7-5-2019

Investigating the use of technology in communication exchanges and visual support for students with autism

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INVESTIGATING THE USE OF TECHNOLOGY IN COMMUNICATION EXCHANGES AND VISUAL SUPPORT FOR STUDENTS WITH AUTISM

by

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A Thesis

Submitted to the
Department of Interdisciplinary and Inclusive Education
College of Education
In partial fulfillment of the requirement
For the degree of
Master of Arts in Special Education
at
Rowan University
May 15, 2019

Thesis Chair: Amy Accardo, Ed.D.

Dedication

I would like to dedicate this manuscript to my family who supported me throughout my years of education.

Acknowledgment

I would like to express my gratitude to my professor, Dr. Amy Accardo for all of her support throughout this entire process. Without her Saturday phone calls, meetings, and check-ins, this project would not be successful.

Abstract

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2018-2019
Amy Accardo, Ed.D.
Master of Arts in Special Education

The purpose of this study is to examine the effects of technology in a first-grade resource classroom. The participants used in this study were first grade nonverbal students diagnosed with Autism Spectrum Disorder. The data collected during this study reflected if Apple iPads™ increased the number of communication exchanges between teachers and students in a classroom using a Picture Exchange System on each screen. The study also examined the increase in independent task completion using the iPad™ in a first grade classroom. The students used a checklist of six items to complete, and had to complete this checklist independently using the checklist shown on each iPad™.

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Chapter 1

Introduction

Autism spectrum disorder (ASD) is a developmental disability defined by diagnostic criteria that include deficits in social communication and social interaction, and the presence of restricted, repetitive patterns of behavior, interests, or activities that can persist throughout life (Biao et al., 2018). ASD is characterized by difficulty in social interaction, problems with verbal and nonverbal communication, and repetitive behaviors (Biao et al., 2018). The most obvious signs of autism often appear in the early stages of childhood, between the ages of two and three. Children with autism are defined as being part of a large spectrum because each individual is different. Initial signs and symptoms are typically apparent in the early developmental period; however, social deficits and behavioral patterns might not be recognized as symptoms of ASD until a child is unable to meet social, educational, occupational, or other important life stage demands (Biao et al., 2018).

The rate of children identified with an autism spectrum disorder has risen to 1 in 59 children nationally (based on the CDC's evaluation of health and educational records of 8-year-old children in 11 states in 2014). New Jersey again has the highest rate of those states evaluated: 1 in 34 children (1 in 22 boys) (Biao et al., 2018). “An urgent public health concern,” according to the CDC, the ASD rate has tripled since 2000. The Autism and Developmental and Disabilities Monitoring, or, ADDM, estimates ASD prevalence among children aged 8 years in multiple U.S. communities have increased from approximately one in 150 children during 2000–2002 to one in 68 during 2010–2012, more than doubling during this period (Biao et al., 2018). The observed increase in

ASD prevalence emphasizes the need for continued effective strategies in education as these numbers increase.

Parents, educators, and other professionals use a variety of strategies in communicating with nonverbal children with ASD. Common communication methods include assistive technology, the Picture Exchange Communication System (PECS), and applied behavior analysis techniques. With research, experts can individualize the use of communication strategy such as PECS, to best meet the communication needs of each individual with ASD.

Independent task completion is also a highly sought out area for educators and students with ASD to achieve in the classroom. Teaching students to use a Visual Activity Schedule, or VAS, can be beneficial for students to complete daily tasks without the need for extra prompts. This goal can be achieved for students with picture prompts and possibly technology as well.

Statement of the Problem

The first sign of impairment is found in early preverbal communication of children with autism (Tager-Flusberg, 1993). While children with ASD may use gestures, or vocalization to express their needs (called protoimperative gestures), they may not communicate objects of shared interest (protodeclarative gestures) (Tager-Flusberg, 1993). Children with ASD may not use language to communicate with others, let alone share and ask new information (Tager-Flusberg, 1993). Finding an efficient way for each individual child with ASD to communicate will benefit them in the long term.

For example, an Applied Behavior Analyst may develop an early intervention program for a student with ASD and create a form of communication that is beneficial for that young child. The present study will investigate the use of communication strategies to increase the communication of children with ASD in a first-grade classroom.

Visual Supports for Communication

One effective strategy teachers can use in communicating with children with ASD is organized visual schedules (Flores, 2012). Children with ASD often prefer routine and benefit from a schedule (Flores, 2012). By using organized visuals such as charts, posters, and graphs, teachers are able to receive reactions and emotion from students. Because of this, the student with autism may be excited and eager to use such visuals, especially if the visual is full of color and designs.

Especially in classrooms today, iPads™ are becoming more integrated and useful as communication tools. Various applications are being created in order for students to communicate through technology, recordings, and sounds as well. By incorporating the child's interest through the iPad™, motivation to communication may be increased.

Purpose

On many occasions, behaviors of children with autism include difficulty in social interaction, verbal and nonverbal communication, and repetitive behaviors (Biao et al., 2018. Many times, these behaviors become noticeable in children between the ages of two and four (Biao et al., 2018). The goal of the present research study is to examine the impact of the use of the Picture Exchange Communication System (PECS) and

technology integrated communication strategies on the communication and task completion of children with ASD in a first-grade resource classroom.

Research Questions:

1. Does the use of PECS on an iPad™ increase the number of communication exchanges in children with ASD and limited verbal skills?

2. Does the use of a PECS picture schedule on an iPad™ increase the independent task completion of children with ASD and limited verbal skills?

3. Are students and teachers satisfied with the use of PECS on an iPad™?

Chapter 2

Review of the Literature

PECS on the iPad™ was chosen as the communication method to be investigated in the present study because of its accuracy, practicality, and familiarity to students with ASD. This chapter will begin with a description of PECS on an iPad™. Next, communication exchanges using a speech generating device, and independent task completion using visual prompts will be discussed. The study will conclude with a review of related conducted studies.

The Picture Exchange Communication System

PECS is an augmentative communication system frequently used with children with autism (Charlop-Christy, M.H., Carpenter, M., Le, LeBlanc, L.A., & Kellet, K. 2002). PECS is a pictorial system that was developed for children with social-communication deficits (Bondy & Frost, 1994). The system uses basic behavioral principles and techniques such as shaping, differential reinforcement, and transfer of stimulus control via delay to teach children functional communication using pictures (black-and-white or color drawings) as the communicative referent. The pictures are kept by the child on a notebook (PECS board) with Velcro® in order for the child to create phrases and eventually sentences regarding what he/she wants to communicate (Charlop-Christy et al., 2002). PECS allows nonverbal students to initiate questions, respond to, and make comments using pictures on the board.

