TEACHER DECISION MAKING PROCESSES AND AN ANALYSIS OF THE AVATALKER APPLICATION WHEN USED BY STUDENTS WITH AUTISM

A Dissertation
by
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Abstract

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This study was an investigation into the elements that teachers of students with autism use to select applications (apps) for student use and an analysis of the Avatalker application when used by students diagnosed with autism to increase verbalizations. Results showed that teachers used technology, most especially the iPad and applications, in their classrooms with students diagnosed with autism. Teachers were also unsure of any app selection process for the school, such as the use of a selection rubric or any type of app selection committee or review team. Results also showed that teachers use the elements of ease of use for students, student motivation, student engagement, flexibility of use across ages and levels, and relevancy of the app to student needs when choosing apps for student use. The analysis of the Avatalker app when used with students diagnosed with autism to increase student verbalizations resulted in a need for closer examination of the needs

of students with autism with interactions with peers. The results showed that peer interactions were limited and students did not interact at high percentage with others around them when opportunities were available. The study results can be utilized to help implement strategies and procedures for selecting apps for students use. The use of a committee or school based team to review app selections using selection criteria, such as a rubric, can lead to more research based apps used with students. The results also shed light on the continued need to find strategies to increased verbalizations, conversational methods, and peer interactions in students diagnosed with autism.

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Dedication

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me, patting me on the back, listening to me when times were bad, encouraging me when I felt like I could not continue, and for being my biggest advocate. I love you both very much!

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Chapter One: Introduction

Context and Background

The Diagnostic and Statistical Manual of Mental Disorders-DSM-5 (American Psychological Association, 2013) characterizes individuals with autism spectrum disorder (ASD) as demonstrating:

> communication deficits, such as responding inappropriately in conversations, misreading nonverbal interactions, or having difficulty building friendships appropriate to their age. People with autism spectrum disorder may be overly dependent on routines, highly sensitive to changes in their environment, or intensely focused on inappropriate items (p. 4)

Students with ASD are present in public, private, and charter schools nationwide. Throughout the last seven decades, opportunities for schooling for students with autism have changed considerably. In the public, private, or charter school environment, students with autism can be served in both the self-contained classroom with their peers, who also have an individual diagnosis of ASD, or in an inclusive classroom of peers without disabilities. However, due to communication and social skill deficits, students with ASD need supports to be successful in school settings.

The use of technological supports, in the form of iPads, laptop computers, and interactive boards is growing in presence. The fast injection of devices has changed the way people live their lives, in both the home and personal settings (Huneycutt, 2013). Students demonstrate purpose by interacting with these devices through the push of a button to organize and solve problems, and use the tools to attain a goal (Hendricks, 2013). Merely being present in a classroom does not ensure that a student with ASD is a fully included

member of the class. Boutot and Bryant (2005) write that successful integration into the general education classroom consists of three factors: visibility to other students in the classroom, being in the classroom with others that the students wishes to spend time with each day, and being an active player in a group that spends a portion of their time together. The use of technological interventions can help ensure that students with ASD are fully included as successful members of their general education classroom environment.

Universal Design for Learning

In the 1990's, David Rose of the Harvard Graduate School of Education and Center for Applied Special Technology (CAST) designed the framework known as the Universal Design for Learning (UDL). Universal Design for Learning is defined as a framework that "can be used to design technology rich curricula that are more flexible, providing students with a range of options to meet diverse needs" (Rose & Strangman, 2007, p. 381). The UDL framework was used to inform and design the present intervention.

Edyburn (2005) writes, "the CAST philosophy of UDL is embodied in a series of principals that serve as a core component of UDL" (p.17). There are three guiding principles that encompass UDL. The first principle includes multiple means of representation to give learners various ways of acquiring information and knowledge. The second principle focuses on multiple means of expression to aid learners in alternatives for demonstrating what they know, while the third principle centers on multiple opportunities for engagement to focus on learner interests, challenges, and motivation (Edyburn, 2005). Hitchcock, Meyer, Rose, & Jackson (2002) report that when using UDL principles in the design process an activity's "goals provide an appropriate challenge for students, materials have a flexible format, methods are flexible and diverse to provide appropriate learning challenges, and assessment

is sufficiently flexible to provide accurate, ongoing information that helps teachers adjust instruction" (p.8).

UDL aligns with new technological additions that are commonly available in schools. UDL also aligns with teacher planning for technology, choosing technology tools for their students to use, and selecting effective means of instruction for student use. In a 2007 study by Spooner, et al., when teachers were exposed to one hour of intervention using UDL for lesson planning purposes, the experimental group showed progress in developing lesson plans accessible for all students.

Pisha and Coyne (2001) report, "new multi-media learning tools, including ubiquitous classroom computers, offer students and teachers a range of exciting new options for capturing, storing, retrieving and displaying information in non-textual forms, such as images, sounds, and videos" (p.199). Pisha and Coyne (2001) also state, "UDL suggests that these tools be employed to develop a new generation of flexible curricula and materials that accommodate each student's strengths, weaknesses, styles, interests, and background knowledge" (p.199).

This study was framed around the three UDL principles: Provide Multiple Means of Representation, Provide Multiple Means of Action and Expression, and Provide Multiple Means of Engagement. Analysis of the data was completed using the three principles as a framework.

Problem Statement

The problem statement for this study has two areas. Both of these areas are distinct, however, they overlap as the focus moves from a general assessment of the processes used by school personnel to identify technological approaches to use in their specific settings to the

more specific evaluation into the usefulness of those particular technologies. When looking at the prevalence of ASD among children 8 years of age, Christensen et.al (2016) reported that the likelihood of autism occurring in boys is higher (23.6 per 1,000) than girls (5.3 per 1,000). Falco (2014) reports that 1 in 68 children will be diagnosed with autism spectrum disorder. Growth in the interest of identification of evidence-based practices for students with autism spectrum disorder is pushed by several influences (Odom et.al., 2003). Some of these influences include identifying effective interventions, social skills training, and cognitive behavior therapy.

First, as technology becomes more available to all students in the educational setting, the manner in which teachers of students with autism choose applications for use in the classroom is of the utmost importance. As such, this was the first area of focus for this research study. Current research is not keeping up with the changing environment of technology, requiring teachers to evaluate the technology tools and applications, also known as apps, they use in the classroom (More & Travers, 2013). App developers often label apps as educational; however, developers are not researchers who study pedagogy and student learning (Zosh, Hirsh-Pasek, and Golinkoff, 2015). In order to help educators make curricular decisions, research that focuses on how teachers choose apps for student use is critical piece to improving the processes used for selection.

The second area for research for this study focuses on the use of an individual app to increase verbalizations in students with autism, Avatalker® (Metova, 2014) which is available on the Apple® iTunes store. Avatalker® is an app designed for use with students diagnosed with autism. This app is not currently being used in the researcher's home county. Avatalker was chosen for this study due to the possibility of purchase to be used with

students who are diagnosed with autism. This app was not currently being used in the research setting so no data had been collected on the app prior to the research study. McEwen and Dube (2015) report that, even though computers are being utilized by students for educational purposes, there is little research on how interactions with the technology is affecting learning in the classroom.

Purpose of Study

Several areas of research are evident when focusing on apps that build communication skills with students with autism. First, the processes that teachers use for the selection of apps were a focus of this research. When teachers are given the task of selecting apps for use in their classrooms, what do they look for in an app in order to choose it for use by the students? The results of this research will help school districts make informed decisions about the usefulness of the app prior to purchasing it. The results of this study will be shared with the exceptional children's directors and assistant directors, exceptional children behavioral and curriculum coaches, and teachers of students with autism. This leads to the research questions of the study.

Research question #1: When searching for apps that focus on communication to use with students diagnosed with ASD, what key elements must be encompassed in an app in order for it to be chosen by the teachers of students with autism for the student's educational plan?

