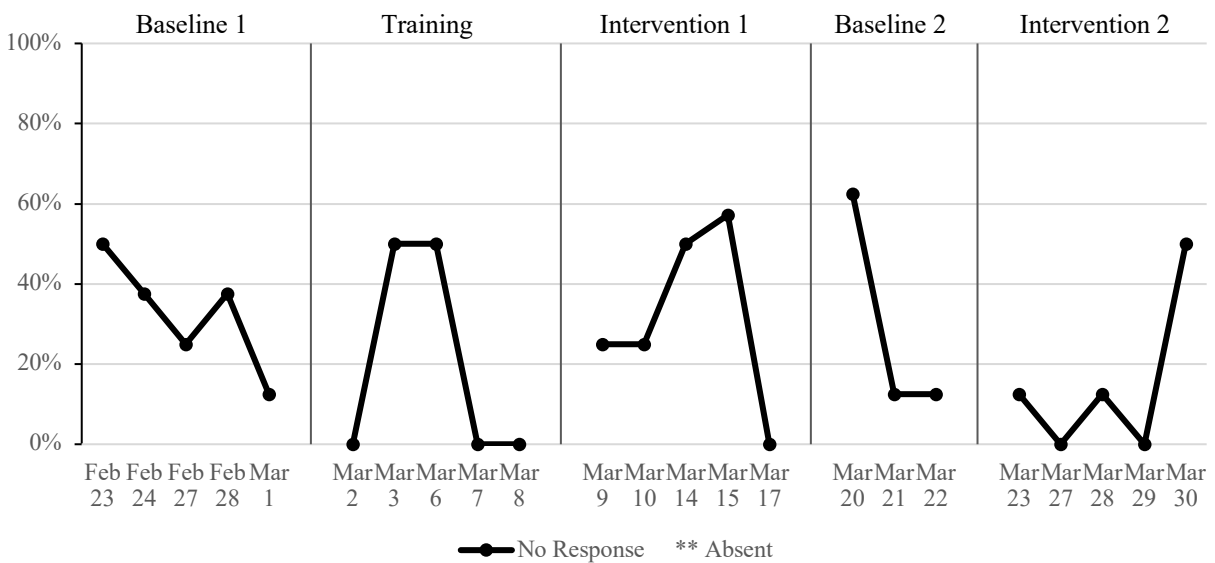

Figure 5

Uno – No Response Results

Figure 6

Dance Festival – No Response Results
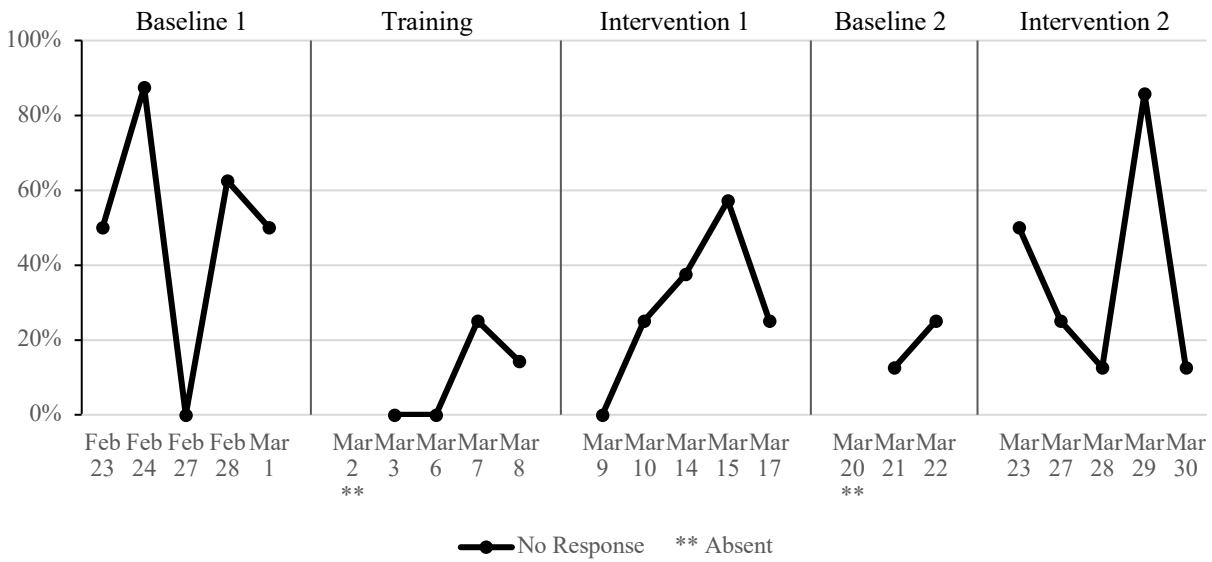

Figure 7

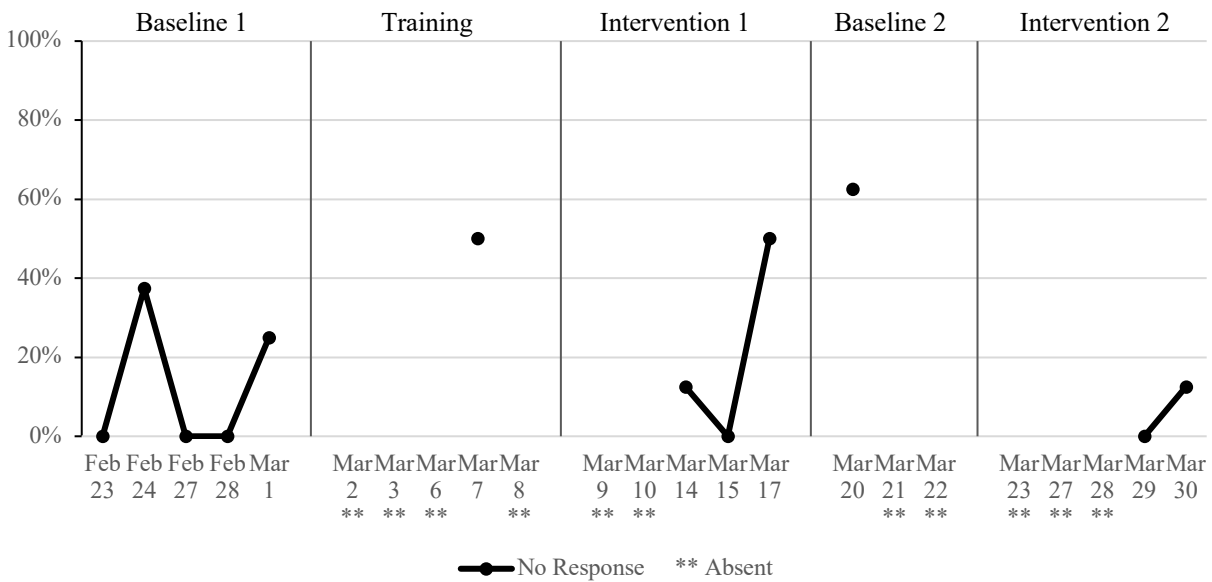*N – No Response Results*
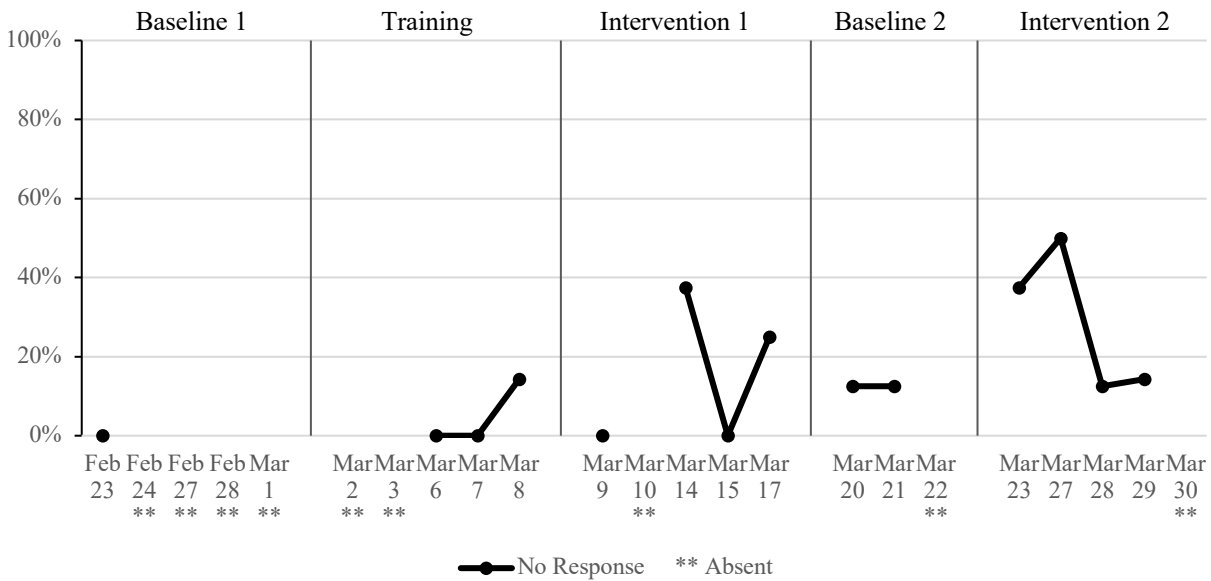
Figure 8

Elephant – No Response Results

Partial Response Results by Participant

       Bubbles. Bubbles began the study with an average of 25% of partial responses during

Baseline 1. There was an immediate increase in the number of partial responses as Training

began, and Bubbles averaged 37.86% partial responses during this phase. There was a slight

increase in partial responses as Intervention 1 began, but Bubbles' average of partial responses

went down to 6.25%. There was another slight increase in partial responses between Intervention

1 and Baseline 2, but Bubbles maintained her average of 6.25%. Intervention 2 began with

another slight increase in partial responses, and Bubbles average of partial responses during this

phase was 8.21%.