For several reasons, PECS has become a widely used and practical communication method for students (Bondy & Frost, 1994). First, the system requires

few complex motor movements on the part of the speaker and does not require the listener to be familiar with an additional language, such as sign language (Bondy & Frost, 1994). Second, PECS has a relatively low cost and is portable and suitable for use in many settings. Third, case reports indicate that the system can be taught relatively rapidly (Charlop-Christy et al., 2002). Finally, PECS incorporates functional communicative responses that promote meaningful interactions between the child and the environment. PECS is unique among alternative communication systems in that it requires the child to approach a listener and initiate interaction (Charlop-Christy et al., 2002). With this, PECS is a method that has increased communication skills (Charlop-Christy et al., 2002) and decreased misbehavior (Charlop-Christy, 2002).

In a study by Charlop-Christy et al. (2002), three boys with autism participated in biweekly sessions using PECS at an afterschool behavioral treatment program. All children had an extensive history of verbal speech training that had been ineffective in increasing communication. These children were taught because they were the first three children in the program after the initiation of the study that did not speak or rarely spoke and needed language programming (Charlop-Christy et al., 2002). During training, the three children were taught PECS for 15-minutes twice per week. PECS was taught using prompting and differential reinforcement procedures (Charlop-Christy et al., 2002). This protocol involves six training phases: (a) physical exchange, (b) expanding spontaneity, (c) picture discrimination, (d) sentence structure, (e) "What do you want?" and (f) commenting (Charlop-Christy et al., 2002). The children were taught to deliver a picture to an adult, who then provided the object and stated the name of the object (Charlop-Christy et al., 2002). The final phase incorporated a form of specific training in which the

child was taught to describe an object in his or her environment. The criterion for successful completion of each phase was 80% unprompted successful trials in a 10- trial block (Charlop-Christy et al., 2002).

According to Charlop-Christy (2002), an average of 2.9 requests and initiations per session occurred during the baseline, which increased to 38 per session following PECS's training. The children had great success from the PECS training. The greatest change was the elimination of disruptions in the academic setting for one student, and the elimination of tantrums in the play setting for another student. A 70% or greater reduction was observed for 10 out of 12 behaviors, and four were eliminated (Charlop-Christy et al., 2002).

This study illustrated the effects of the PECS training procedure on several behaviors related to communication: vocal communication, social communicative behaviors, and problem behaviors (Charlop-Christy et al., 2002). Children with autism frequently learn tasks presented in a structured concrete format more easily than tasks presented in a more abstract format (Schopler, Mesibov, & Hearsey, 1995). Therefore, the structured context and concrete nature of the physical exchange is perhaps better suited for learning for children with autism than traditional spoken language of an adult (Charlop-Christy et al., 2002). PECS provides a visual representation of communication, which keeps children with autism engaged, and may also reinforce positive behavior.

PECS on an iPad™

In another study conducted by Flores, Musgrove, Renner, Hinton, Strozier, Franklin, and Hil (2012), the comparison between PECS and an Apple iPad™

communication system were analyzed using five elementary students with autism spectrum disorder and developmental disabilities. The purpose of this study was to investigate the utility of the Apple iPad as a communication device compared to a non-electric system (such as PECS) using symbols only.

At the time this study was done, the iPad™ had not been released to the public, therefore, applications and software were limited. In order to complete this study, researchers used an application called, "Pick a Word" that allowed the student to touch a color photograph on the screen in order to make a request (Flores et al., 2012). For example, if the student wanted a pretzel, a picture of a pretzel was a real-life photograph containing a pretzel. The I-Want picture was a photograph of open hands together depicting the American Sign Language sign for I-Want (Flores et al., 2012). Using the voice output, students could make one-word requests or multiple word requests. The speech output consisted of a young child's voice which was not identified as a male or female. The voice output was activated when the picture was highlighted and the child touched the photograph (Flores et al., 2012).

The design and frequency of the communication behaviors were compared using PECS and the Apple iPad™. None of the communication behaviors were prompted beyond an initial offer of a snack by a teacher. Communication behaviors for PECS was defined as one of the following: pointing to a picture card, removing a picture card from its Velcro® and giving it to the teacher, or removing the picture card from the Velcro® and placing it on its sentence strip (Flores et al., 2012). As for the iPad™, communication behaviors were defined slightly differently. The student had to touch the picture on the iPad™ screen so it was highlighted or touch the screen long enough to generate speech

(Flores et al., 2012). Before this testing was implemented, each child received training in using the iPad™ since no child had ever used the device prior to testing.

The findings resulted in communication behaviors increasing with the use of the iPad™. The Apple iPad™ is a practical communication device that allows for much more pictures and speech communication (Flores et al., 2012). This device can easily be transported and can be prepared by an educator prior to a student using it for the day. Accessibility is another advantage of the iPad™ in terms of availability to the general public. Although this device may be costlier in the end, investing in such a communication device has additional benefits as it can contain more utilities to support children with autism in communication (Flores et al., 2012).

Ultimately, there are various communication methods and devices for children with autism to use; however, the most effective system may vary based on individual student strengths and needs. PECS has been effective with nonverbal students for quite some time. Frost and Bondy (1994) describe the system as using behavioral principle techniques such as shaping, differential reinforcement, and the transfer of stimulus control via delay to teach children functional communication using pictures. PECS can be used not only as a communication device, but also a behavioral reinforcement in children with autism in procedural trainings. However, children on the autism spectrum display such a widespread developmental and cognitive development, that other communication systems may be more beneficial (Tincani, 2004). Imitation skills and other pre-existing skills enhance the use of such devices in which all children with autism differ. Currently, the use of technology such as the Apple iPad™ may generate even more opportunity to

individualize communication with such an endless choice list of Applications to choose from.

Communication Exchanges Using a Speech Generating Device

In a first grade resource classroom, nonverbal students with autism use various methods of communication throughout the school day. Whether it be hand gestures such as pointing, PECS on a board, or other visual supports, these students are developmentally and socially progressing daily. Using the preferred form of communication for each student is an important factor in supporting nonverbal students to communicate. Each child's verbal ability is limited, therefore, in the present study I will compile data using tally marks in order to document the frequency of communication exchanges in a specific setting.

In a study conducted by Agius and Vance (2016), the communication of nonverbal preschool children with autism was compared using PECS on an iPad™, and a speech generating device (SGD). The intervention of PECS on an iPad™ was completed using an application known as the SoundingBoard™ app (Agius & Vance, 2016). This app was chosen for the study because it allowed the children to view multiple grids to be linked together on the screen in order to create complete sentences. The SoundingBoard™ app also provides a "rearrange" feature that slightly mimics the PECS board (Agius & Vance, 2016). For all intervention phases, the initial screen displayed a home page with symbols for I WANT, FOOD, DRINK, and TOYS which are considered concrete forms of communication for the preschool children (Agius & Vance, 2016).