With this guiding question, the focus was on the decision-making process of teachers of students with autism when deciding on the best app for the student's education. This question was answered by surveying teachers of students with autism to center on factors used for choosing apps. Survey questions focused on the qualities of the app and how apps are chosen for students with autism to use on the iPad (see Appendix A). Also, five open-

ended questions were asked on the survey to give teachers a forum to expand on their responses. Interviews were also conducted as a follow-up based on descriptive and qualitative analysis of these surveys. The interviews focused on providing additional depth and context for the app selection process.

Research question #2: Will verbal interactions increase in elementary aged students diagnosed with autism when using the Avatalker® iPad app?

Autism spectrum disorder is a disorder consisting of varying areas of social impairment and severity levels (Gillis & Butler, 2007). Stevenson, Hedberg, Highfield, and Diao (2015) report that, as more devices are placed into use in classrooms, educators must think beyond the normal print-based literacy and related educational research. The student participants in the study that used the Avatalker app on the iPad were students diagnosed with autism who demonstrated limitations in social and communication skills. The app was used during baseline and intervention sessions with the student and communication opportunities observed, recorded, and evaluated.

Study Setting

The study was conducted in a rural county in western North Carolina. The researcher met with the Superintendent of Schools and the Director of Exceptional Children to review the components of the study, the confidentiality factors of the study, and the benefits to the overall educational community. Once permission was obtained to complete the study, the researcher worked with central office leadership to decide on a placement (school and classroom setting). The researcher began conversations with school administrators and teaching staff at the cooperating school for placement in a classroom that served students with autism. Teachers of students with autism were trained on the use of the app prior to

beginning the research study. Upon completion of the research study, teachers involved with the project were allowed to keep the app so they could continue to use it in their classroom. Parent permission to observe students was obtained prior to beginning any research. Permission to view the IEP (Individualized Education Plan) of the students was obtained prior to the start of any research method being employed. Other testing and assessment results, such as reading levels, were also reviewed with parent permission. The classroom setting consisted of students diagnosed with ASD, and who had limited verbal communication.

Assumptions

As the number of children with autism increases, the use of technology by the students will continue to become a focal point. Many districts are moving toward one-to-one technology initiatives inside the classroom, which will help place devices with students with autism. As students struggle with social interactions and communication, educators who work with the students look to technology to aid these students to be successful.

Due to the increase in prevalence of ASD, more and more apps will be added to the iTunes store in the coming years designed for users with autism. The apps may or may not be research based, hence the importance of this type of research. Teachers and school leaders look to research to make curricular decisions for students. Additionally, research in this area will pave the way for the areas of app development, design, and assessment. As more apps are placed into circulation for potential download, researchers must be vigilant in assessing the app for its usefulness with student populations.

During the planning and organization phase of the research project, it was assumed that the researcher would have access to a classroom where students with autism were

present. Several of the assessment tools used in this study were data collection sheets used during baseline and intervention sessions with students with autism, and surveys and follows up interviews with teacher s of students with autism. The study was designed around a school with teachers and staff who were agreeable and accessible for follow up surveys and interviews. The parents were open to observation and interaction with their child during the research process. Also during the research process, there were opportunities for interaction with parents and teachers in an Individualized Educational Plan (IEP) meeting. All of these data sources added to the overall findings of the project. The outcome of the research project added to the professional conversation and dialogue focusing on the benefit of communication apps for the iPad. Through the completed research in the area of app benefits, students with autism benefited greatly as these apps are used to supplement the educational program.

Significance and Rationale

By conducting this study, the fields of educational leadership and curriculum will benefit from added insight regarding the benefits of iPad communication apps. School leaders can use results from the study to aid in building technology plans for schools and districts. Administrators and teachers can utilize research that focuses on one important facet: tablet use for students with autism and other special needs. The results from the study can also be used to open doors for teachers and principals to find usefulness of technology in the classroom that serve students with autism. The research will provide results that can be used from the classroom teacher all the way to the district superintendent. The study will open up more avenues for students with autism to use the skills developed through dialogue and communication. This research helped explore the use of apps to increase verbalizations in

students with autism and characterize key elements needed for selection of apps. This will help school leaders and educators make more informed decisions on the direction of instruction and supplemental decisions for children with autism.

Organization of the Dissertation

The dissertation is organized in a traditional, five-chapter format. Chapter 1 is comprised of an introduction, which covers the background of the study, problem statement, information about the setting of the study, and significance of the study. Chapter 2 reviews literature focusing on the research topic. In the review of the literature, overlapping themes were noted and further inquiry is made to show connections. Chapter 3 describes the methodology used to gather information, observations, and data about the research topic. Analysis, coding, and interpretation of the data is reviewed in this chapter. Chapter 4 consists of the findings of the study. Tables, charts, and graphs are utilized to give a summary of the study and the findings. Chapter 5 is comprised of the interpretation, conclusion, and summary of findings.

Chapter Two: Review of the Literature

Introduction

Students with autism are an integral piece of the school environment, whether they are being served in a classroom for students with autism or as a mainstreamed student with their peers without disabilities. Due to challenges in their visual, auditory, spatial, and tactile sensory systems, children with relationship and communicative disorders often experience difficulties comprehending a broad range of concepts and relations expressed through words (Ricamoto, 2008). Deficits in language, especially those centering on interaction in social settings, are among the prime characteristics of autism. A variety of problems are often observed in infant and young children with autism, with communication being a prominent concern (Turygin, Matson, Konst, & Williams, 2013).

The world that students inhabit now is filled with opportunities for digital devices to be an active part of the school day. Smartphones, tablets, and MP3 players are now crucial everyday tools for most of the population (Kellems et al., 2015). Whether the student is using the device for a picture exchange system to communicate needs to peers or using an app on a tablet to speak to the teacher, technology is becoming a larger part of the student's everyday life.

The literature surrounding the key topics of technology use with students diagnosed with autism and teacher choice pertaining to selection of apps to use with students with autism will be introduced in sequential format. A historical theme showing progression from early forms of communication instruction to the present day methods of delivery using technology devices will lay the groundwork for this topic by presenting a chronological

pathway. All of these deliveries continue to build upon the foundation for advancement in technology use with students diagnosed with autism.

Autism Defined

ASD is a range of complex developmental disorders that can cause problems with thinking, feeling, language, and the ability to relate to others. The condition is a spectrum disorder because it affects people in many different ways and to varying degrees, from mild social skill deficits to a severe inability to communicate (Tachibana, 2009). Most cases of autism are identified in the first 3 years of a child's life. Studies have found the same results as those found by clinicians skilled in early diagnostic assessments; children can be diagnosed by 24 months of age (Towle, Vacanti-Shova, Shah, & Higgins-D'alessandro, 2014).

As the number of children diagnosed with autism increases, the needs of this community become more salient (Hourcade, Bullock-Rest, & Hansen, 2012). The inability to communicate effectively in a social setting with peers is often an obstacle for students with autism. Students with autism, who are nonverbal or who use little speech in their everyday lives, are missing out on a vital piece of the social interaction puzzle. Tager-Flushberg, Paul and Lord (2005) stated "milestones in language and communication play major roles at almost every point in development in understanding autism" (p.335). People diagnosed with an ASD show a reduction in flexibility in the cognitive realm, which leads to a difficult shift from an established pattern to one where a new pattern or routine is being established (Miller, Rogozzino, Cook, Sweeney, & Moscani, 2015). People with autism tend to cling to sameness, repetition, and predictability to navigate the anxiety of the demands of daily life and to avoid new situations, which results in a lack of spontaneity (Cashin, 2005).

Autism Theories

After decades of intensive research into ASD, it is still unclear what causes this disorder and how this disorder emerges. Current approaches are not able to account for the myriad of symptoms and heterogeneity present within students with autism (Hellendoorn, Wijnroks, & Leseman, 2015) although several theories have been proposed to explain ASD. These theories include abnormalities in brain structure, family genetics, and irregular segments in the genetic code (Autism Society, 2015) and vaccines, vaccine antigens, vaccine preservatives, metal metabolism disorder, and mercury (Ratajcak, 2011). Although once theorized as potential agents in the cause of ASD, research indicates there is no causational or correlational link between vaccines and ASD (DeStafano,Price, & Weintraub, 2013). In addition to genetics and vaccines, Cannell (2015) formulated several theories for the cause of autism, including genetic injury due to radon or radiation, uncontrolled inflammation in the body due to vitamin D deficiency, and autoimmune disease. Cannell (2015) also theorized deficient mitochondrial energy in cells, toxins, such as cadmium, mercury, and nickel, and high serotonin levels in the bloodstream as possible reasons for autism.