       The trend of partial responses slightly increased for Bubbles over the course of Baseline

1. Training, Intervention 1, and Baseline 2, each had a decreasing trend in the phase. There was a

very slight increasing trend of partial responses in Intervention 2. Bubbles had some variability

in the percentage of partial responses she had throughout the study, however overall, the

variability remained low and decreased throughout the study. Baseline 1 and Training had some variability, Intervention 1 and Intervention 2 had low variability, and Baseline 2 had minimal variability.

S323. In Baseline 1, S323 had an average of 12.5% partial responses; this phase is where S323 had his highest data point of partial responses. There was a decrease in partial responses as the study transitioned from Baseline 1 to Training. S323 averaged 5% partial responses during Training. There was no change in the level of partial responses between Training and Intervention 1. In Intervention 1, S323 averaged 6.25% partial responses. There was a slight increase in partial responses as Baseline 2 began, and S323 averaged 12.5% partial responses during Baseline 2. Intervention 2 began with no change in the level of partial responses from Baseline 2. S323's average did decrease to 10% partial responses during the final intervention phase, Intervention 2.

S323 had an increasing trend of partial responses during Baseline 1, and a slightly increasing trend in Training. The trend reversed as Intervention 1 began, and S323 had a slightly decreasing trend of partial responses in Intervention 1 and a decreasing trend in Baseline 2. There was a slightly increasing trend of partial responses in Intervention 2. S323 had the most variability in Baseline 1, and low levels of variability in the remaining phases.

Gomo. Gomo had very low levels of partial responses throughout the study. In Baseline 1, he had 0% partial responses, which did not change entering Training. He did average 9.82% partial responses during training, which decreased back to 0% in Intervention 1. There was no change in level between Intervention 1, Baseline 2, and Intervention 2. Gomo had an average of 4.17% partial responses in Baseline 2 and 0% partial responses in Intervention 2

Gomo had level trends of partial responses in every phase of the study except one. In Training, Gomo had a slightly increasing trend of partial responses. In the two phases that were not 0% throughout (Training and Baseline 2), Gomo had low levels of variability in his partial responses.

GN?. In Baseline 1, GN? had an average of 4.17% partial responses, which decreased to an average of 0% in Training. There was a slight immediate decrease in her partial responses as the training phase began. Transitioning to Intervention 1 resulted in an immediate increase in partial responses from GN?, and her average for Intervention 1 was 13.10%. Though there was no immediate change between Intervention 1 and Baseline 2, GN?'s average increased to 25% in Baseline 2. GN? finished the study with an immediate decrease in partial responses and an average of 12.5% partial responses in Intervention 2.

In Baseline 1, GN? had a slightly increasing trend of partial responses, which leveled out in Training. The trend began slightly decreasing in Intervention 1 and began increasing in Baseline 2. In Intervention 2, there was a slightly increasing trend of partial response. Throughout the study, GN? had minimal to low variability in her partial responses. In Training, there was no variability.

Uno. In Baseline 1, Uno averaged 30% partial responses, which was his highest average of partial responses during the study. There was a decrease in partial responses between Baseline 1 and Training. In training, Uno averaged 2.86% partial responses. As Intervention 1 began, there was a slight increase in partial responses. During Intervention 1, Uno averaged 5.36% partial responses. His average decreased slightly in Baseline 2, where he havered 4.17%. There was no immediate change in the level of his responses in which he gave a partial answer. Intervention 2 began with a decrease in partial responses, and for the phase Uno averaged 2.5%.

Uno began with a decreasing trend of partial responses during Baseline 1. In each of the remaining phases, Uno had a slightly increasing trend of partial responses. Similar to his trend patterns, Uno had the most variability in the level of partial responses during Baseline 1. In the remaining phases, there was minimal variability of partial responses.

Dance Festival. Dance Festival had low levels of partial responses throughout the research study. She began by averaging 5% partial responses during Baseline 1. As Training began, there was no immediate effect on her partial responses, though her average during this phase increased to12.50%—her highest percentage during the study. There was a slight increase of partial responses between Training and Intervention 1. Dance Festival's average decreased to 2.5% partial responses during Intervention 1. In both Baseline 2 and Intervention 2, Dance Festival had 0 partial responses resulting in no change between phases and an average of 0% for both phases.

In Baseline 1, Dance Festival had a decreasing trend of partial responses. The trend reversed to a slightly increasing trend in Training, and then reversed again to a slightly decreasing trend in Intervention 1. In Baseline 2 and Intervention 2, Dance Festival had a level trend of 0. Dance Festival had low levels of variability throughout the study. Training had the most variability. Baseline 1 and Intervention 1 had low and minimal levels of variability respectively, and Baseline 2 and Intervention 2 had no variability.

Summary of Partial Response Results. Five students overall had decreasing trends of partial responses throughout the study (Bubbles, S323, Gomo, Uno, and Dance Festival). These students also had less variability in the number of partial responses at the end of the study than they did in the beginning. Dance Festival and Gomo had no partial responses in Intervention 2. For two students (Bubbles and Uno), the mean of partial response was significantly lower in

Intervention 2 than it was in Baseline 1. It was lower for an additional two students (S323 and

Dance Festival), and equal (0%) for Gomo. GN? had opposite results of partial response

compared to the rest of the participants. She experienced an increasing trend of partial response,

had a higher mean of partial responses in Intervention 2 compared to Baseline 1, and had more

variability in her data.