As a result of the communication study using PECS on an iPad™, the children were successful in using the technology. Two of the three children were experienced with

iPads™, which resulted in less prompting in creating basic interactions. Once participants mastered the motoric elements of the iPad™, and was able to achieve mastery in using the screen (Agius & Vance, 2016). Although the intervention of teaching the children how to use the iPad™ and the SoundingBoard™ app was difficult, the results suggest that the children are more effective and less prompt-dependent in creating initial communication (Agius & Vance, 2016). An early intervention such as an SGD or an iPad™ can be beneficial in supporting children with autism's early communication progress.

Independent Tasks Using Visual Prompts

According to Bryan and Gast (2000), students with autism frequently experience difficulty attending to, regulating, and understanding auditory input, and visual prompts seem to enhance the communication process. Visual stimuli such as photographs and pictures using lines or drawings can be used to teach children with autism. Visual prompts and schedules are used to communicate what and how much work is to be completed (Bryan & Gast 2000). Activity schedules require individuals to transition from one activity to another, in sequence, in order to complete assigned tasks. Children with autism have been reported to have difficulty when making transitions between activities (Bryan & Gast, 2000). This usage of visual activity schedules has been reported to help students to independently transition from one activity to another. Such visual prompts provide a structured teaching environment, make expectations clear, and lessen the need for continuous adult prompting (Bryan & Gast, 2000).

Task Completion

Completing a task can be difficult for students with disabilities, especially those with ASD. Many educators create a visual activity schedule in the classroom in order to specifically display the activities that will occur throughout the day. Visual activity schedules (VAS):

are pictures, images, symbols or text prompts that are arranged in a sequence for a specific task. Knight, Spriggs, & Sherrow (2014) found VAS to be an evidence-based practice for on-task, on-schedule, and transition behaviors of individuals with ASD. VAS can aid students in independent transitions, possibly because they create clear instructions and expectations, provide a structured teaching method, and decrease the need for external prompting (Spriggs et al., 2014). In the study conducted, four high school students were given an iPad with the application, My Pictures Talk™, in order to visualize the schedule on the iPad. This application was broken into steps per each task. For example, the first task given to a student was, "Getting Calendar Board." In order for the student to successfully complete this task, six simple tasks were given that the student must follow:

1. Walk to drawer
2. Open drawer
3. Select correct calendar
4. Select Marker
5. Close drawer
6. Return to seat

Participants were given ten seconds to complete each step for data collection purposes. If he/she could not do so, the researcher would use this data as an incorrect response (Spriggs et al., 2014). As a result, the four students mastered the use of technology and completed the tasks given to them.

Summary

Lessening adult prompting was one of the goals described for children with ASD to achieve. As discussed, there are a variety of communication strategies that should be utilized for children with ASD. However, depending on the child's skills and development, one strategy may be more beneficial than another. Discovering the most effective tool for communication and independence in the classroom can be challenging, but once this piece is found, each child with ASD can excel as a student.

Chapter 3

Methodology

Setting

School. The study was held at Hillside Elementary School; a suburban elementary school in Mt. Laurel, New Jersey. The elementary school begins at preschool and continues to grade four. In the 2018-2019 school year, approximately 360 students attended Hillside Elementary School. The district offers preschool disabled classes that students attend as well. Along with this, Hillside Elementary School offers resource services, as well as inclusion classrooms in each grade. Each of the three participants included in the present study are part of a First Grade Resource Classroom. These students are also classified as children with autism with Individualized Education Plans set in place.

Classroom. This study was conducted in a first-grade resource classroom with eight children. There were two kidney tables with five chairs around each, along with a long table with chairs around it as well. The kidney tables faced the SMART board®, which was in the front of the classroom, while the teachers' desks were located in the back of the classroom. Three filing cabinets were set up in a row in the back of the room as well, next to the coat and backpack closet. In the middle of the classroom, a large green area rug was set up for the children to sit while participating in activities. During the day, two teachers were available to students, as well as a teacher's assistant. These three adults work very well with one another in a professional manner.

Participants

Three first grade students classified with ASD participated this study. The students have the most difficulty with communication and have limited verbal ability. The three students currently used a PECS board to communicate throughout the day with the three teachers in the classroom. Behaviorally, the students did not show any misbehavior, and enjoyed working for a specific reward, such as pretzels or stickers.

Participant 1 is an Indian-American female who is seven years old. She has attended Hillside Elementary School since preschool and is a happy student. Her IEP goals include using phrases and words to express her wants and needs in an age appropriate manner.

Participant 2 is an Indian-American boy who enjoys participating in hands-on activities in the classroom. His strengths include building structures or putting pieces together such as puzzles. This participant has been attending Hillside Elementary School since preschool as well. He follows simple directions such as get your snack, and enjoys the company of the other children in the classroom.

Participant 3 was born in Egypt and moved to New Jersey when he was four years old. Now at age six, this student is acclimating to a new culture and language. An IEP goal of his is to respond to questions with 70% accuracy through structured observations and writing as a target behavior.

Table 1

Participant Description

Student	Age	Grade	Classification
Participant 1	7	1	ASD
Participant 2	7	1	ASD
Participant 3	6	1	ASD

Materials

Using the app on the Apple® iPad™ called Visuals2Go™, the special education teacher began an intervention with the three participants in a separate resource classroom. For five days, (Monday through Friday), the small group of children were instructed for fifteen minutes per day to learn how to use PECS on an iPad™. For example, to locate categories: sentence starters, chat, feelings, activities, toys, food, colors, numbers, people, shapes, places, and colors. The students learned the location of the categories on the main screen. Once this was mastered, the children were taught to touch specific categories given by the examiner in order to become familiar with the application.

Research Design

The study was conducted using a single subject design with ABAB phases. During Phase A, or the baseline, typical instruction of PECS was used to communicate in the classroom. After this, instruction began, and students were taught PECS on an iPad™. During this week of instruction, students learned the settings, pictures, categories,

and other availabilities in the application; this was followed by Phase B, or the intervention phase. During the second Phase A, the iPad™ was removed and students used PECS in the classroom to communicate on a daily basis. The final week was used as the second Phase B. Each student was given their own iPad™ to communicate.

Variables. The independent variable was the use of Visuals2Go on an iPad™. The dependent variables investigated included (1) the number of communication exchanges and (2) task completion.