History of Autism

The earliest descriptions of autism come from the beginning of the 20th century. In 1908, Dr. Eugen Blueler, a Swiss psychiatrist, observed several patients who exhibited characteristics of being withdrawn and self-absorbed. In 1943, Dr. Leo Kanner studied eleven patients who displayed symptoms of a mental disability that centered on being withdrawn from peers. In the 1960s and 1970s, children with autism were given trial medications in hopes of helping to alleviate the condition. Prior to the 1940s, diagnosed cases

of students with autism were rare; however, in the 1980's the diagnosis became more common with 4,500 new cases of autism diagnosed during that decade. Today, behavioral therapy and intervention have become the primary focus for helping students with autism, both in school and at home. Park (2012), reporting on a study by Geraldine Dawson from the University of North Carolina- Chapel Hill, stated that intervention is not a cure, but brain changes within the brain point to some drivers of ASD may be channeled toward a more normal developmental pattern.

The Diagnostic and Statistical Manual of Mental Disorders (American Psychological Association, 2013), or DSM-5, definition of autism is broken down into severity levels. The three corresponding levels of severity of ASD begin with Level I and continue to Level III. Level I in the DSM-5 severity chart is described as "requiring support," with the level being characterized by an individual who can speak in full sentences but has odd attempts at conversation engagement and often has difficulty in switching activities and routines. Level II is described in the DSM-5 severity chart as "requiring substantial support," with characteristics such as deficits in conversation and social interactions, speaking in a simple sentence, and repetitive behaviors. Level III is described in the DSM-5 severity chart as "requiring very substantial support," with severe verbal and nonverbal communication, inflexibility with behavior, and distress in changing routines and plans.

Triad of Impairments

One of the organizational structures that best describe the deficits that students with autism have in terms of interaction and communication is the triad of impairments. Pioneering work in the late 1970s gave rise to the concept of the triad of impairments as the central plank of the construct of autism impaired communication, impaired social skills, and

a restrictive and repetitive way of being-in-the-world (Cashin & Barker, 2009). These are often known as the traditional triad of impairments.

The first area in the traditional triad is impaired verbal and nonverbal communications. Communication impairment may be related to either the acquisition of words or the social use of language. For example, there may be difficulties with communication with others in their environment, although some people who have autism may have no impairment or may even be hyperlexic (Cashin, 2005). Hyperlexia is characterized by a student reading well above expectations for their age, while struggling with processing and using verbal language. This area can also focus on voice tone and quality as many people with autism have a monotone style of speaking.

The second area of the triad of impairments, impaired social skills, is significantly intertwined with the first area. One component of the second area is known as "Theory of Mind" (ToM). Baron-Cohen, Leslie, and Frith (1985), when defining Theory of Mind, state "the ability to make inferences about what other people believe to be the case in a given situation allows one to predict what they will do (p.39). This can be applied to students with autism and their inability to recognize emotions on another person's face (e.g., disgust, anger, sadness, or happiness). Theory of mind centers on body language and body stance clues that can help the other student recognize the emotion being exhibited while the two are conversing. Cashin (2005) states:

> if one cannot make such guesses about the feelings and thoughts of others, it is difficult to take part in reciprocal relationships. To engage in successful interaction, one must be aware of the needs of oneself and the other involved. People with autism

> can recognize their own needs, but have difficulty recognizing those of others, which comes across as a marked lack of empathy. (p. 15)

The third area of the traditional triad of impairments is restricted or repetitive behaviors including the inability for flexibility. Individuals in society rely on communication to relate to others. The ability to communicate with others is built upon communication skills. Interpretations of the implied routines of daily life and negotiation, such as asking for help if confused, are difficult or sometimes impossible for individuals with autism. Additionally, with the third triad of impairment, students with autism may exhibit various motor behaviors. These behaviors may consist of spinning, twisting, or flapping. As students with autism and average intelligence approach school age, the stereotypical behavior is often replaced by obsessions; however, more subtle versions of stereotypical behavior, resembling motor tics, may continue (Cashin, 2005).

Social Communication Disorder

Social communication disorder centers on those students who struggle with communication skills but may not be diagnosed as being on the spectrum. According to the American Speech Language Hearing Association (2016), social communication disorder is described as:

> problems with social interaction, social cognition, and pragmatics. A social communication disorder maybe a distinct diagnosis or may occur within the context of other conditions such as autism spectrum disorder, specific language impairment (SLI), learning disabilities (LD), language learning disabilities, intellectual disabilities (ID), developmental disabilities (DD), attention deficit hyperactivity disorder (ADHD), and traumatic brain injury (TBI). (para. 3)

The National Institute on Deafness and Other Communication Disorders (NIDOCD) (2015) identified four areas of communication patterns with children who are diagnosed with ASD:

1. Child may have repetitiveness or rigidness when communicating. Characteristics of this pattern focus on the child speaking about subjects that have no meaning or seem out of context in the situation
2. Child may have narrow interests. The child in this language pattern could talk about a topic with great expertise, but would be unable to carry on reciprocal conversation about the topic.
3. Child may have uneven language progress and development. Children with autism are characterized by some language development but in a non-normal progression.
4. Children with autism often do not interpret non-verbal cues, such as eye contact or posture.

Social Conduct

Students with autism spectrum disorder find it hard to relate and empathize with peers and have difficulty understanding and using verbal and nonverbal communication, coupled with rigidity and inflexibility in thinking, language, and behavior (Moore, Cheng, McGrath, & Powell, 2005). One of the most important reasons for helping students with autism develop the skills needed to be successful in society is that the child already realizes they are different from their peers. Myles and Simpson (2001), writing on the topic of social conduct, state that the child or youth with communication disorders, such as those associated ASD, act differently from those around them.

Social conduct is the unwritten code of conduct rules, or behaviors for social conduct, and this is often an area where individuals with autism have difficulty. The fundamental concept behind this area is based on cultural considerations (Myles & Simpson, 2001). Endow (2010) states that the "difficult thing about social rules is that they are often a moving target. The rules change depending on a whole host of variables, such as age, who you are with, gender, culture, and circumstances" (p. 6). Most people learn these rules by interacting socially with others, however, individuals with autism often do not acquire these rules due to inabilities with social interaction and communication deficits. The inability to interact with others can have a negative impact on those individuals' daily routines and lifestyles. Accordingly, this includes knowing (a) teacher expectations, (b) teacher pleasing behaviors (c) students who potentially make good friends compared to those whose actions are less than honest, (d) behaviors that attract positive attention from teachers and peers, and (e) behaviors that are considered negative or inappropriate by teachers and peers (Myles & Simpson, 2001). As described earlier, one theory behind why individuals with autism have difficulties with social conduct is known as Theory of Mind. Simon Baron-Cohen, Alan Leslie, and Uta Frith formulated this theory in 1985. They state, "by theory of mind, we mean being able to infer the full range of mental states (beliefs, desires, intentions, imagination, and emotions, etc.) that cause actions. Difficulty in understanding other's minds is a core cognitive feature of autism spectrum disorders" (p.169).

In order for students with autism to be successful with the concepts of social conduct, language acquisition is essential to the students acquiring and successfully using language to overcome the deficits in communication that they may possess.

Language Acquisition Instruction

Since language deficits can be disabling, and the acquisition of language is important for outcomes, autism interventions have focused much attention on helping children with autism spectrum disorder acquire language (Rogers et al., 2006).