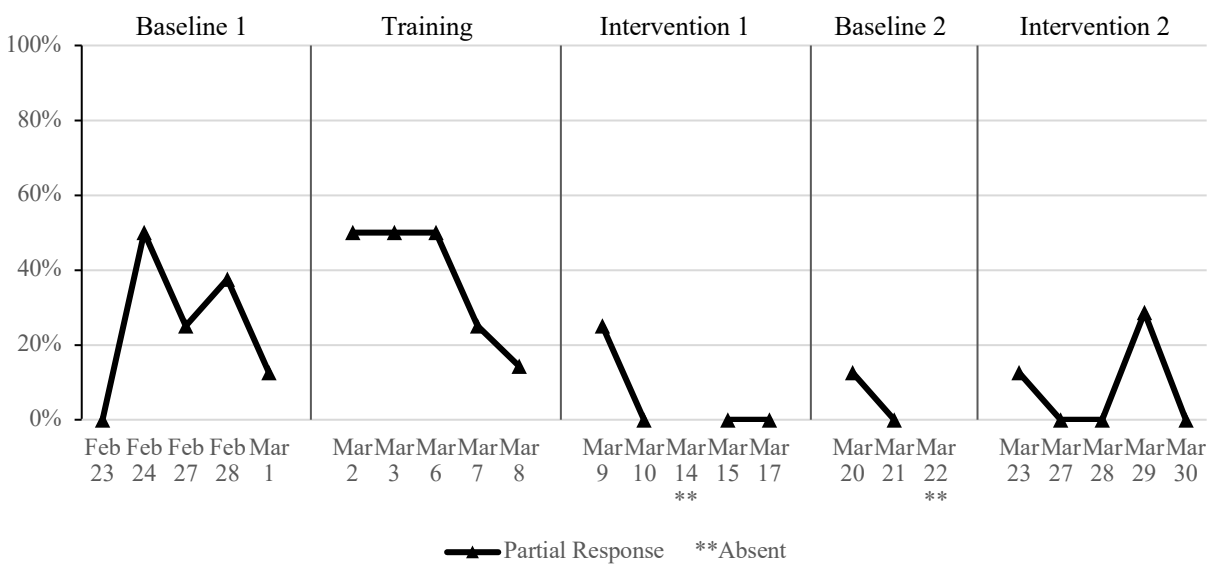**Figure 9**

Bubbles – Partial Response Results

| Baseline 1 | Training | Intervention 1 | Baseline 2 | Intervention 2 |

Partial Response   **Absent

Figure 10

S323 – Partial Response Results
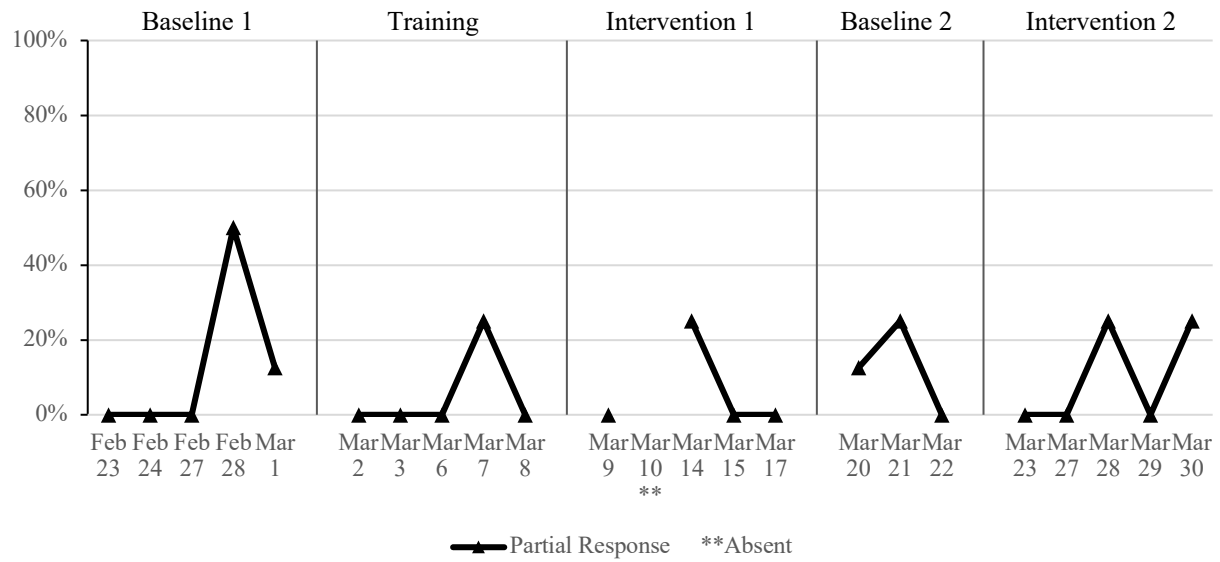

Figure 11

Gomo – Partial Response Results
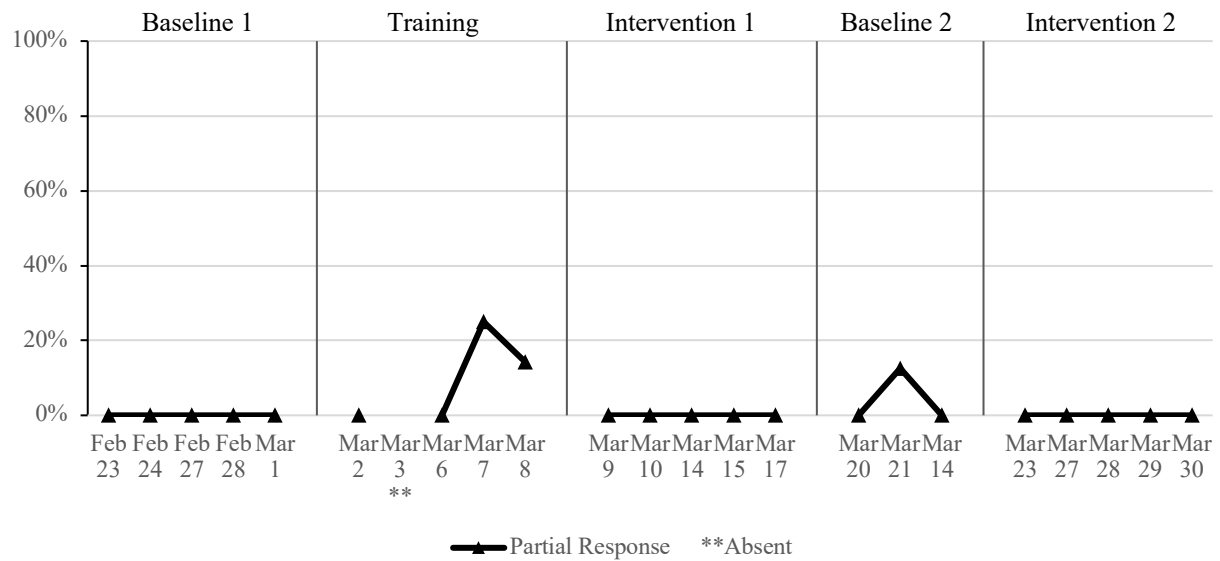
Figure 12

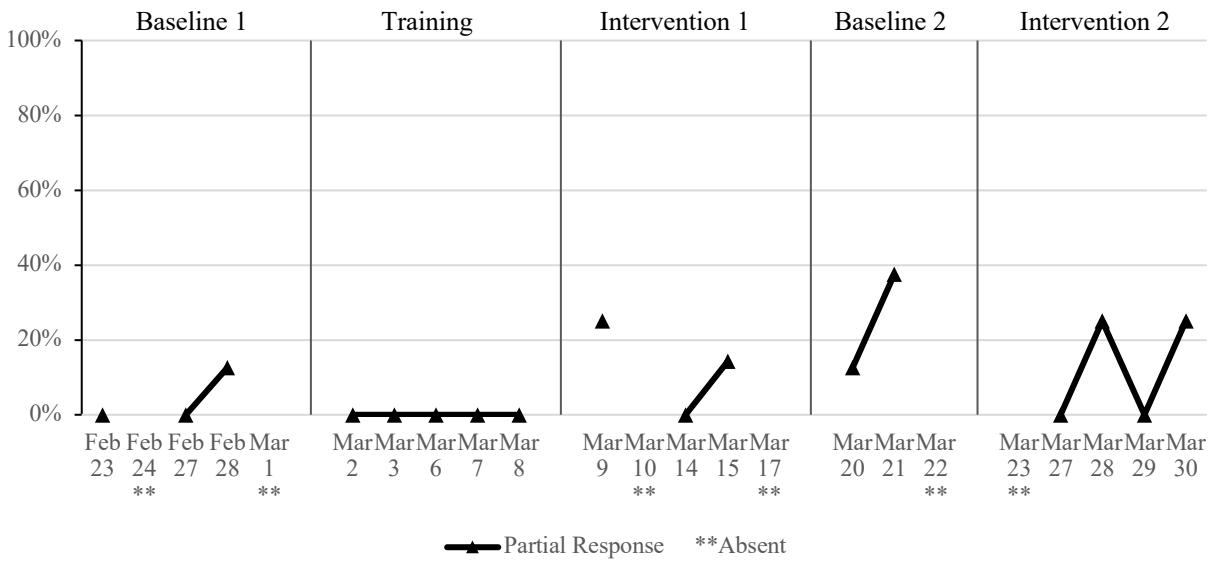*GN? – Partial Response Results*

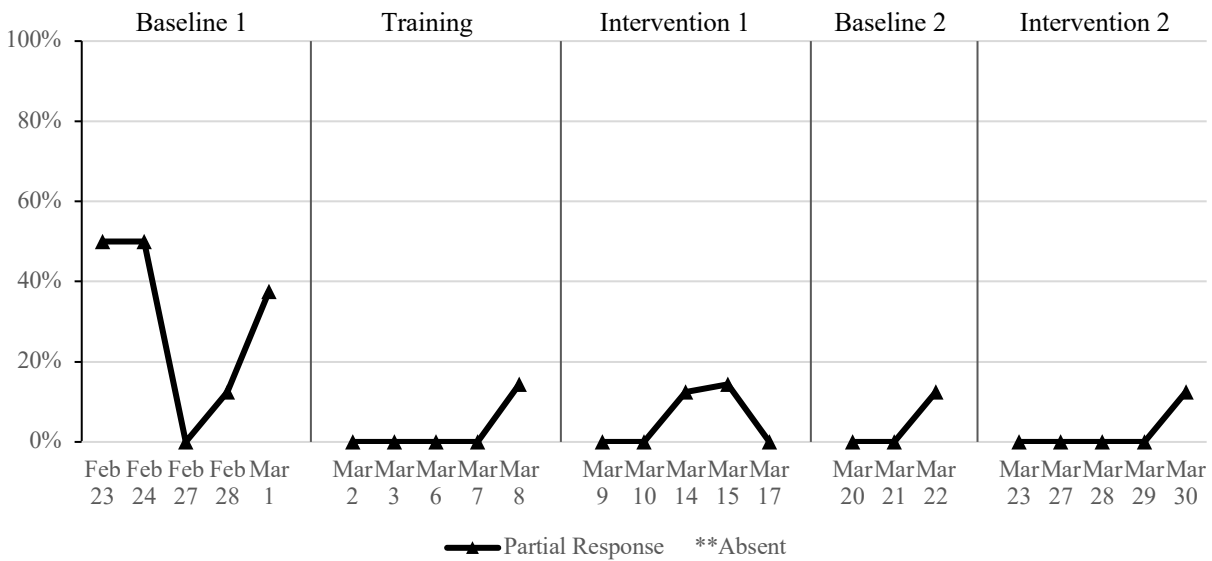**Figure 13**

Uno – Partial Response Results

Figure 14

Dance Festival – Partial Response Results
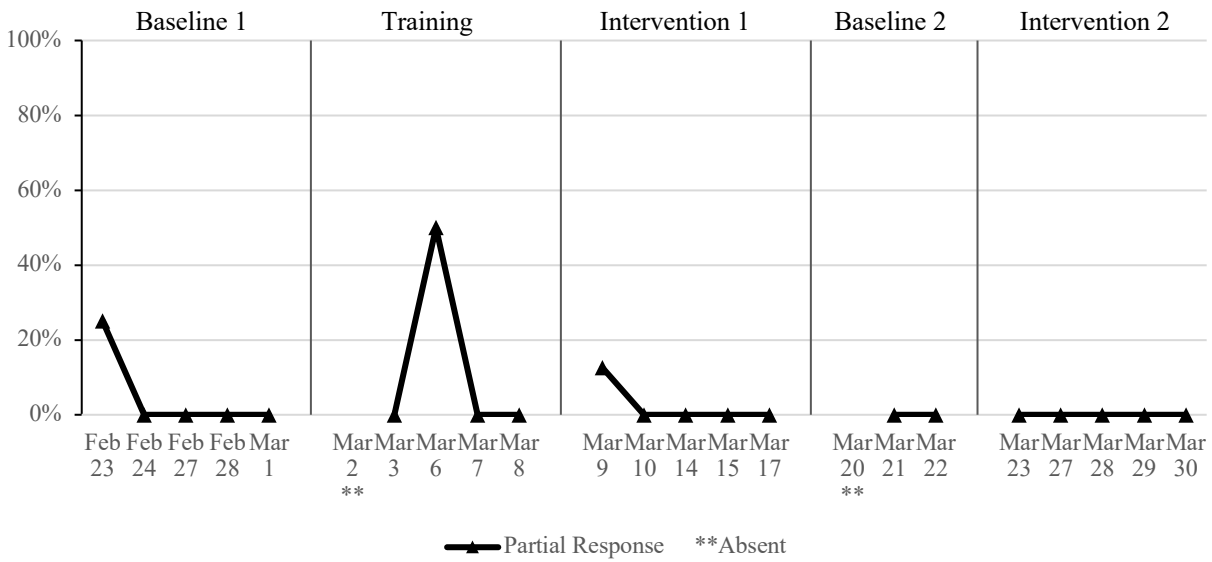