Communication exchanges. For the number of communication exchanges, the children used the app individually in order to respond to an initial question asked by the proctor. For example, each student held the iPad™ that was prepared beforehand with the correct screen regarding the app, Visuals2Go. The proctor announced statements such as, "How are you feeling today?" "Which snack do you like?" "Which number is less than ten?" "Which shape has a straight line?" "Which school activity is your favorite?" In order for the student to score a point, he/she must answer the questions appropriately. The highest score a student could earn was five points, while the lowest score was zero points.

Task completion. Throughout the ABAB design, an independent task completion study was completed simultaneously with the same participants. This study was used to investigate the use of Visuals2Go on an iPad™ as a visual activity schedule on the independent task completion of students. During Phase A, the students used PECS as a visual schedule in order to complete the five independent tasks. Verbal prompting was used for each student in order them to complete each task in a timely manner. In Phase B, students used the iPad™ as a visual schedule in order to complete the same tasks with no verbal prompts

After lunch, the examiner provided a visual checklist of five activities that the child had to complete independently. The amount of time the task takes to complete cannot exceed ten minutes. For example, when the students came back inside from recess, they were prompted to get the iPad™ which displayed a checklist of five tasks:

1. Hang up coat
2. Clean up books
3. Push in chair
4. Sit on carpet
5. Be a good listener

The visual activity schedule was displayed on the iPad™ on each students' desk after recess. The first task was to hang up his/her coat without being prompted. This is a normal routine that takes about two minutes to complete. By using a picture of a coat, the child is prompted by the picture in order to reinforce the behavior. Before lunch and recess, we read a book that is left on the students' desks. After the children remove hats, gloves, and coats, they are to but the book on their desk for the next day. After this, the children must make sure that his/her chair is pushed into the desk. The first-grade children do this procedure each day with prompting, so the routine is not new. With the support of a picture, the students' behaviors are reinforced to continue the routine. The data was collected using the iPad™ such for communication exchanges and classroom routines, which will be the dependent variable in this research design.

Measurement Procedures

PECS on an iPad™ data was collected by using a discrete trial chart measured out of five trials. The chart was graded on a scale that each student could earn up to a maximum of five points per day. By the end of the week, the student had answered twenty-five questions. The students were asked five questions each day, where each question measured one point. If the student responded, the student earned a point. If the student did not respond or answer correctly, a zero was placed on the chart.

Task Completion Data Collection

In order to collect data using the iPad™ in the classroom regarding independent task completion, a discrete trial was used as well. The students could earn a total of five points. Each task was worth one point and was monitored for five days. Students could earn a total of twenty-five points by the end of the week.

Survey

At the conclusion of the study, the three first grade students were given a survey using a smiley face scale. Students answered five questions regarding using PECS on an iPad™ and his/her feelings toward this method. The researcher distributed the survey to the students and read each question aloud while the students answered independently. The participants answered honestly, circling the happy face if he/she strongly agreed with the statement, circled the neutral face if he/she was undecided, or circled the sad face if he/she disagreed. Table one represents the smiley face scale that was given for the students to complete independently.

Statements	Strongly Agree	Undecided	Disagree
I like using the iPad™ at school.			
I prefer using my book (PECS's board) with my teacher.			
I would prefer using the iPad™ with my teacher			
I like using the pictures to complete work			
I liked learning on the iPad™			

Table 2

Scale for PECS on an iPad™

Data Analysis

Graphs were created and compiled after the study was completed. The results were then gathered and converted into individual Excel line plots. The data from the variables discussed were displayed in visual graphs to determine the increase or decrease in communication exchanges and task completion. The results of the intervention were compared to the baseline, or, Phase A was compared to Phase B. The data points were used to identify changes between each phase, specifically after the intervention was

provided. Mean and standard deviations for communication exchanges are reported in the line plots. A comparison of results can be easily viewed using a visual graph.

Chapter 4

Results

The purpose of this study was to increase the number of communication exchanges using an iPad™ for students with autism. The children who participated in this study had no prior experience with the iPad™ as a communication method, therefore, an intervention was necessary. The first week of the study consisted of collecting data using a PECS board. This baseline data allowed change to occur and be graphed throughout the study. Data was collected using a discrete trial method out of five trials. The student earned a point if they answered the question appropriately, and a zero if they did not. Table 3 exemplifies the means and standard deviations of student scores throughout the study.

Table 3
Number of Communication Exchanges on an iPad™: Mean and SD of Communication Exchanges across Phases

	Baseline 1 Intervention 2		Intervention 1		Baseline 2		
	Mean %	SD %	Mean %	SD %	Mean %	SD %	Mean % SD
Participant 1	1.0	0	1.0	0	2.0	1.0	00
Participant 2	0	0	0.5	0.5	0	0	00
Participant 3	0	0	0	0	0	0	1.00

PECS on an iPad™ Research question one asks, using PECS on an iPad™, does the number of communication exchanges in children with ASD and limited verbal skills increase? The mean score shown in Table 3 decreases with every student in each phase, except for intervention two phase, where the mean increased for participant three. The standard deviation remained between 0 and 1.0 at the highest. Throughout all of the phases, the participants could either earn one point or no point, allowing 1.0 to be equivalent to 100% accuracy.

Participant one is a seven-year-old first grade student who is eligible for Special Education Services. She is classified as a student with ASD. During the baseline phase, the use of PECS on a board was used. She scored a 1.0, which is equivalent to 100%. When asked the question, "how are you feeling?" she chose appropriate emotion pieces to place on her PECS Velcro™ strip. The mean remained the same during the first intervention phase, then increased to 2.0 during the second baseline. The final phase of the study, or intervention two, she decreased from a mean of 2.0 to a 0. Her standard deviation altered slightly during baseline two increasing from a 0, earning a 1.0, then decreasing to a 0 for the final phase.