Over the years, the methods in which students with autism have been instructed in language acquisition have varied in delivery. Sign language and picture exchange systems were early instructional methods for teachers and parents who worked with students with autism. Tan, Trembath, Bloomberg, Iacono, and Caithness (2014) reported that early research involving children with ASD centered on students with little or no functional speech and their acquisition of signing. As personal computer use became more prevalent in the 1980s, instruction of students with autism moved forward as this new technology was introduced into classrooms. The Internet, or World Wide Web, coupled with a personal computer added a new flare to instructional practices of teachers.

As the use of technological tools and user sophistication increases, the opportunities and advancement of education and the usefulness in everyday lives will continue to grow (Shic & Goodwin, 2015). Technology can aid in the instruction of skills needed for students with autism to be successful in social settings and with communication needs that may be characteristic of the child. Now, with the use of mobile technologies, smart phones, iPads, apps, and virtual environments, instruction of students with autism has taken the educational arena to yet another level in the instructional practices of educators. If the device is to be used as a tool, it can give the user increased capabilities by making the process easier through calculations or aiding in the selection of the correct processes (Ohrstrom, 2011).

As new technology is introduced, the opportunities for students with autism to grow and develop continue to improve. Hourcade, Bullock-Rest, and Hansen (2012) found three basic general observations when working with apps on multi touch tablets with students who have autism.

1. Technologies can help us learn more about children with autism spectrum disorder, how their minds work, and how they relate to the world.
2. Technology itself may be enough of an incentive to improve the quality of social interaction.
3. In order for the successful interaction of students and technology devices, students should have a safe space in which to learn. (p. 20).

The opportunities for success with students with autism when paired with technology depends on the guidance offered so that they can clear the "digital divide."

The Digital Divide

Information and communication technology (ICT) can be very beneficial to students with disabilities. The existence of information and communication technologies (ICT) in everyone's daily lives is an outstanding phenomenon (Charitaki, 2015). ICT not only enhances learning, but also allows for easier participation during learning activities. The benefits of ICT for students with disabilities might include: accessing online courses easily, working at their own pace, learning at home, communicating with peers easily, feeling more independent, and using materials in alternate formats (Wu, Chen, Yeh, Wang, & Chang, 2014). As researchers studied the access individuals had to technology and how they utilized the technology, the term "digital divide" was coined. In the 1990s, the term "digital divide" was developed to show the growing gap between those who had access to technology and the

Internet and those who did not have that access (Braverman, 2016). The digital divide refers to the gap created by the access to technology and how people use the technology they have access to each day. In a National Council on Disability 2011 report on the power of digital inclusion, researchers noted that not only was the digital age a great opportunity for individuals with disabilities, but also a challenge. Policymakers have shown concern for those individuals in the population who faced disparities in how information is funneled to the masses along with other social concerns, such as focusing on how the information was utilized by populations of people (Eastin, Cicchirillio, & Mabry, 2015). Concerns with the digital divide on individuals with autism can center on three distinct areas: funding for digital devices, access to digital devices by individuals, and teacher instruction and training.

Lack of accessibility is a major element of the digital divide. People with disabilities are less likely to have access to the Internet or use a computer than people without disabilities at all income levels, although this disparity declines as income rises (Kalyanpur & Kirmani, 2005). The disability itself can be a barrier to proper access to the technology. Some buildings and classrooms may not have adequate access for individuals with disabilities. For example, a person with a wheelchair may have difficulty accessing the computer lab on an upper floor if no elevator is available to help transport them to the technology. Despite the mandate for assistive technology (AT) devices and services to be made available to students with disabilities, school administrators with an eye to the needs of the larger population of regular education students often hesitate before investing large sums of money to procure computers, particularly modified units, for this minority population (Kalyanpur & Kirmani, 2005).

Teacher training is also a major element of the digital divide. Harvey (2014) reported that the use of laptop computers, mobile phones, and other devices used to share knowledge was a tremendous opportunity for students to develop skills needed to communicate and collaborate with others. Teachers must be able to integrate the technology into the lesson in a way that the two move fluidly together and the students are able not only to be successful in their use of technology but can also be an active part of the digital learning environment.

In order to tackle the challenges of the digital divide, students must have technology in the classroom to be successful. Through the use of technology, students can communicate with others. Students can use skills, such as sign language, or a technology tool, such as an iPod, to communicate. As the conversation moves from the digital divide to the ways in which students can learn to communicate, it is important to describe the different approaches that have been and are currently being used in classrooms.

Alternative and Augmentative Communication

Mirenda (2001) writes, "augmentative and alternative communication systems (AAC) (i.e., systems used by persons with disabilities to replace or supplement insufficient communication skills) are widely used to assist with communications deficits of individuals diagnosed with autism spectrum disorder and related disabilities" (p. 395).

AAC techniques available to students are divided into two categories: aided and unaided. Unaided AAC techniques do not involve any tool that is external to the body. This technique focuses on the use of drawings, gestures, and signs. Aided AAC techniques involve equipment that is external from the body, such as an iPad, topic chart, or picture exchange. Opportunities for students with autism included sign language, picture exchange

systems, and social stories. These opportunities are described in more detail in the following sections.

Early Opportunities for Learning

Before the influx of technology into the classrooms, teachers of students with autism used varying approaches to aid in the student's acquisition of language skills (each of these is still used to varying degrees). Sign language, used primarily for those with deficits in hearing, is used for some nonverbal students with autism. Social stories and picture exchange systems are also utilized as early methods for instructing students with autism.

Sign language. Although aided communication systems, ranging from low (e.g., pictures) to high tech (e.g., speech output devices), have been used with children with autism, unaided systems of communication (e.g., gestural communication or sign language) continue to be recommended as well to provide children with autism an augmentative or alternative means of communication (Schwartz & Nye, 2006). These systems also include sign language, either alone or in combination with speech; electronic communication devices; or "low- tech" communication systems that use either abstract symbols or pictures with varying degrees of symbolic representation (Bondy & Frost, 1994). Even though the concept of sign language was developed for use with individuals with hearing impairments, evidence suggests simultaneous communication training in teaching signs and speech produces favorable communication outcomes for children with autism and other developmental disabilities (Ticani, 2004). However, Seal and Bonvillian (1997) reported that the acquisition of signs is related to fine motor abilities, suggesting that children with low levels of fine motor development are less likely to benefit from this form of AAC. Ticani (2004), in an alternating treatment design study on two students with autism, ages 5 and 6, reported that

students without hand-motor imitation skills may be better served by a picture exchange system, while those students with moderate hand-motor imitation skills benefited from sign language.

Another area that is used to help students with autism gain communication skills is social stories. Social stories help students recognize areas of the hidden curriculum and build on those areas for success.

Social stories. Students with autism often struggle with social situations due to impairments in recognizing emotions, facial expressions, body cues, and communication. The use of social stories has presented yet another method for these individuals to learn proper methods of communication and interaction with peers. Gray (2010) defines a social story as: a situation, skill, or concept in terms of relevant social cues, perspectives, and common responses in a specifically defined style and format (p. 2). Social story research has shown contrasting conclusions when focusing on the growth of interaction and communication skills in students with autism. In a study by Hanley-Hochdorfer, Bray, Kehle, and Elinoff (2010), three elementary school children and one middle school child were exposed to social story interventions. Social behavior and verbal interaction with others was the focus of the study and the results were inconclusive as to the effectiveness of social stories. However, a multiple baseline study by Wright and McCathern (2012) concluded the effect of social story use with 4 elementary-aged students with autism (ages 4-5) had a positive outcome for building social and communicative skills. Doyle and Arnedillo-Sanchez (2011) utilized social stories from the "Reach and Teach" program to better serve students with autism. Their findings demonstrated that social stories developed using computer-based

instruction were successful in aiding students in areas in the hidden curriculum where they may have deficits.

Parallel to the area of social stories is the technique of cartooning, which is also used to help students learn communication skills. Cartooning and the use of cartoon strips with students with autism are another intervention for teaching students about the rules, communication techniques, and concepts of the hidden curriculum. Rogers and Myles (2001) state these techniques turn an abstract situation into a concrete representation that allows for reflection. Social stories use a brief narrative that describes a situation, relevant social clues, and responses. Along with social stories and cartooning, students can also use picture exchange communication systems (PECS) to aid in communication skill growth. PECS is often one of the first interventions that students use in order to build communication skills.