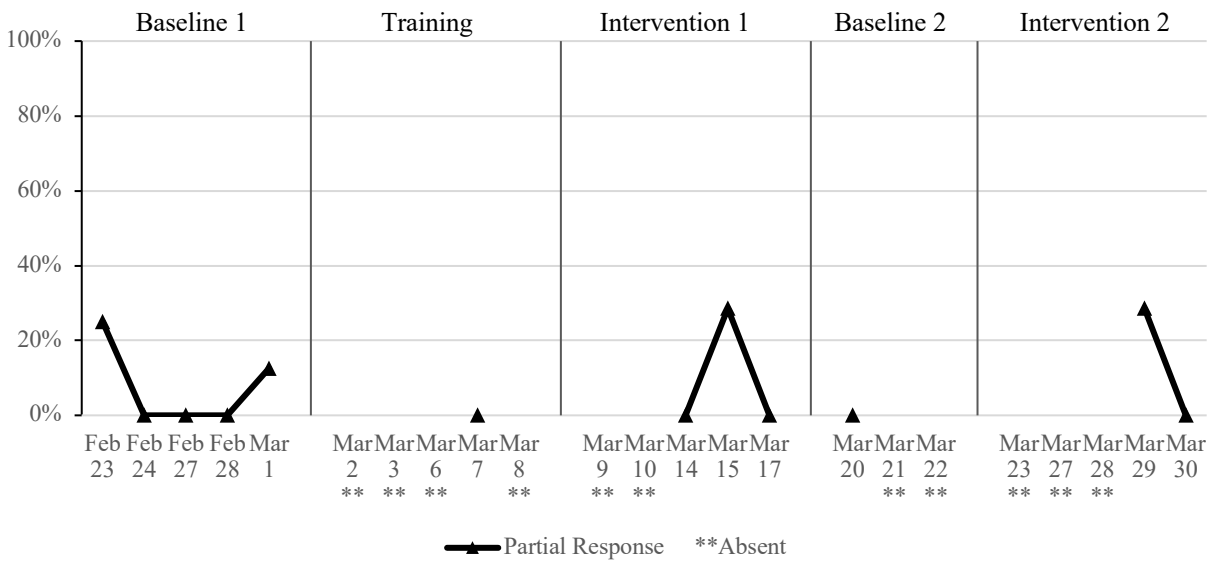**Figure 15**

N – Partial Response Results

Figure 16

Elephant – Partial Response Results
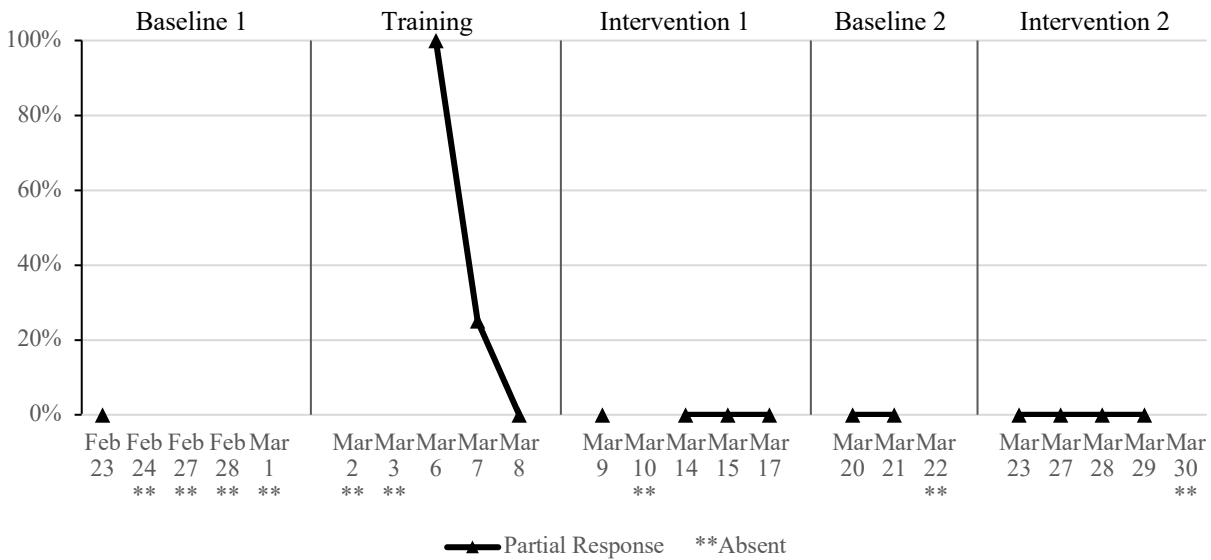
Complete Response Results by Participant

Bubbles. In Baseline 1, Bubbles answered an average of 52.5% of questions with a complete response; during this phase, she had her highest percentage of complete responses of 87.5%. Upon initiating the training, Bubbles had an immediate decrease in the number of complete responses she gave and averaged 43.57% of questions answered with a complete response. As the study progressed into Intervention 1, Bubbles answered questions with a complete response an average of 51.79% of the time and had an immediate increase in her complete responses from Training to Intervention 1. There was no change in the level of Bubbles responses from Intervention 1 to Baseline 2, however, she only answered an average of 18.75% of questions with a complete response during Baseline 2. In Intervention 2, Bubbles had an immediate increase in the number of complete responses given during the first session of Intervention 2. She also averaged 46.79% complete responses throughout this phase.

During Baseline 1, Bubbles had an increasing trend of complete responses. Throughout Training, Intervention 1, and Baseline 2, Bubbles rate of complete responses trended downward, reaching the low point of the trend at the end of Baseline 2. In Intervention 2, however, Bubbles percentage of complete responses increased throughout the phase, which resulted in an increasing trend of complete responses for the phase. Bubbles had various rates of variability throughout the study. The lowest rates of variability occurred in Training and Baseline 2, followed by some variability in Intervention 1. Baseline 1 and Intervention 2 had the highest rates of variability for Bubbles.

S323. Throughout the research, S323 had a high percentage of complete responses. In Baseline 1, S323 answered an average of 77.5% of the questions with a complete response. As training began, there was an immediate increasing effect on the number of complete responses he gave, moving to 100% complete responses in the first session of the training phase and averaging 87.14% complete responses in Training and 86.61% complete responses in Intervention 1. There was also an immediate decrease in complete responses when Baseline 2 began. S323 only answered with a complete response an average of 41.67% during this phase. However, his participation with a complete response immediately went up upon returning to the second intervention phase (Intervention 2); S323 averaged 72.14% complete responses in this final intervention phase.

In each phase, S323 started with a fairly high percentage of complete responses and had a decreasing trend of participation over the duration of the phase. There was some degree of variability in S323's complete responses. The highest rates of variability occurred in Baseline 1 for S323 and the lowest occurred in Intervention 1.

Gomo. Gomo began the study with an average of 87.5% of complete responses in Baseline 1. He maintained a high percentage of participation and complete responses throughout the study. In transitioning to the training phase, Gomo's number of complete responses saw no change, thought the mean of his complete responses decreased to 60.72%. Gomo had an immediate increase from Training to Intervention 1, moving from 42.86% to 100% complete responses. His average during Intervention 1 was 94.64% complete responses. The transition to Baseline 2 created an immediate and significant decrease in complete responses—Gomo had answered 100% of questions with a complete response at the end of Intervention 1 and only 12.5% of questions with a complete response in the first session of Baseline 2. Gomo averaged 58.33% complete responses in Baseline 2. In the final intervention phase, Intervention 2, Gomo had no change in the level of response between Baseline 2 and Intervention 2, however his average complete responses increased to 82.14% in Intervention 2.

Baseline 1 began with a decreasing trend of complete responses for Gomo. Training had a similar decreasing trend. Intervention 1 had a slightly decreasing trend, but as discussed previously, the percentage of complete responses was higher than the previous two phases. Both Baseline 2 and Intervention 2 had increasing trends of complete responses for Gomo. The amount of variability for Gomo throughout the study was typically moderate or lower. In Baseline 2, Gomo had the highest range of variability. There was moderate variability in Baseline 1 and Training, and minimal variability in Intervention 1 and Intervention 2.

GN?. GN? averaged 62.5% complete responses in the first baseline phase of the study. As Training began, there was an immediate increase of complete responses, and GN? averaged 61.43% complete responses during training. Although there was a slight decrease in complete responses as Intervention 1 began, GN?'s average of complete responses increased to 70.24%

during Intervention 1. This phase had her highest average of complete responses followed by

Intervention 2. As Baseline 2 began from Intervention 1, GN? had an immediate decrease in her

complete responses. She averaged 37.5% correct responses in Baseline 2. There was an

immediate increase in complete responses when Intervention 2 began, and GN? averaged

64.29% complete responses in Intervention 2.

During Baseline 1, GN? had an increasing trend of complete responses. During Training,

she experienced a slightly decreasing trend, but had an increasing trend of complete responses

during Intervention 1. GN?'s trend decreased through Baseline 2 and Intervention 2. GN? had a

ranging amount of variability in complete responses during the study. In Baseline 1, Intervention

1, and Baseline 2, she had only some variability. However, in Training, she had maximum

variability. In Intervention 2, she had moderate variability of complete responses.

Uno. In Baseline 1, Uno answered questions with a complete response an average of

32.5% of the time. There was an immediate increase in complete responses as Training began

and Uno had 100% complete responses in the first session of Training. Uno averaged 74.29%

complete responses in the training phase and 63.21% complete responses in Intervention 1.

There was a slight increase in the level of responses between these two phases. There was an

immediate and significant decrease in the percentage of responses for Uno as Baseline 2 began.

He averaged 62.50% complete responses in this phase. There was an increase in the percentage

of complete responses between Baseline 2 and Intervention 2. Uno finished Intervention 2 with

an average of 82.5% complete responses.

Uno had mostly increasing trends throughout the study. He started Baseline 1 with an

increase trend in the percentage of complete responses. Training and Intervention 1 had very

slightly increasing trends. Baseline 2 also had an increasing trend. Intervention 2 ended with a

low point of complete responses resulting in a decreasing trend in this phase for Uno. There was

a moderate to moderately high level of variability for Uno throughout each phase of the study.