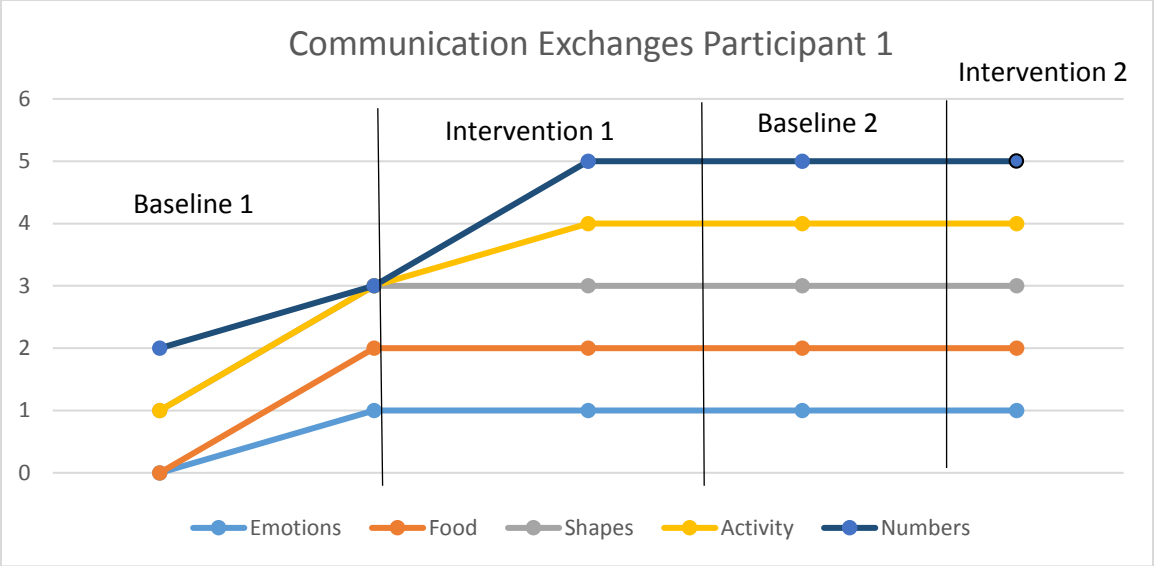

Figure 1. Communication Exchanges Scores of Participant 1 through all Phases

Participant 2 is an Indian-American seven-year old boy who is also classified with ASD. Throughout the phases of the study, participant 2 remained consistent, and earned 0 points for the mean and standard deviation. The earned points throughout the study were not consistent to decide an increase or decrease in the scores. A review of graph data shows a visual increasing then decreasing trend across four of five areas. In figure 3, participant two's scores are represented in each phase.

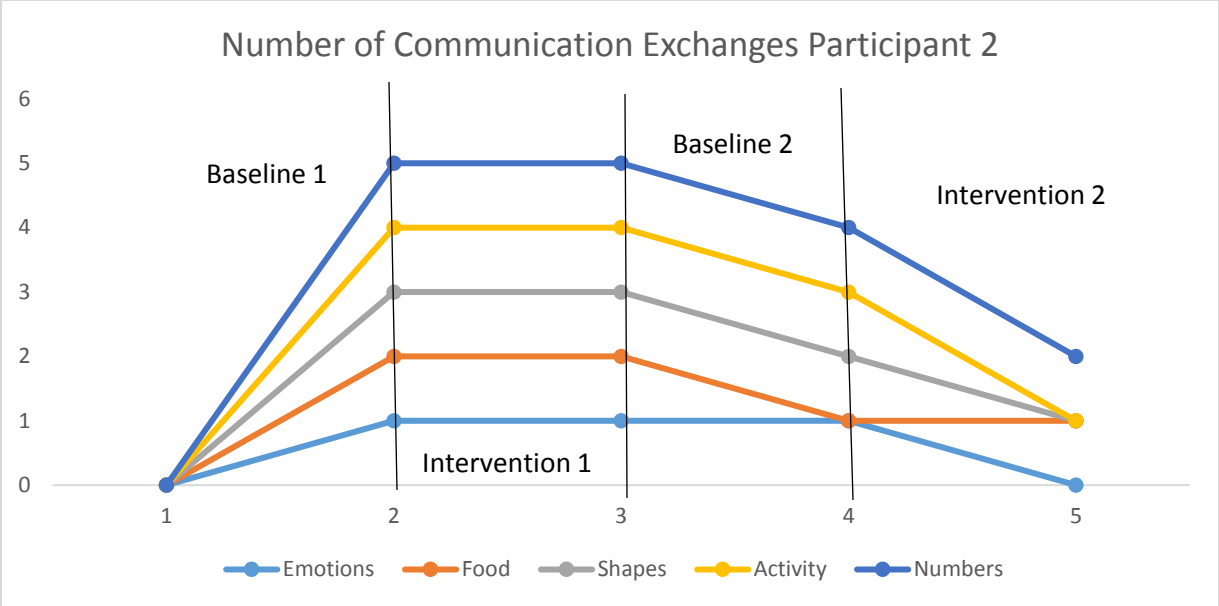

Figure 2. Communication Exchanges Scores of Participant 2 through all Phases

In a first-grade resource classroom, participant 3 is classified as a student with ASD. He is a seven-year old boy who recently moved to the United States from Egypt. Participant 3 earned 0 points as his mean and standard deviation score throughout the entire study. In the intervention 2 phase, this student earned 1.0 points as a mean score. He increased by 100% from the other mean and standard deviation scores in each phase. As the study continued, this student began to earn more points, which increased his score. Figure 4 displays the data that was collected.