Picture exchange communication system. Bondy and Frost (1985) define PECS is a pictorial system used by students with communication disorders. The use of pictures to relay what the child wants characterizes this system, with the ending phase focusing on the child making vocalizations to questions asked of them. PECS contains six phases, with each one building on the previous phase. To begin using a picture exchange system, a reinforcer sample is completed. The sample is an inventory of the items of interest to a child, which can be compiled through observations or interviews with parents or teachers who work with the child. Bondy and Frost (1985) explain the six steps of PECS through phases:

- Phase 1: the initial step in the PECS technique in which the student actively picks up a picture card and hands it to the person with whom they wish to communicate
- Phase 2: the child still uses the picture cards with new communication partners and across distance (child has to bring picture across the room)

- Phase 3: the child is given two or more pictures from which they will need to make a decision
- Phase 4: the child begins simple sentence formulation using "I want"
- Phase 5: PECS aids the child answering the question "What do you want?"
- Phase 6: the child begins to make comments to a communication partner in response to the questions "What do you see?" or "What do you hear?" (p. 6)

Greenburg, Tomaino, and Charlop (2013), used a multiple baseline design to study frequencies of vocalizations among four males with ASD and limited verbal communication skills when exposed to PECS. They found that three out of the four males had higher frequencies of vocalizations after using the PECS than at the beginning baseline. In a study by Lerna, Esposito, Conson, Russo, and Massagli (2012), 18 preschool children (mean age of 38 months) were divided into two groups, with one group exposed to PECS and the other to Conventional Language Therapy (CLT). Conventional language therapy is a systematic teaching technique using prompts from the adult through simple instructions. Students in the study participated in treatment for 6 months, three times a week for 30 minutes. At the conclusion, students who were exposed to PECS (stages I-IV) improved on social-communicative skills and showed higher scores on the VABS (Vineland Adaptive Behavioral Scale) social domain as compared to those exposed to CLT only.

In the current digital age, opportunities for students to utilize technology for communication are plentiful in number. Computers, tablets, smart phones, and iPods are now large players in the arena of communication for students with autism. These types of tools will be discussed in the following sections.

Current Opportunities for Learning

In recent years, advancements in classroom technology have been integral in helping students with autism learn appropriate communication techniques. Computers, tablets, smart phones, and mobile files sharing devices (such as the Apple® iPod) have been introduced to students with communication disorders at an intensely fast pace. As personal digital assistants and smartphone devices are now being used for task management, opportunities to study these devices have been outpaced by the rapid deployment of the technology (Gentry, Lau, Mollinelli, Fallen & Kriner, 2012). In order for these tools to be used effectively, the students must possess the digital literacy skills to be successful in their utilization of the technology.

Digital literacy. Recent developments in mobile technology, with the introduction of tablet technology such as the Apple® iPad, along with smartphones, have provided many new tools for communication for students (McNaughton & Light, 2013). This finding is true for all students, especially those with developmental disabilities. New developments open up new arenas for learning that can have an impact on the growth of communication and social skills. In order for students to successfully use the technology to aid in situations where communication skills, recognition of emotions, or social skills are needed, they must understand how to manipulate the digital device. The building of these skills begins with digital literacy. Eshet-Alkalai (2004) defines digital literacy as a survival skill in the digital era.

> It constitutes a system of skills and strategies used by learners and users in digital environments. By employing different types of digital literacy, users improve their

performance and 'survive' a variety of stumbling blocks that lie in the way within this special medium. (p. 28)

The large numbers of smartphones, iPads, iPods, and other handheld devices have led to the creation of digital learning and digital literacy opportunities. Many students handle some type of mobile device daily, whether they are at home or in a learning environment. Technological advances led to the development of tactile digital interfaces, which tap into the somatosensory system, the iPad being amongst the most widely adopted at the current time (Flewitt, Kucirkova, & Messer, 2014). The somatosensory system is comprised of receptors throughout the central nervous system that respond to changes at the surface or inside the body. Through these skills and strategies, digital literacy has started to influence daily school practices. Classroom teachers are now lobbying for more technology in the classroom. Wang (2016) reports that 84% of teachers at the K-12 level use some type of technology in their lessons. Digital literacy continues to set the foundation for how students communicate, complete homework tasks, and interact on social media. Students are now interacting with instructors via video or an online classroom. According to Bruce and Casey (2012), "digital literacy has a power dimension: in the last few decades, it has transformed from technical or specialist literacy into an everyday literacy" (p. 22). There are daily opportunities to practice digital literacy skills. Opportunities to use technology help build digital literacy for each student.

Eshet-Alkali (2009) identified six areas that users of technology encounter when digital literacy is put into practice. The six areas are:

1. Photovisual literacy is the ability to work with digital interfaces, that employ graphical communication.

2. Reproduction literacy is the ability to create authentic, meaningful art work by reproducing pre-existing digital text.
3. Branching literacy is the ability to construct knowledge by a nonlinear navigation through knowledge domains, such as the internet and other hyper-media environments.
4. Information literacy is the ability to consume information critically and sort out false/biased information.
5. Socio-emotional literacy is the ability to communicate effectively through online communication platforms, such as discussion groups and chat rooms.
6. Real time thinking skills is the ability to process and evaluate large volumes of information in real time, such as a computer game or chat room.

Digital literacy skills can be a challenge to students with autism or intellectual disability. Park and Nam (2014) state that "a digital environment might help disabled individuals overcome obstacles and become better integrated in society: it can also personally isolate them, leading to social inequality" (p. 7). The ability to simply have access to technology can be a stumbling block for individuals with disabilities.

Digital literacy skills help the students successfully use a piece of technology. Students today function in environments that are ingrained with texts and are constantly confronted with complex and challenging reading, writing, and literacy opportunities, often simultaneously (Buckley, 2014). Cihak, Wright, McMahon, Smith, and Kraiss (2015), using a multiple probe study with three high school students with intellectual disabilities, found that three areas of digital literacy mastery could occur via digital literacy instruction. Those three areas are email, social bookmarking, and cloud storage. Student instruction in digital

literacy can help to bring the students up to speed on how to use tools to communicate with others around them. The students learn how to branch out with the technology in order to better serve themselves and others through the correct use of technology. Computer instruction is often one of the beginning interventions that teachers use to help students with communication skill acquisition.

Computer-assisted instruction. Computer-assisted instruction is another method teachers can use to instruct students with autism. Pennington (2010) highlights the fact that "computer programs can be used to highlight, slow down, and repeat social cues, thus teaching social contingencies in controlled formats" (p. 4). The computer becomes a vehicle that can be used to build individual skills in communication, socialization, and comprehension. The fact that most children, including those with ASD, show an affinity for computers has led researchers to recognize the potential of computer technology as an effective and efficient tool in research and treatment (Ploog, Scharf, Nelson, & Brooks, 2012). Researchers have suggested that the controlled presentation of instructional stimuli during computer-assisted instruction may benefit learners with low incidence disabilities (Moore, McGrath, & Thorpe, 2008).

In a multiple probe design study of simultaneous prompting by Pennington, Stenhoff, Gibson, and Ballou (2012), a 7-year-old student with autism used a sentence building program for four weeks to aid in sentence development and construction. The student had no sentence construction skills at the start of the intervention but, after the intervention, was able to write 13 words and 3 sentences on the word processor program.