Dance Festival. Dance Festival began the study with an average of 40% complete

responses during Baseline 1. She saw an immediate increase in complete responses as Training

began, moving from 50% complete responses in the last session of Baseline 1 to 100% complete

responses in Training. There was also an immediate increase of responses between Training and

Intervention 1. In Training, Dance Festival averaged 70.54% complete responses and 68.57%

complete responses in Intervention 1. There was also an increase of complete responses for

Dance Festival as the study transitioned from Intervention 1 to Baseline 2. In Baseline 2, she

averaged 81.25% complete responses. There was a decrease in complete responses between

Baseline 2 and Intervention 2, and Dance Festival averaged 62.86% complete responses in the

final intervention phase.

In Baseline 1, Dance Festival had an increasing trend of complete responses. Training

and Intervention 1 both had decreasing trends. Baseline 2 had a slightly decreasing trend, which

was followed by a slightly increasing trend in Intervention 2. Dance Festival had a wide range of

variability in the level of complete responses she gave throughout the study; some phases had

minimal variability, whereas others had maximum variability. Baseline 2 had the least amount of

variability, followed by Training, Intervention 1, and Intervention 2. Baseline 1 had the highest

level of variability.

Summary of Complete Response Results. Results of complete responses mostly

divided students into two groups. Bubbles, S323, and Gomo had lower means of complete

responses in Intervention 2 than in Baseline 1, while GN?, Uno, Dance Festival had higher

means of complete responses. Overall, Bubbles, S323, and Gomo had decreasing trends of

complete responses. GN? had a slightly decreasing trend. Uno and Dance Festival had an

increasing trend. While some students had a decreasing trend overall, Bubbles, Gomo, and

Dance Festival had an increasing trend of complete responses in Intervention 2. Four students—

Bubbles, S323, Gomo, and GN?—had their lowest means of complete responses during Baseline

2. Uno's lowest mean was Baseline 1 followed by Baseline 2. S323 and Gomo had less

variability in their complete responses at the end of the study compared to Baseline 1.

Figure 17

Bubbles – Complete Response Results
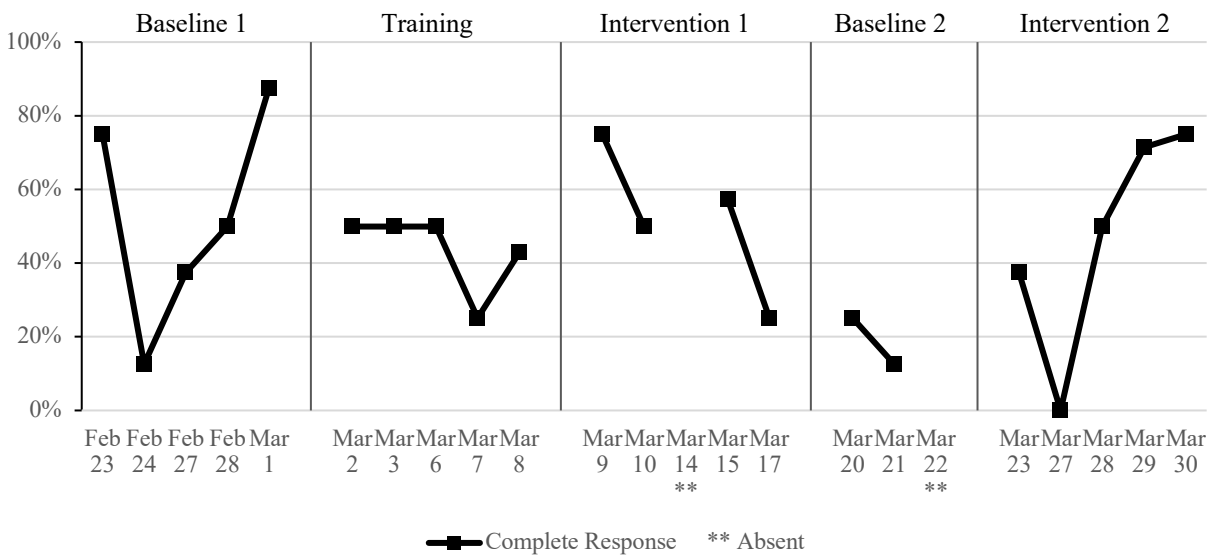
Figure 18

S323 – Complete Response Results

Baseline 1 Training Intervention 1 Baseline 2 Intervention 2

Feb 23 Feb 24 Feb 27 Feb 28 Mar 1 | Mar 2 Mar 3 Mar 6 Mar 7 Mar 8 | Mar 9 Mar 10 Mar 14 Mar 15 Mar 17 | Mar 20 Mar 21 Mar 22 | Mar 23 Mar 27 Mar 28 Mar 29 Mar 30

Complete Response ** Absent
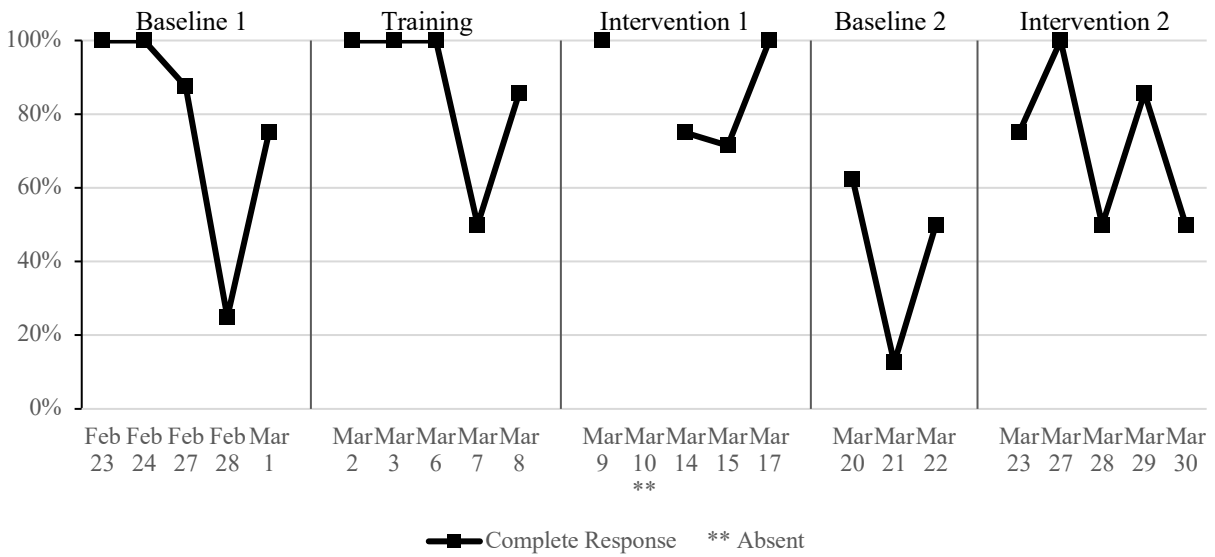
Figure 19

Gomo – Complete Response Results

Baseline 1 Training Intervention 1 Baseline 2 Intervention 2

Feb 23 Feb 24 Feb 27 Feb 28 Mar 1 | Mar 2 Mar 3 Mar 6 Mar 7 Mar 8 | Mar 9 Mar 10 Mar 14 Mar 15 Mar 17 | Mar 20 Mar 21 Mar 14 | Mar 23 Mar 27 Mar 28 Mar 29 Mar 30