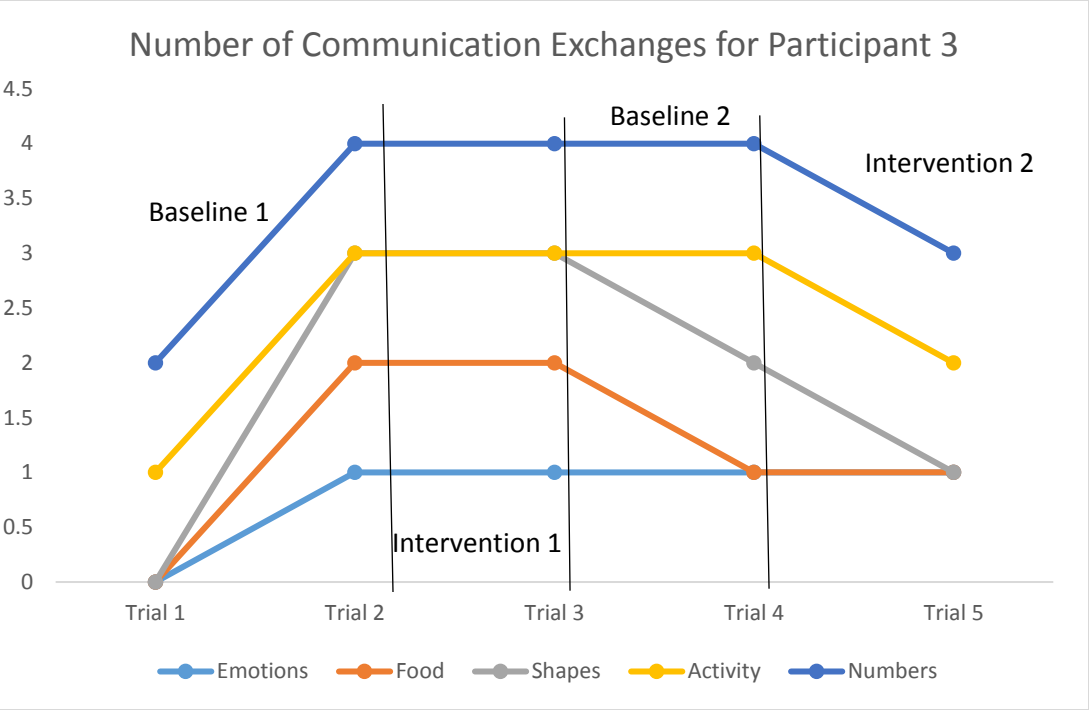

Figure 3. Communication Exchanges Scores of Participant 3 through all Phases

In addition to scoring communication exchanges of students with ASD in a first-grade classroom, data was collected simultaneously regarding independent task completion using an iPad™ with a visual activity scheduled available for the students to reference. Research question number two asks, does the use of a PECS picture schedule on an iPad™ increase the independent task completion of children with ASD and limited verbal skills? Each student was given a list of tasks to complete:

6. Hang up coat
7. Clean up books
8. Push in chair
9. Sit on carpet

10. Be a good listener

Students earned a point if they completed the task so a student could earn a total of six points per day. The length of this study was ten days. There was no time limit in completing each task. Students' scores of independent task completion using an iPad™ are represented and calculated in Table 4.

Table 4

Standard Deviation and Mean of Independent Task Completion on an iPad™ of 3 Participants

	Baseline 1		Intervention 1		Baseline 2		Intervention 2	
	Mean (%)	SD (%)	Mean (%)	SD (%)	Mean (%)	SD (%)	Mean (%)	SD (%)
P1	3.0	0	4.0	0	4.0	0	4.6	1.04
P2	4.2	0	2.6	0	3.0	0	3.0	0.72
P3	0	0	2.0	0	2.0	0	3.0	1.28

The scores earned throughout the study were very low, which created a score of 0 for each student's mean and standard deviation. During baseline 1, participant 1 earned 3 points each day. On day 6, she then earned 4 points each day until the 17th day. By the intervention 2 phase, she earned 5 points for each day.

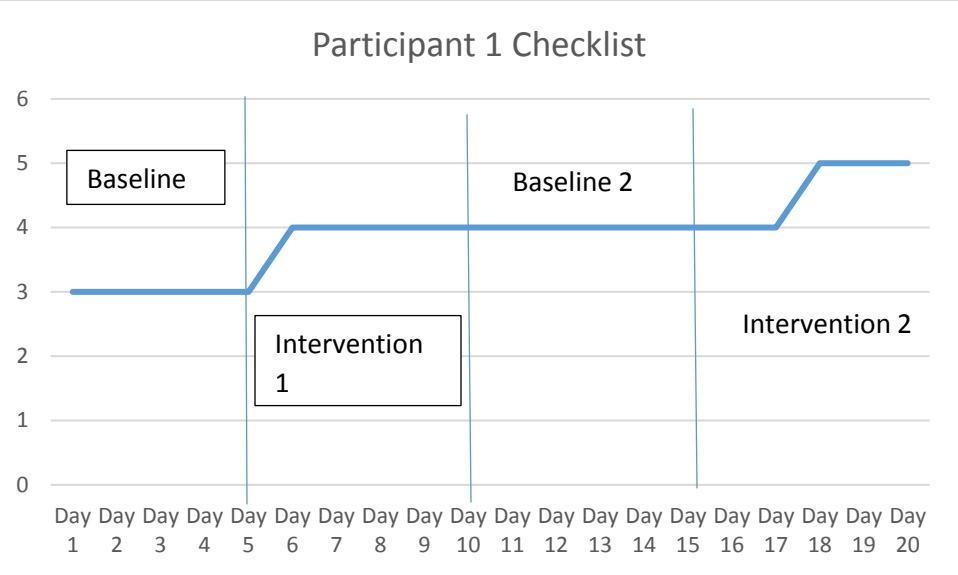

Figure 4. Participant 1 Checklist

Participant 2 earned fewer points during baseline 1 phase. He earned 4 points for each day, then earned 5 points on day 5. During the intervention 1 phase, his points decreased each day, and he earned 2 points on day 7 and day 8. On day 9, his scored increased and participant 2 earned 4 points for the next few days. Throughout the rest of baseline 2 and intervention 2 phases, this student remained consistent and earned 3 points for each day. He completed 3 out of 6 tasks independently using an iPad™ in the classroom during the last two phases.

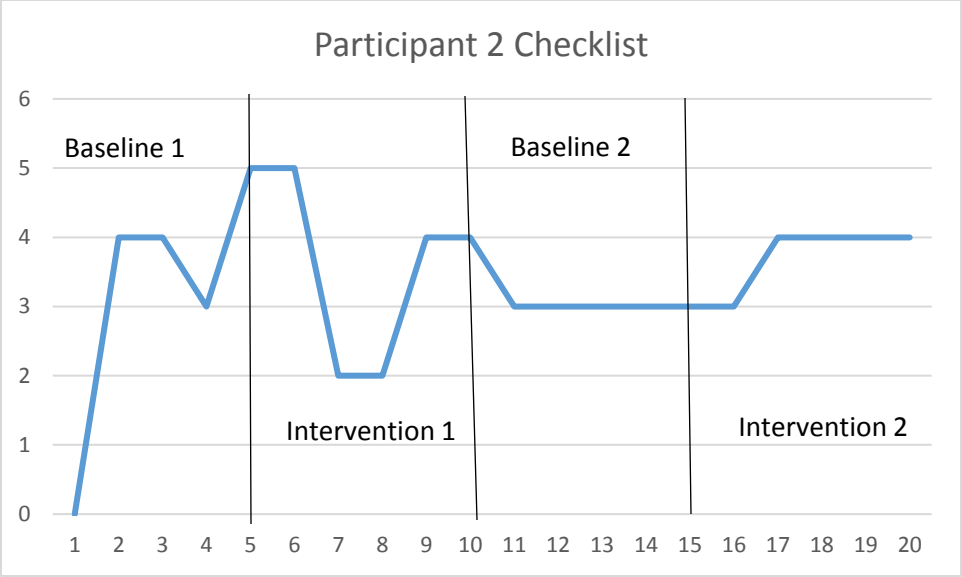

Figure 5. Participant 2 Checklist

The last participant earned the least amount of points during each phase according to the trial data recording sheet. During phase 1, or baseline 1, he earned 0 points for the first five days. During intervention 1 and baseline 2 phases, he remained consistent and earned 2 points each day. He completed the first two tasks independently using the iPad™ as a checklist. The time was not recorded because there was no time limit given for each student to complete a number of tasks. During the final two phases, participant 3 earned 3 points each day and completed half of the checklist independently. On the final day of the study, the student earned 4 points, and completed 4 out of the 6 tasks independently using the iPad™.