Computer-assisted instruction plays a role in the development of student's communication and social skills. Students with autism may have difficulty with social

situations that involve some form of problem solving, however, they are skilled in responding to pictures and other visual cues (Bernard-Opitz, Sriram, & Nakhoda-Sapaun, 2001). As technology continues to develop and become a stronger tool for educators to use, handheld mobile technology use continues to gain speed. These handheld devices range from small iPod devices to iPad tablet technologies.

iPod technology. On March 10, 1997, a precursor to the iPod, the Palm Pilot was introduced to the world as a new way to stay organized with calendars and other tools that could be held in the palm of the hand. These devices helped launch a handheld technology revolution. Many professionals and students used the Palm Pilot as a daily tool to manage aspects of their personal and professional lives. The Palm Pilot was one of the first digital devices used by students in schools. Students in regular education classes, students in classrooms for those with disabilities, and students learning English as a second language used the Palm Pilot as a method of instruction. From the concept of the Palm Pilot, newer and more advanced technologies started to take shape. The iPod, first introduced in 2001 by Apple®, is an external data and media file storage device. Students in differing learning environments also utilized the iPod device. Patten and Craig (2007) state, "considering the large number of immigrant students entering public schools, one cannot overlook the potential value of the iPod in assisting students who are entering a new school environment, learning English as a second language, and becoming familiar with a new cultural environment" (p. 2). The iPod, which is available in several different versions, such as the Classic, Nano, Mini, Shuffle, and Touch, can be used for music, games, apps, email, texting, and video. These devices, along with the introduction of the Apple® iPad and other tablet devices, may not have started the handheld revolution, but they helped to kick start the

arrival of more advanced systems of technology in the classroom, such as up to date tablets, video modeling, wireless headphones, and virtual environments.

The iPod is also a tool utilized for those individuals with disabilities to make everyday life and communication easier. Gentry et al. (2012), examined iPods as a vocational support aid for adults who have autism, and found the device helped to support the needs of individuals in the workplace and home. They state, "it seems evident that people with cognitive-behavioral challenges may benefit from a judicious assessment, product customization, and training process that includes supported utilization and follow along in the workplace" (p. 35).

Tablet technology. Mobile technology is bringing communication strategies in reach for many more students, allowing them to find a voice (Stuart, 2012). A more advanced tablet with further capabilities has emerged in classrooms beginning in the mid 2000s. Tablets, typically much larger than the iPod and with more opportunities and new apps, can be used as a device for students with communication disorders. For students with poor fine-motor skills, the touch screen is easier to use than a desktop with a mouse or a laptop touch pad (Shah, 2011). According to Rushowy (2012), the new generation of computer technology can be used to improve learning while giving children a voice with apps that "talk" for them. Tablets, especially the Apple iPad, quickly are becoming a valuable therapy tool for those with cognitive-communication deficits (Atticks, 2012). With the large influx of tablet technology into the everyday schedule of these students, the opportunities for fresh research are becoming available on a daily basis.

One of the most popular tablets is the iPad, which was designed and developed by Apple®. The iPad serves many purposes, including email capability, gaming, music,

pictures, videos, and app downloading, which can center around interests of the user (i.e., games, books, or maps). The size of the tablet interface has made digital literacy easier to accomplish than in the past. iPads are easily transported, carried, and utilized once inside the classroom. Unlike more cumbersome equipment, such as desktop computers, interactive white boards (IWB's), and augmentative communication devices, the lightweight iPad has afforded mobile, independent, and flexible use (Flewitt et al., 2014).

The iPad can also be used as a speech-generating device for students with autism. Waddington et al. (2014) reported that functional communication skills can be taught to children with ASD who have limited or no speech via systematic instruction with the iPad. The study focused on three elementary aged male students with autism who were characterized by little or no communication skills. In order to determine whether systematic instruction involving prompting, time delay, and error correction was effective, the researchers utilized a multiple baseline across participants design. After the intervention was complete, all the children showed improvement in performance. The results suggested that the instructional protocol needed to be modified for more individualization. Overall, the study showed favorable results for use of the iPad tablet as a resource for teaching communication skills.

Tablets can also be used in tandem with PECS to help students acquire the skills needed for communicating requests to others. King et al., (2014) completed a study with the iPad and the Proloquo2Go™ app. Three students with autism, ages 3-5, in a multiple probe research design, were exposed to the PECS intervention through the iPad. The multiple probe design compared data that was collected during the baseline and the intervention phases. The intervention consisted of teaching the students to push the buttons on the iPad, picking up the

iPad and taking it close to the researcher and pushing the button to request an item. The phases also included requesting preferred and non-preferred items, discriminate between multiple preferred items, and using "I want" along with the pictures of the preferred items. Results showed that the students acquired requesting skills and increased vocalizations when making requests using the iPad and the accompanying app.

The iPad, however, is helpful only with proper teacher planning and commitment on instructing the students on how to properly use it. iPads can supplement learning however, the technology may not have the desired impact on learning if the levels of the students using the technology is not taken into account by the instructor (Powell, 2014).

Tablets can also be used for video modeling, which has become an integral part of helping students learn to communicate effectively. These students can use videos to help complete desired tasks and steps to be successful when communicating expectations to themselves and others around them.

Video modeling. Video modeling with handheld devices is a current intervention in the aid of the acquisition of social skills and communication techniques in students with autism. Studies have shown that video modeling is effective in instructing individuals with autism to manage skills for social and self-help situations (Besler & Kurt, 2016). Video modeling involves a video showing desired tasks completed correctly. The individual with the handheld device is able to view the video and imitate the correct sequence of behaviors. For example, the behaviors could focus on correct social interaction, correct communication techniques, or accurate distinguishing of facial or body cues when interacting with others in a group. Portable devices also allow students to use video prompts to learn new skills and complete learned skills with relative ease (Hammond, Whatley, Ayres & Gast, 2010). Along

with video modeling, video prompting is an intervention for teaching skills to students with ASD. Video prompting provides the user with ample opportunities to practice a skill (Giess & Poretta, 2015). Video modeling and video prompting, though often used in conjunction with instruction, are two different techniques. Video modeling involves the wholesale modeling of the desired behavior, whereas video prompting involves a short video clip of one step of the desired technique or behavior.

Jowett, Moore, and Anderson (2012), using a single subject, multiple baseline design approach, found that a high level of skills acquisition occurred when video modeling was utilized to teach the numbers 1-7 to a 5-year-old student with ASD. During follow-up sessions, the student continued to perform at a 93% and higher success rate on tasks involving the numbers

1-7. Hammond et al. (2010) used a multiple baseline study involving three students ages 12-14 with intellectual disabilities, focused on the use of video modeling to instruct students to navigate an iPod to find music, videos, and photos. Results of the study reflected a functional relationship between video modeling and an increase in the successful steps being used to move through the interface. Nikopoulos and Keenan (2007) used a multiple baseline study to test video modeling to teach social skills sequences to three students with autism, ages 6 to 7. Results showed an increase in the correct behaviors being used in the social sequence. Cihak, Fahrenkrog, Ayres, and Smith (2010), using an ABAB design study, focused on the use of video modeling with an iPod to improve social sequences in four elementary aged children, ages 6 to 8. Results indicate that video modeling with the use of an iPod resulted in independent transitions throughout the school day. Along with video modeling, virtual environments are also used extensively with students to aid in helping them be successful in

social settings through communication and interaction. Virtual environments will be discussed further in the following section.

Virtual environments. Virtual environments offer opportunities for students with autism to grow in the areas of social interaction and communication. Actively participating in a virtual environment allows students to interact in a social situation similar to one the student may find him or herself in real life. This experience can lay the groundwork for the student to build confidence in these types of situations. Perhaps the most important advantage is that users can role-play in an environment designed to mimic specific social situations (Parsons, Mitchell, & Leonard, 2004). The virtual environment method of instruction allows users to interact with a 3-D computer world coupled with up-to-date graphics and design. These types of settings allow the student with autism to access a situation on the computer and work to overcome the communication or social anxiety that come along with those situations in the real world. Ringland and Hayes (2014) state that "using virtual worlds as a form of social support and means of communication is one important avenue of exploration because it is already a pervasive practice and can inform future design of communication systems for this population" (p. 1). There are several positive outcomes for students with autism when using the virtual environment. The virtual environment is accessed in a safe situation, in which a teacher or teacher assistant can be of assistance. Also, the virtual environment is accessible by students who are handicapped. Although some scenarios call for students to access the scenario in a "real world" frame, the virtual environment allows the student who may be confined to a wheelchair the opportunity to complete the scenario without leaving the classroom. Cheng, Moore, McGrath, and Fan (2005), in a study that focused on avatar emotion use with students with autism, found that of the 10 students with

autism who used an avatar in the virtual environment, eight were successful in choosing the correct emotion on the avatar. The connection between emotion and avatar shows growth in recognizing emotions and applying them to real world situations.