Complete Response ** Absent

Figure 20

GN? – Complete Response Results

Figure 21

Uno – Complete Response Results
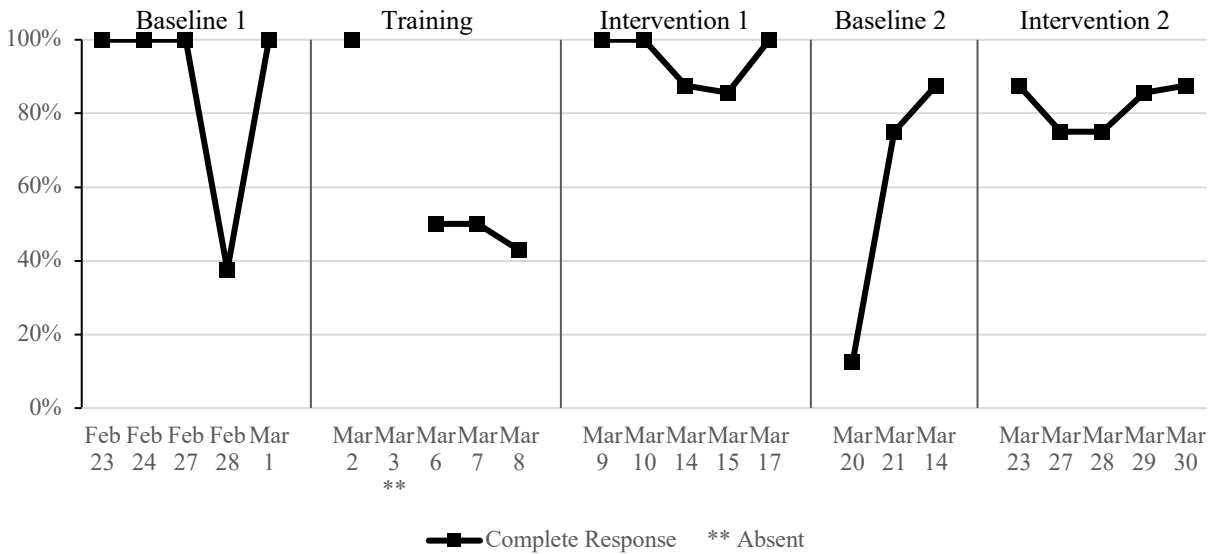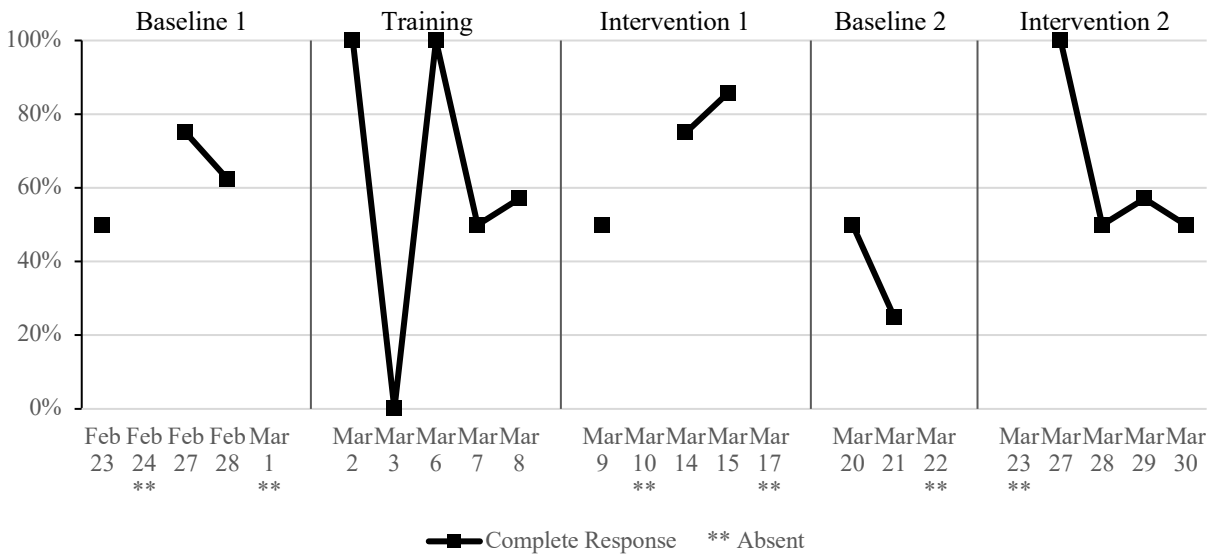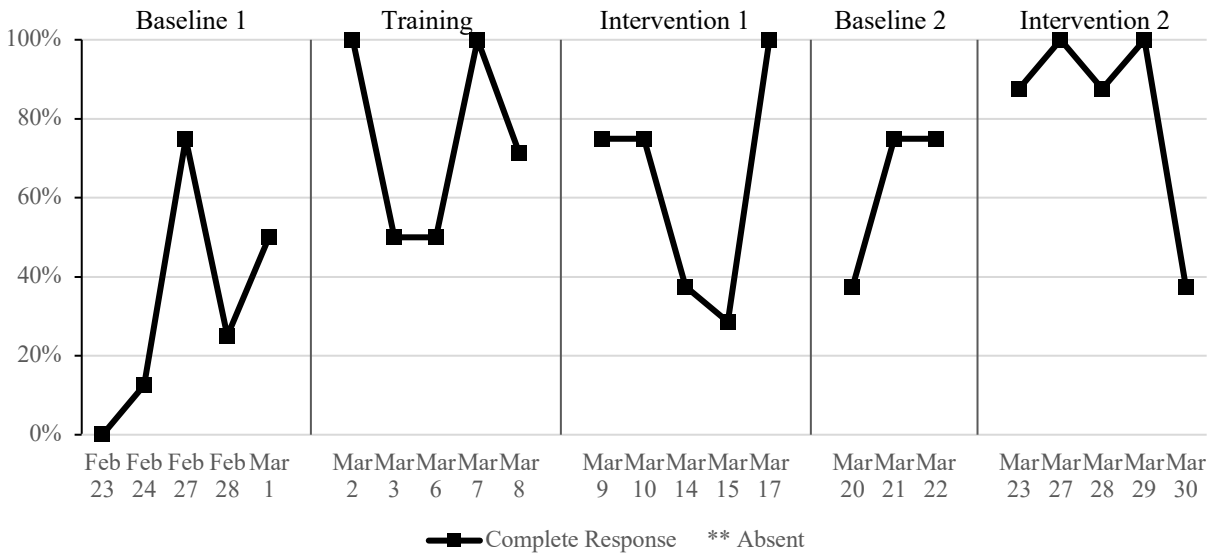
Figure 22

Dance Festival – Complete Response Results
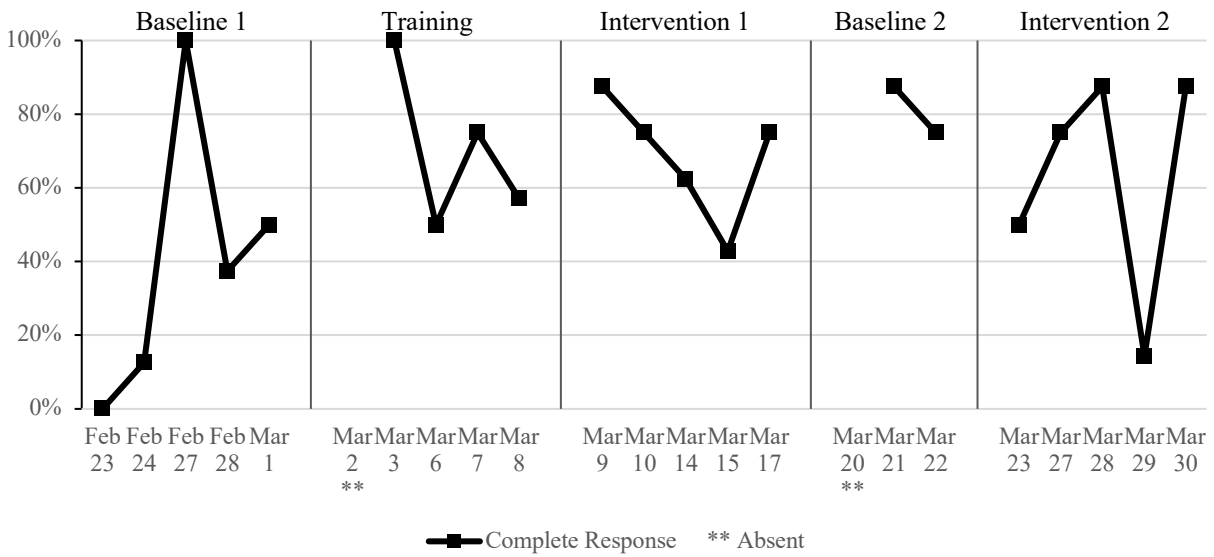
Figure 23

N – Complete Response Results
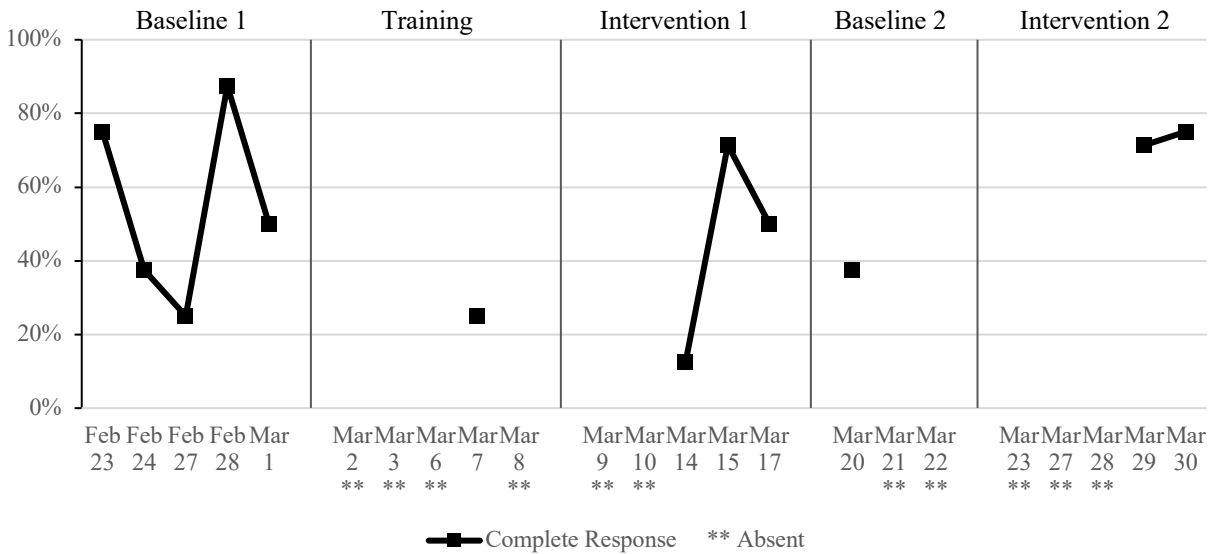
Figure 24

Elephant – Complete Response Results
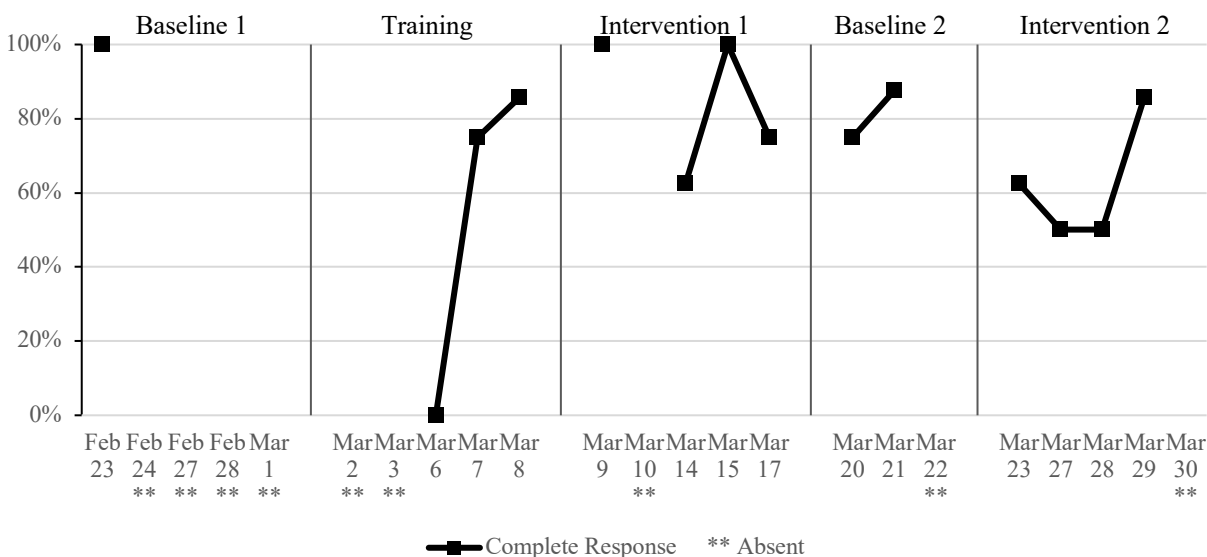
Results for Research Question 2

Research question 2 asked: To what extent are students that use AAC to communicate able to provide responses using a variety of different response methods (i.e., gestural, multiple choice, AAC device)? Tables are provided below for all participants. Data were analyzed for the same six participants described in the results section for question one (Bubbles, S323, Gomo, GN?, Uno, and Dance Festival). Results include the percentage that each student gave a complete, partial, or no response for each response method as well as the overall percentage of question types answered using the corresponding response method.