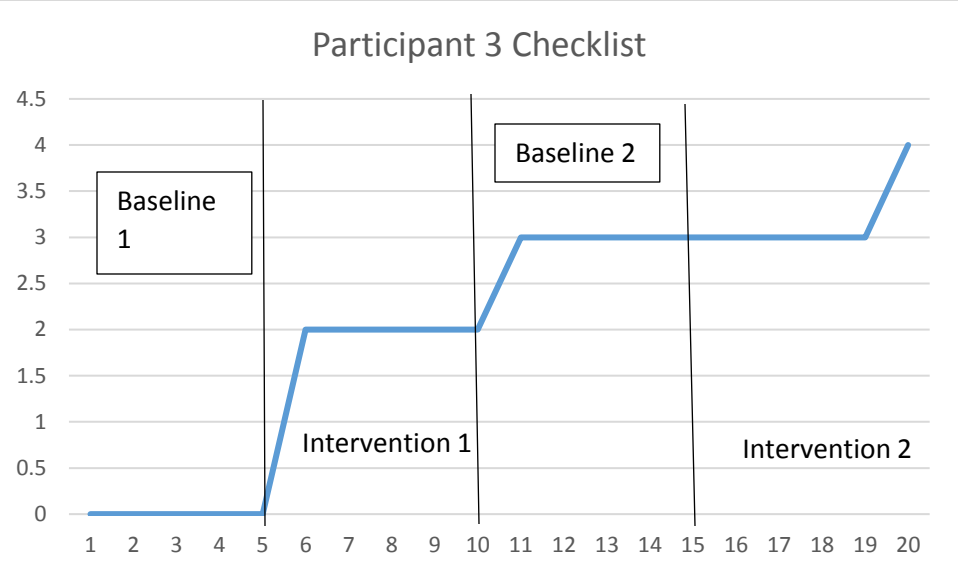

Figure 6. Participant 3 Checklist

Survey Results

The final research question asks, are students and teachers satisfied with the use of PECS on an iPad™? All students completed a scale using a smiley face, neutral face, or sad face as a satisfaction survey after the first intervention phase of the study and at the end of the study. Results were tallied and scored using the students' results. Table 5 represents the students' scales after the first intervention phase of the study. Table 6 represents the students' results at the very end of the study.

Table 5

Student Results in First Phase

Statements	Strongly Agree 	Undecided 	Disagree 
1. I like using the iPad™ at school.	100%	0	0
2. I prefer using my book (PECS's board) with my teacher.	100%	0	0
3. I would prefer using the iPad™ with my teacher	100%	0	0
4. I like using the pictures to complete work	100%	0	0
5. I liked learning on the iPad™	100%	0	0
6. I like using the pictures to complete work	100%	0	0
7. I liked learning on the iPad™	100%	0	0

The first-grade students pointed to their choice, and the proctor circled their answer. The proctor of the study read each statement out loud, and the students pointed to their personal opinion regarding the smiley face. The students associate happy faces with rewards in the classroom, leading each of them to choose a happy face for each statement. Each first-grade student chose a happy face 100% of the time. There was no

change in each scale completed before and after this study. As the student data was inconclusive, an adult in the room was surveyed for their input to determine the social validity of using a Likert Scale.

Table 6

Teacher Results in First Phase

Statements	**Strongly Agree 5**	**Agree 4**	**Undecided 3**	**Disagree 2**	**Strongly Disagree 1**
1. I like using the		X			
2. iPad™ at school.		X			
3. I prefer using my book (PECS board) with my teacher.		X			
4. I would prefer using the iPad™ with my teacher			X		
5. I like using the pictures to complete work	X				
6. I liked learning on the iPad™		X			

Before the study, the results shown in Table 7 were created from the decisions of the classroom teacher assistant. Each X stands for the choice the assistant chose. This classroom teacher assistant is assigned to this particular first grade classroom and supports the children daily. She is familiar with the routine and ability of each child and

understood the meaning of the study prior to collecting results. During the study, she aided in collecting data, and observed the intervention and each phase of this study. Results show that she 100% agrees with using pictures to complete work. This aid also only agrees with using the iPad™ at school, prefer using the PECS book, and enjoys learning on the iPad™.

Table 7

Teacher Results at End of Study

Statements	**Strongly Agree 5**	**Agree 4**	**Undecided 3**	**Disagree 2**	**Strongly Disagree 1**
1. I like using the iPad™ at school.	X				
2. I prefer using my book (PECS board) with my teacher.	X				
3. I would prefer using the iPad™ with my teacher	X				
4. I like using the pictures to complete work	X				
5. I liked learning on the iPad™	X				

At the end of the study, the same classroom teacher assistant answered the same questions regarding the study. The results changed in that she decided the first-grade students should be using more technology in the classroom, and strongly agreed with each statement. She strongly agreed with each statement with using the iPad™ in the classroom and PECS as a communication method.

Chapter 5

Discussion

Findings

The purpose of this study was to examine the impact of the use of PECS using an iPad™, as well as using a VAS as a checklist for students to complete tasks independently. After collecting data, the first-grade students were much more interested in the iPad™ and learned that it had more use than they knew. The results of this study showed that each participant had different results throughout each phase. During the baseline, each student remained consistent with increasing scores for each category.

According to Flores, Musgrove, Renner, Hinton, Strozier, Franklin, and Hil (2012), the Apple iPad™ should have had a positive increase in communication exchanges with the nonverbal children. Using a similar app on the device, prompt, picture, and output voice feature, the studies were very similarly conducted. However, the children in Flores' study was able to receive proper training in the iPad™ device prior to its use. At the time of the study in 2012, the Apple products were beginning to develop and be introduced to society. Therefore, the researchers conducted vigorous intervention and training prior to the study. In this particular study, the first-grade students had used the device on separate occasions for games and such, but never in this ability. Perhaps a more intense intervention could have increased the scores of each child.

Participant one was able to identify an appropriate emotion, food type, shape, activity, and number when encouraged. For this specific student, there was no prompting involved, and no time limit as well. She carefully chose her five choices within a

reasonable time frame. In this phase, she scored 100% in the first category, emotions. The second category, food, this student only scored 20% accurately. During the phase, she was distracted by the picture choices on the iPad™. This could have altered her score. In the shapes category, participant one scored 80%, missing only one response. Her last answer was not a shape therefore, it was not added to her score. The activity category was recognizable because we use pictures like these for the classroom. She scored 60% in this specific area. Finally, participant one was able to identify 100% of her numbers.