From video modeling and virtual environments, the next step is to describe the literature associated with apps. In order for these technologies, such as iPods and iPads, to aid the students who are using them to learn the skills needed for growth, apps on the devices should be research based.

Apps. Apps have added another method to the ways in which students with autism are instructed. The iPad, iPhone, and Android devices are designed with mobile phone operating systems that extend capabilities by enabling the user to complete tasks using apps (Purcell, Entner, & Henderson, 2010). There are thousands of apps available. Powell (2014) claims the real challenge happens when users have to choose apps that are pedagogically based from the many apps available online. The evaluation of commercially available software is often lacking in academic research (Higgins, Boone, & Williams, 2000). The literature often focuses on the usefulness of the apps when used by students with autism and the fact that not all apps are research based. Cashin (2005) states, "because attempts to establish the effectiveness of treatments have only occurred after treatments are in place, most research struggles to keep up with the marketplace" (p. 11). The marketplace in this context refers to the venues in which technology is purchased and utilized. The unrestricted development of apps results in unpredictable quality. Though research has not kept up with the rapid pace of product development over the past few years, the potential for the use of these devices as an assistive technology is readily apparent (Gentry et al., 2012).

King, Thomezak, Vories, and Scott (2014) concluded that with the growth in technology outpacing research, education professionals are putting iPads and apps into use in the classrooms without research guidance on how to do so effectively and efficiently. Wendt and Miller (2014), in a review of empirical support documents for apps, stated that with the fast introduction of new mobile technologies into the classroom, there comes a need for the practitioners in the classrooms to select the apps that are supported by empirical evidence. Wendt and Miller (2014) later wrote that selecting a suitable mobile/tablet and app solution out of the plethora of available offerings can already be a daunting task, but finding those that have research backing them is the greatest challenge they face. Gosnell, Costello, and Shane (2011) identified four areas to consider in making an informed app purchase for students with communication disorders. Those areas include identification of strengths and needs (current and future) of the individual using the app, comparison of the features of available communication apps, matching of the needs and strengths to the app, and trials to determine the appropriateness of the app for the individual. One noticeable omission from the four areas is evidence of research-based analyses being used in the development of the app or review of research associated with the app to show its effectiveness.

When prepping for app use in the classroom, teachers must develop plans that meet or exceed the learning goals and targets for the students in their classrooms, especially those students with disabilities. The plans must all connect to the students IEP. Teachers often move towards learning without considering the physical, sensory, emotional, or behavioral needs that must be understood for students with disabilities to successfully use these apps (Powell, 2014). In order for the students to find success in the integration of technology into

their daily lives, the classroom teacher will need to find a delicate balance when instructing students with disabilities to utilize the apps.

Conclusion

Autism is a disorder that affects many children and families. Ulke-Kurkcuoglu (2015) states, "one of the fundamental problems of individuals with autism spectrum disorder is the failure of social interaction and communication skills" (p. 500). From the earliest methods using sign language to the recent introduction and use of tablet devices, researchers in this field are continually looking for innovative ways to help instruct both the students and parents on methods to ease the flow of the child's daily routine and facilitate communication. These innovative methods, combined with teacher planning and professional development, can lead to a positive experience with digital learning.

As researchers in the field of autism look to the future, they must put a critical eye on the manners and methods of instruction for students with ASD. As students with autism are being prepared for accountability assessments across the nation, there is an increasing need for best practice instruction in the classroom (Finnegan & Mazin, 2016). Funding and access to the technology are two critical pieces that must remain the focus to which everyone involved is committed if instruction of students with disabilities is to be successful. Educators and school leaders must develop ways to implement digital literacy and overcome the obstacles of the digital divide. If teachers feel comfortable integrating the technology into the curriculum, many concepts and goals can be taught and successfully accomplished by the teachers, parents, and students.

Autism research can be completed using different research designs. The most common type of research design used when studying individuals with ASD is a single subject

research design (SSRD). These designs allow for a degree of experimental control and provide information beyond the traditional descriptive case study (Horner et al., 2005). The topic of single subject research when utilized with students with autism will be expanded further in the methodology section.

With the technology currently present in classrooms, the opportunities for growth in communication with students who have autism should be meaningful. Apps that are used for student instruction should show not only their effectiveness when instructing students but also that they (apps) have been designed using research based criteria. Many times, the apps that are developed are not researched based. The reviews of the apps included on the website contain only anecdotal data and observations.

The current study investigated the processes through which apps are selected and a study of the use of the Avatalker® communication app on the iPad to increase verbalizations when used by students with autism. This will give insight into the apps that are being used and whether they are indeed effective in aiding students to communicate. This research helped explore the use of apps to increase verbalizations in students with autism and characterize key elements needed for selection of apps. This will help school leaders and educators make more informed decisions on the direction of instruction and supplemental decisions for children with autism.

Chapter Three: Methodology

Overview

One method that educators have utilized to help accommodate the needs of students with ASD is through the implementation of technology, especially tablets, into the learning environment. These types of technology are entering the school environments at a fast pace. It is inevitable that the promotion of technologies will assist in supporting students on the autism spectrum (McCleery, 2015). Each day, more tablets, computers, interactive boards, and mobile file supporting devices, such as iPods, are placed into the hands of students, especially those students with autism. Goldsmith and LeBlanc (2004) report, "some technology-based interventions are designed for indefinite use as an assistive tool (e.g., voice-output, augmentative communication devices, microswitches, etc.) while others are introduced as a temporary instructional aid to be removed once the goal of behavior change has been met" (p.166). Blended learning, which mixes traditional curriculum and web-based learning, has filtered down into the early elementary classrooms. Supraha and Subramonian (2015) reported that blended learning offers a great opportunity to weave the advances that technology devices offer with the collaboration of traditional learning. With the influx of technologies into the classroom, the creation of apps, which are downloaded on the devices, has exploded. Since the number of apps available to users continues to grow, this study had two main focal points. The first focal point centered on what characteristics teachers were looking for when choosing apps for student use. The second focal point centered on the use of the Avatalker® app when used to increase student verbal interactions when used by students with autism. The methodology and design for the following research questions are

explored in this chapter. In order to effectively address each question; a separate methodology description will be given for each one.

Methodology for Research Question #1

The first research question for this study is as follows: When searching for apps that focus on communication to use with students diagnosed with ASD, what key elements must be encompassed in the iPad app in order for it to be chosen by the teacher of students with autism for the student's educational plan?

Information needed and data resources. Surveys were employed for data collection for research question #1. In order to better identify the decision-making process that teachers of students with autism use when selecting apps, a survey was used to ask questions specifically designed to explore the characteristics evident in the selection of tablet apps. The survey consisted of 10 questions that focused on the teacher and the decision-making processes they used for choosing apps for use by the students they instruct (see Appendix A). Follow-up interviews were conducted with participants based on a descriptive and qualitative review of the data from the surveys. The questions used during these interviews were tailored to gather additional insight and context surrounding the issues that were raised in the survey responses.

Data collection plan and methods. The data collection plan and methods used for the study are described in detail in the following section. The methods used include surveys and follow up interviews.

Access and recruitment. Access to the teaching staff of the school was requested during the opening meeting with the county-level leadership. During the initial meeting, a synopsis of reasoning for the research study was presented to district-level leadership. Upon

gaining approval from the superintendent to complete the study, school-level administration, classroom teachers, and teacher assistants were presented with an overview of the study and data collection strategies. During this presentation, the research design was also shared and how the findings from the study could assist the school and county to make more informed curricular decisions for students with ASD.