During the intervention, student participants were asked four types of questions and instructed to answer using a specific response method. These methods could be accessed via multiple access methods (i.e., direct selection, eye gaze, visual-auditory scanning, etc.). The four question types were dichotomous questions, multiple choice questions, close-ended questions, and open-ended questions. For dichotomous questions students used three gestural

movements/actions to indicate a response for Yes, No, and I Don't Know. To answer multiple choice questions, students indicated they were ready to answer the question by giving a "ready" signal, which sometimes overlapped with the gestural response method. Then students would select an answer using an individualized access method. For close-ended questions, an adult helped navigate a student to a specific page on their AAC device that included at least one correct answer. Students then selected their answer from that page or navigated to another page to select an answer. In open-ended questions, students were not given navigational assistance. Students accessed their AAC device using their individualized access method for close-ended and open-ended questions.

Results for this research question were taken from the ten data sessions in Intervention 1 and Intervention 2. During these two interventions, 17 dichotomous and multiple-choice questions were asked. There were 16 close-ended and open-ended questions asked. All six students answered at least 25% of the questions using each response method, and most answered over 50% of the questions for at least three of the four question types. Individual student tables (Tables 3–10) are included at the end of this section.

Overall, there were 376 question opportunities for the six students to answer [(17 dichotomous questions + 17 multiple choice questions + 16 close-ended questions + 16 open ended questions) * 6 students]. Of the 376 possible opportunities to respond, the participants answered 257 of the opportunities; this was 68.35% of questions. Overall, the question type students answered the most was dichotomous questions (84.54). Students answered 68.04% of the multiple-choice questions, 61.54% of the close-ended questions, and 58.24% of the open-ended questions. A table of the complete responses, partial responses, no responses, and absences is included in Table 2 below.

Table 2

Overall Student Responses to the Four Question Types

	Dichotomous Questions	Multiple-Choice Questions	Close-Ended Questions	Open-Ended Questions
Complete Response	84.54%	68.04%	61.54%	58.24%
Partial Response	0.00%	2.06%	10.99%	6.59%
No Response	11.34%	25.77%	20.88%	27.47%

Table 3

Bubbles' Response Rates

	Dichotomous Questions	Multiple-Choice Questions	Close-Ended Questions	Open-Ended Questions
Complete Response	64.71%	58.82%	37.50%	25.00%
Partial Response	0.00%	5.88%	12.50%	0.00%
No Response	17.65%	17.65%	25.00%	56.25%
% of Absences	11.76%	11.76%	12.50%	12.50%

Table 4

S323's Response Rates

	Dichotomous Questions	Multiple-Choice Questions	Close-Ended Questions	Open-Ended Questions
Complete Response	88.24%	82.35%	50.00%	62.50%
Partial Response	0.00%	0.00%	25.00%	12.50%
No Response	5.88%	5.88%	18.75%	12.50%
% of Absences	0.00%	0.00%	0.00%	0.00%

Table 5

Gomo's Response Rates

	Dichotomous Questions	Multiple-Choice Questions	Close-Ended Questions	Open-Ended Questions
Complete Response	94.12%	58.82%	100.00%	100.00%
Partial Response	0.00%	0.00%	0.00%	0.00%
No Response	5.88%	41.18%	0.00%	0.00%
% of Absences	0.00%	0.00%	0.00%	0.00%

Table 6

GN?'s Response Rates

	Dichotomous Questions	Multiple-Choice Questions	Close-Ended Questions	Open-Ended Questions
Complete Response	58.82%	58.82%	50.00%	25.00%
Partial Response	0.00%	0.00%	18.75%	18.75%
No Response	11.76%	17.65%	6.25%	18.75%
% of Absences	17.65%	17.65%	18.75%	18.75%

Table 7

Uno's Response Rates

	Dichotomous Questions	Multiple-Choice Questions	Close-Ended Questions	Open-Ended Questions
Complete Response	100.00%	70.59%	62.50%	43.75%
Partial Response	0.00%	5.88%	6.25%	6.25%
No Response	0.00%	23.53%	25.00%	43.75%
% of Absences	0.00%	0.00%	0.00%	0.00%

Table 8

Dance Festival's Response Rates

	Dichotomous Questions	Multiple-Choice Questions	Close-Ended Questions	Open-Ended Questions
Complete Response	76.47%	58.82%	50.00%	75.00%
Partial Response	0.00%	0.00%	0.00%	0.00%
No Response	23.53%	41.18%	43.75%	25.00%
% of Absences	0.00%	0.00%	0.00%	0.00%

Table 9

N's Response Rates

	Dichotomous Questions	Multiple-Choice Questions	Close-Ended Questions	Open-Ended Questions
Complete Response	35.29%	17.65%	37.50%	25.00%
Partial Response	0.00%	11.76%	0.00%	12.50%
No Response	11.76%	11.76%	6.25%	6.25%
% of Absences	29.41%	29.41%	31.25%	31.25%

Table 10

Elephant's Response Rates

	Dichotomous Questions	Multiple-Choice Questions	Close-Ended Questions	Open-Ended Questions
Complete Response	58.82%	58.82%	62.50%	68.75%
Partial Response	0.00%	0.00%	0.00%	0.00%
No Response	17.65%	17.65%	12.50%	12.50%
% of Absences	11.76%	11.76%	12.50%	12.50%

Discussion

Key Findings for Research Question 1

To effectively determine the effects the intervention had on students' active participation during literacy instruction it is helpful to discuss the results using the same categories as they are separated into in the results section. The order from the results section will also be used.

No Responses

While evidence of a functional relation was not present in the data, there was evidence of some isolated effects that the intervention had on the number of no responses given by some participants. Four students ended the study with a lower mean of no response than they began, and half of the students had a decreasing trend of no response throughout the study. The intervention provided clarity in how to answer a question, and this clarity could have helped students know what to do to engage and participate in class.

It is also noteworthy that four students answered a question a total of 12 times after the wait time ended. This suggests that some students need a longer amount of wait time when being

presented with a question. Bubbles had the majority of these instances—having seven questions that she answered after the wait time was completed. The procedures guided to mark these instances as no responses, but an increased wait time could have decreased Bubbles no responses further. It is important to find an individualized wait time when working with students who have significant disability and who use AAC (Mathis et al., 2011).

Partial Responses

The results from partial responses also indicate that while there was not evidence of a functional relation, the intervention may have resulted in isolated effects across two phases for some students on partial responses. Throughout the study, the majority of students (5 of 6) had both a decreasing trend of partial responses and a decreased average of partial responses in Intervention 2 compared to Baseline 1. These students also had less variability in the number of partial responses they gave. Like in the effects on no responses, the intervention may have given clarity to students on how to engage and participate in class, resulting in less partial responses. Some response methods in intervention also could not result in a partial response (e.g., gestural responses were either completed or not. There was not a partial gesture response). This is discussed further below in the discussion for question two. The specified ways of responding in intervention provided students a tool to use to engage with instruction as opposed to having no guidance for response in baseline.

Complete Responses

The effects of complete responses on student engagement and participation are less clear than the effects of no response and partial response. Participants have been in the researcher's classroom for 3–4 years, and over that time, the researcher has continued developing his students' ability to actively participate in class. This work could have yielded the high rates of

participation from several students in baseline and affected the intervention results. For three

students, there did seem to be an effect from the intervention across two phases; a lack of

evidence of effects across at least three points in time indicates there was not a functional

relation. However, these students had an increased average rate of complete responses at the end

of the study than in Baseline 1. Two of the students also had an overall increasing trend of

participation.

For the other three participants, they had a slightly decreased average rate of participation

in Intervention 2 compared to Baseline 1. However, for 5 students—after the intervention

began—their lowest rate of participation throughout the study was in the return to baseline

(Baseline 2). This could indicate that the students had high rates of participation before

intervention, learned to use specific tools to answer differing question types during intervention,

and then preferred participating in class using the methods from the intervention as opposed to

the methods they had used in class prior to the study. It could also indicate that because the

students already had high rates of participation in class, there was not an effect that

implementing specific response methods had on the number of complete responses students

gave. These results open several doors for future research, which will be discussed later.