Participant 2 had very successful baseline results. He increased his scored with each category in the first phase of the study. He scored over 60% in accuracy in four of the five categories. He scored the lowest in the food category. This student chose three pictures that were not appropriate responses to the question, allowing him to score a 40% in this category. Participant 2 had good background knowledge of the iPad™ and uses it at home for games and other activities. This could have been used as an advantage for this student throughout the study.

The final first grade student, participant 3, also had strong results during the baseline phase. Interestingly enough, in the first category labeled emotions, this student chose the picture labeled, embarrassed. After he chose this, he looked up questioningly as if he could not identify this emotion. Besides this, his lowest score was an 80% in the shapes category. He chose lines instead, which did not represent a shape. Other than this, he was able to score more than 80% in each of the other categories during this phase.

With each phase, the participants were inconsistent. Participant one increased scores in the first intervention phase but did not increase or decrease by any points throughout the rest of the study. She remained consistent in using the PECS board, as

well as identifying appropriate choices from each category on the iPad™. Her results showed that the use of technology did not increase the number of communication exchanges.

Participant two was inconsistent with his scores throughout the duration of the study. His scores increased after the baseline and first intervention phase. During the baseline two phase, his scores began to decrease. This is interesting because these changes occurred during the use of the PECS board. After this, his scores then decreased in the final phase. Participant two did not benefit with using technology in the classroom. Communication exchanges for this particular student using technology was unsuccessful.

The final participant was also inconsistent in his scoring throughout the study. In the first baseline phase, this student was able to accurately score above 80%. However, as the study continued, he began to decrease his score with each phase. In the first intervention phase, participant three remained consistent throughout while using the iPad™ for the first time. After this phase, his scores began to gradually decrease in baseline two phase. By the final intervention phase, this student earned a 60% in accuracy. Altogether, each participant was inconsistent in their scores. However, using the data collected, the number of communication exchanges using an iPad™ did not benefit these first-grade nonverbal students.

Independent Task Completion Findings

The VAS checklist task completion was provided for each student with their own iPad™ on their desk for a duration of twenty days. There was no time limit or verbal prompting for these tasks. Each day, the independent tasks were completed at the same

time of day. After lunch, the students continue a daily routine in which they are familiar. Instead of the students completing the daily routine with many prompts and positive reinforcement, the iPad™ displayed a checklist of items they must complete before the next class activity began.

As Spriggs et al. (2014) conducted in his study using a VAS, each participant was given a prompt and a specific amount of ten, ten seconds, in order to complete the task. Even though high school students were studied, perhaps these few adjustments would have increased the number of tasks each student completed in the first few days. Also suggested was the audio voice on the device in order for the child to hear the activity instead of use the picture as a prompt. Another idea would be to positively reinforce the student each time a task is independently completed. For example, if number one on the list is completed, a sticker or highly interested reward is given to the child immediately. The quick reinforcement is a good way to keep the student working and motivated.

After introducing the iPad™ to each of the students, they each scored less than six points in using the checklist to complete independent tasks. Each task was scored as one point. Participant one was able to complete three of the tasks with no prompting, then began to increase as each phase continued. By the end of the study, he had been able to earn five points, or complete five of the tasks independently using the iPad™ as a reference.

In the first two phases of the study, participant two had a variety of inconsistent scores using the iPad™ in completing independent tasks. Interestingly enough, this student had difficulty in using the iPad™, and was very distracted with the new tool on his desk. He also had no verbal prompting but was unable to complete the tasks in a

timely manner. As the study continued, his scores decreased, only completing two of the tasks independently. This was stimulating because the routine had not been changed since September, yet this child had difficulty. By the end of the twenty days, participant two was able to complete three of the six tasks independently using the iPad™.

Finally, the last participant earned the fewest amount of points in using the iPad™ to complete independent tasks. During the first five days of the study, or phase one, he was unable to complete any task independently. The iPad™ was out of his normal routine, even though it displayed the exact daily routine he has completed since the beginning of the school year. Perhaps the technology was too much change at once. This student surprisingly shut down and was unable to complete much in his own. After a few days, the student began to feel more comfortable with the technology and continued his routine. He did not use the iPad™ as a visual schedule aid, instead, he completed the tasks he knew. By the end of the phases, this student was able to complete half of the checklist independently. The use of technology was not used to his advantage.

Limitations

Throughout the entire process, there were limitations with every student due to factor that were uncontrollable. Snow days, for example, took over for two days in the beginning phases. We had two snow days that altered the routine of the students', as well as one delayed opening. For a classroom that thrives on routine, this was difficult for the children to accept. The change in scheduled varied, and the students had to visit the iPad™ at different times of the day. Even though the children continued the process, their routine was difficult to maintain.

Indoor recess occurred many days this winter, which forced the students to have recess in a first-grade classroom instead of the playground. According to the study, the children used the same routine daily after coming inside from recess. However, on these days, the students follow a different schedule. Instead of hanging up coats and cleaning up their area, students are to clean up toys from their recess. I did not factor this limitation into the study. Some days were skipped due to indoor recess. On indoor recess days, the students did not follow the iPad™ as a visual schedule.

A final limitation in the study was the absence of students. One of the students was very sick and had the flu this winter. He was absent for an entire five days. Unfortunately, he had a difficult time getting back to school and beginning the daily schedule. Another student went away for vacation for five days. Although these absences were understandable, the study was difficult to continue with rigorous training and intervention because of these limitations. Even though the students had some areas of difficulty, the study was able to be completed in a reasonable amount of time.

Implications and Recommendations

Despite some uncontrollable limitations of this study, the research shows that the iPad™ had a negative effect on communication exchanges and visual aid with first grade students. Even with interventions, the first-grade students had difficulty with the transition with technology. A recommendation for this particular study would be to use students that are familiar with technology and the use of iPads™ at school. The students had used iPads™ at home, but in the school, setting was difficult for each of them to become accustomed.

A practical suggestion would also be to use older students for a study similar to this one. Even though the students were involved in interventions, they are still being taught PECS on a board. Integrating the iPad™ in a learning period for these students may have caused a negative effect because of the change in routine. Young students must be consistent in using a particular use of communication, such as these first-grade students, and integrating a new piece may have been detrimental to learning new strategies.

Conclusions

This research study was encouraging in the fact that technology is becoming more practical in the school system, and students can begin to use it to their fullest potential. The idea behind the study is to create a communication system so that any educator can communicate easily with nonverbal ASD students, without specific training. With the use of iPads™ and technology being used in the classrooms, one day students will be able to have positive effects using specific apps in communicating universally.

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