Key Findings for Research Question 2

Student participants were able to use multiple response methods to answer four question

types for 68.35% of opportunities to respond. All students answered at least 25% of each

question type using the corresponding response method, and most answered over 50% of each

question type. It was anticipated that students would answer less dichotomous questions because

the response method assigned to that question type was the least similar to any response tool

students had used previously in class. Collectively, students answered 84.54% of dichotomous

questions—the most of any question type. Participants were able to learn and effectively

implement a new response tool to answer a specific question type. It was also surprising to note

that students answered the fewest open-ended questions. Students only answered 58.24% of

open-ended questions. This was the lowest percentage of questions answered. This question type

is likely to be the most complex linguistically, which could have impacted the results. It does

however align with previous research conducted by Mathis, Sutherland, & McAuliffe (2011).

Question types and response methods with fewer choices had higher levels of response than did

the question types with many response options.

Implications of the Study

Active student participation can be impacted as teachers provide their students with

multiple opportunities to respond and provide tools for students to respond to multiple types of

response opportunities. The results from this study suggest that students with significant

disabilities and who use AAC to communicate can use different response methods to participate

in classroom instruction. Previous research indicated that having multiple response opportunities

in multiple formats increases student outcomes (Archer & Hughes. 2011; MacSuga-Gage &

Simonson, 2015). This study lays groundwork in research for students who use AAC that aligns

with the results of previous research. By creating and using a variety of response tools within

their classrooms, teachers can directly impact the frequency with which their students respond

during lessons. Teacher behavior directly influences their students, and as teachers design more

inclusive classrooms by creating multiple tools for diverse students to participate in the

classroom, more students will have opportunities to participate more frequently and in more

ways within the classroom. While this study does not provide a specific script or protocol for

using these tools in instruction, it does provide examples of response tools educators can use to

help them facilitate more frequent participation from their students who use AAC to communicate. Teachers can select and implement these response tools and access methods strategically in their lessons in ways that align with other evidence-based practices like those referenced in the introduction by Archer and Hughes (2011).

Second, the results from this study suggest that AAC users can use multiple tools to interact in the classroom. Their interaction does not need to come from just one source. As AAC users expand the number of ways they can communicate with others, they can use these tools to communicate for a variety of reasons in multiple settings. Participants from this study demonstrated their use of four different methods of communication within literacy instruction. These response methods could also be used in other school, home, and social settings. As AAC users expand the number of communication tools they can use with communication partners, they gain more autonomy in their communication and have greater flexibility to communicate in different settings. Having a variety of tools could impact both the school and home lives of students who are AAC users.

Limitations

There are multiple limitations in this study. Because of time constraints in both the IRB approval process and the timeline for completion of the study, data for fidelity of implementation, inter-observer agreement, and social validity were not included. Videos were collected as part of the procedures, but they have not been reviewed for fidelity at this time. It is also important to note that the results of this study are not generalizable to the larger population of students who are AAC users.

Another limitation of the study was balancing the procedures of the study with the individual needs of students. Because research follows specific protocols, individual

accommodations could not be made in every case. This was most apparent in the procedures

regarding wait time. Some of the participants in the study may have needed more wait time than

was specified in the study procedures. For example, Bubbles initiated answering multiple

questions after the wait time had ended; these responses were recorded as no response even

though she did initiate an answer to a question and participated in class. Another example was

not being able to restate or rephrase a question based on student needs. There is the possibility

that 45 seconds of wait time without repeating the question before answering could be too long

to remember for some students. Individual accommodations should be made within classrooms

to best support students' needs and promote engagement and participation. Additionally, further

research should be conducted to determine appropriate wait-time ranges that consider students'

individual access needs and disabilities.

Finally, the number of response tools and the individualization of these tools for each

student could have impacted the results of the study. Most students were able to use the response

tools provided, but more work and research could be done to better facilitate student

participation in class. For example, it was noted that Dance Festival chose "I Don't Know"

frequently in response to dichotomous questions. She used an iPad to select the responses to the

questions, and "I Don't Know" was added to her communication app as part of the study. The

picture symbol used was of a person shrugging whereas the symbols for "Yes" and "No" were a

checkmark and a not symbol respectively. The newness of the symbol and/or that the symbol

was a person could have impacted how Dance Festival answered dichotomous questions.

Individualized response tools should be created, evaluated, and refined for students within the

classroom to best encourage and support their participation.

Directions for Future Research

This study can provide a basis for the potential of many future studies and directions of future research. First, it would be relevant to replicate this study with students who are not already actively participating in the classroom. This could better demonstrate how multiple response tools and multiple question types provide ways for students to actively engage in the classroom.

Additionally, optimal rates of opportunities to respond, the speed in which students respond, and the accuracy of student responses was not researched in this study. Conducting further research on optimal rates of the opportunities to respond as well as how response tools and access methods might influence the speed at which students respond could impact the number of opportunities students have to engage and participate in the classroom. This information could help guide teachers as they create lesson plans and strive to increase student outcomes. Analyzing student accuracy using varying response methods could help evaluate the effectiveness of differing response tools and create recommendations for effective response methods to be used within the classroom. It is also important to understand how individual student wait and processing times impact how they participate in class during instruction.

Finally, this study only researched whether incorporating a variety of opportunities to respond had an impact on AAC user's engagement and active participation during literacy instruction for individual students. It did not research how to implement choral or group responses when trying to increase participation of AAC users. Previous research included in MacSuga-Gage & Simonsen's (2015) systematic review of literature has shown that a combination of individual and choral responses was more effective than individual responses alone. Some of the response methods used in this study could have potential to be developed into

choral response methods. Future research is needed on how to enable AAC users to participate in

choral response opportunities that are adapted to suit their physical and vocal needs.

Appendix A

Sample Data Collection Sheet

	Question #	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8
All students	Question Type								
	Response Method								
	45 Seconds of Pause Time Given	☐	☐	☐	☐	☐	☐	☐	☐
Student 1	Access Method Used								
	Level of Completion								
	Student Response								
	NOTES								

Sample Data Collection Sheet with Drop Downs Displayed

	Question #	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	
All students	Question Type									
	Response Method	Dichotomous Question								
	45 Seconds of Pause Time Given	Multiple-Choice Question				☐	☐	☐	☐	
		Close-Ended Question		Gesture						
Student 1	Access Method Used	Open-Ended Question		Multiple Choice						
	Level of Completion		Direct Selection	AAC Device (with Navigation Assistance)						
	Student Response		Eye Gaze	AAC Device (No Navigation Assistance)	Complete Response					
			Visual/Auditory Scanning		Partial Response (Student Initiated. Did Not Finish)				Correct	
					No Response				Correct on 2nd Attempt	
					Participation with Prompting or Assistance				Correct w/Assistance	
	NOTES								Adult Modeled Correct Response	
Student 1	Access Method Used								I Don't Know	
	Level of								No Response	
									Open-Ended Response Provided	

Appendix B

Question Types and Response Methods

Question Type	Response Method	Example Question
Dichotomous Questions	Gestural response (or other individualized way to indicate between two choices)	Do the words hat and cat rhyme? *Yes/No*
Multiple-Choice Questions	Multiple options presented in an accessible way	Give me another word that rhymes with the word cat. *Toy, Girl, Bat, I Don't Know*
Close-Ended Questions	Participant AAC device (participant can receive assistance to navigate to a specific area of the device)	Tell me another letter that we could put in front of -at to make a word that rhymes with cat. *(Student given help navigating to keyboard on AAC Device)*
Open-Ended Questions	Participant AAC device (No navigational assistance will be given as this question type does not require a specific correct answer.)	What do you think of cats? *(Student not given any navigational assistance. There is no specific correct response.)*

Coded Question Types

- Dichotomous Question – A

- Multiple Choice Question – B

- Close-Ended Question – C

- Open-Ended Question – D

Sample Lesson Plan

Rhyming

Question Order: D, A, C, B

[Below you will ask four questions about rhyming and assist as needed for each student to answer each question. Give each student at least 45 seconds of wait time to initiate an answer to the questions. Use the response method listed in the table above for each question type. Students may access the response method through their usual access method (eye gaze, direct selection, and/or visual/auditory scanning).]

"We are going to do an activity with rhyming words. Rhyming words are words that sound the same at the end. First, I am going to say some rhyming words, and then I want you to repeat them. You can say the words out loud or in your head."

- *Old, Cold*

- *Went, Sent*

- *Lick, Pick*

- *Duck, Luck*

- *Bare, There*

"I'm going to ask two questions about the word cold."

1. D) *"Tell me about a time you were cold."*

2. A) *"Old and Cold rhyme. Do cold and hat rhyme too?"* Gestural Response for Yes, No, or I Don't Know

"Now, let's read a book about rhyming words. After we read the book, I will ask two more questions about rhyming words. ."

[Book to read: "Dan's Plan" from Bob Books: Rhyming Words Book Set Lynn Kertell.]

3. C) *"Tell me another letter we could put in front of -an to make another real rhyming word that rhymes with plan."*

4. B) *"Which word in this set of words does not rhyme? Ran, Can, Dip, Fan, or I Don't Know"*

Alliteration

"Today's letter of the day was the letter Aa. We are going to read a book that has words that start with the letter Aa. As we read listen for the /a/ sound. After we read the book, I will ask some questions about the letter Aa and the sound it represents."

[Book to read: "I Know the Letter Aa" from The Reading House Letter Recognition A–L Book Set by Marla Conn, MS. Ed.]

Question Order: B, A, C, D

[Read the following questions and assist as needed for each student to answer each question.
Give each student at least 45 seconds of wait time to initiate an answer to the questions. Use the
response method listed in the table above for each question type. Students may access the
response method through their usual access method (eye gaze, direct selection, and/or
visual/auditory scanning).]

1. B) *"Apple starts with the /a/ sound. Which word in this group also starts with the /a/ sound? Mop,
   Duck, Add, Like, or I Don't Know"*

2. A) *"Is /a/ the first sound you hear in the word app?"* Gestural Response for Yes, No, or I Don't
   Know

3. C) *"Find another word that starts with the sound /a/."*

4. D) *"Ask is another word that starts with /a/. We often ask questions. Tell me something you could ask
   a question about."*

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