Surveys. Once the setting was secured and all adult subjects involved were informed of the purpose of the study, surveys were given to all teaching staff that instruct students with autism. The surveys contained the questions listed in the Information and Data Needed section of this chapter. The surveys were distributed to staff during a scheduled staff meeting. Staff had the opportunity to complete the survey on site and return the survey to the researcher at the conclusion of the meeting. This ensured a high survey completion rate and teachers would complete the survey in a timely manner in a scheduled setting (see Appendix B).

Follow up interviews. Following the survey, interviews with a select group of teachers was conducted. These interviews focused on the five open-ended questions listed on the survey. Teachers had another opportunity to expand on their responses to the questions. These responses were coded to identify emerging patterns in the data. The interviews provided opportunities for teachers of students with autism to speak candidly to the researcher about organized topics and areas of inquiry focusing on students' with ASD use of technology and feelings about apps on the tablet for their use. The purpose of an in-depth interview is not to pilot hypotheses, but rather to understand experiences of people and how those individuals use those experiences to make meaning of a topic (Seidman, 2006). Interviews with teaching staff took place at the school, where students with autism are

served. The interviews were recorded and are preserved. Using a pseudonym, such as "Interviewee A," protected the anonymity of those interviewed.

All teachers interviewed for the study were given a form granting consent to the researcher to use their responses for the purpose of the research study. Each consent form contained a section on accountability of the researcher for confidentiality purposes. The researcher did not share legal names, responses, or taped interviews of any teacher during the study (see Appendix C).

Method Summary. The survey used for data collection for research question #1 provided insight into the decision-making processes of teaching staff when selecting an app for student use. The responses given helped to bridge Research Questions #1 and #2. The bridge helped provide insight into selection criteria and the effectiveness of the selected app (AvaTalker®).

Data Analysis

The following section describes the data analysis methods used to analyze data for this study.

Coding procedures. Upon completion of the surveys, the researcher conducted a descriptive analysis of the Likert-type scale responses. During the review, the researcher focused on reoccurring themes in the responses. Additionally, the researcher conducted a qualitative review of the open-ended responses in order to determine if there were any themes that arose from the surveys. The themes helped develop an overall arch that shows the criteria and decision-making process of the educational staff making curricular decisions for students with autism. The follow up interviews were recorded and transcribed. Following transcription, the interviews were coded to identify significant themes that emerged from the

data. The identified themes within the interview transcriptions aided in pinpointing the criteria that teachers used to identify apps for student use.

Interpretation and synthesis of data. The coding process of the survey responses helped to bring out specific themes within the teacher responses. These themes were used to find overarching themes into teacher decision-making when selecting apps for student use in the classroom.

Through descriptive analysis, the data gathered from the survey aided the researcher in focusing on patterns that developed in the responses. The questions on the survey centered on teacher comfort levels in selecting and utilizing apps for use with students diagnosed with autism. Teachers answered the survey questions with Likert-type scale ratings. The options for the question responses were: Strongly Disagree, Disagree, Agree, Strongly Agree, and Not Applicable. The patterns that emerged from the survey helped to shed more light on teacher attitudes when searching for research-based apps for use with students. Also, teachers responded to five open ended questions focusing on app selection criteria. Space was also available on the survey for teachers to write any general comments that they felt appropriate.

Rationale for Methods Selection

For research question #1, the survey method provided an opportunity for teachers to respond to questions focusing on decision-making when selecting apps for students with autism to use in the classroom. The survey took less than 10 minutes to complete. The survey method of data collection aided the researcher to drill into the survey responses to find overall themes.

Trustworthiness

Surveys were used in the study to collect data on teacher decision-making when selecting apps. Mora (2011) reported on three areas that must be addressed when surveys are used for data collection: content validity, internal validity, and external validity. Content validity centered on creating questions that focus on the issue being studied. During this study, threats to internal and external validity did not play a role in outcome of the survey. The intention of the survey was not to generalize but to determine the processes the school and staff use for app choice. The survey was not used as part of a pilot program. Other threats, such as maturation, mortality, and becoming test wise through the study, did not play a role in the validity of the study. Threats to external validity, such as multiple treatment interference, did not play a role as the basis of the study centered on one intervention (AvaTalker® app) being used throughout the study.

Methodology for Question #2

The second research question for this study is as follows: Will verbal interactions increase in elementary aged students with autism when using the Avatalker® iPad app?

Information needed and data resources. Research question #2 focused on the use of AvaTalker® AAC, a communication app for the iPad, at increasing verbal interactions when used by students with ASD. In order to study the app, information and data were collected throughput the study. Strategies to gather information and data for the study included observations and trials of repeated measure.

Data collected during the research study focused on the use of the AvaTalker® iPad app to increase verbalization in students diagnosed with autism. The methods used for data collection for research question #2 helped to establish the evidence needed to explore the app

and to characterize the key elements needed in communication apps chosen for use in the classroom for children with autism. Through the collection process and the final assessment of data, educators, parents, and school leaders will review the outcomes and make more informed decisions on the direction of instruction and supplemental materials for the children with ASD who are present in the school district.

Data Collection Plan and Methods

The research project employed a variety of data collection methods to address each research question. Observations provided data on the use of the tablet by the students with ASD and communication opportunities of the students throughout the day. Trials were utilized to measure skills acquired through the use of the app. Data collected was used to demonstrate the use of the AvaTalker® app to increase verbalizations and a better understanding of the decision-making process of educators selecting apps for student use.

Access and recruitment. Access to the student population for the research study was accomplished during the initial meeting with the school district superintendent. Before data collection began, the researcher met with parents of the students in the classroom to share reasoning for the study and to establish a relationship of trust and professionalism between the researcher and parental figure. During each parental meeting, professional and ethical guidelines were established, concerns documented, and any questions the parent(s) had were answered. At any point in the research process the researcher was available if the parent(s) had questions or concerns about the research process. Parents also signed informed consent release forms; additionally, they were informed that they had the ability to remove and opt out of their child being included in the study at any time. Parent permission was also requested for viewing of speech, reading, or academic assessment completed by the child.

After the site was selected and all individuals involved in the data collection were briefed on the study, recruitment of the students with ASD occurred. The classroom teacher provided data that pared down the subject list focusing on certain traits that the child must possess to be given the treatment. The students selected were elementary-aged students with diagnoses of ASD, aged 7-8, who had limited verbal communication skills. It was assumed that the children in the study were on Level II or Level III of the severity levels from the Diagnostic and Statistical Manual of Mental Disorders (American Psychological Association, 2013). Once the student sample was secured, data collection started.

Observations. Observations were conducted throughout the study. Fox (1998) stated, "observation does not just involve vision; it includes all our senses, although in practice, sight and sound will be those which predominate in most research. And crucially, it also involves the interpretation of that sense data" (p. 2). According to Driscoll (2011), "observations have led to some of the most important scientific discoveries in human history. Today, social scientists, natural scientists, engineers, computer scientists, educational researchers, and others use observations as a primary research method" (p. 160).

From the initial meetings with the superintendent and principal, the need for observations in the classroom and throughout the school setting were crucial for the success of the research study. Once the researcher gained access to the classroom, and after opening interviews with teachers involved in the study, the observation phase of the study began.

Initially, a general observation of the school environment, campus, cafeteria, gymnasium, and classrooms was completed. This aided in understanding the areas that the students with ASD encounter throughout the school day. In conjunction with the overall school campus observation, the classroom observations allowed an opportunity to view the

students inside the classroom environment. Inside the classroom, the student's behaviors, socialization, and communication levels were observed.

Single subject research. Single subject research with repeated measures were utilized to measure the verbalizations of students with autism when using the Avatalker® app. In order to maintain a valid and reliable measurement, repeated trials with several participants took place during the study. Replicating an investigation across several different study participants can help researchers examine generalizations of the effects of treatment. This aided in enhancing the external validity of the investigation (Byiers, Reichle, & Symons, 2012).

The focus of single subject experimental research is to evaluate the effects of an intervention on one person thus the growth of each individual participant can be evaluated (Neuman & McCormick, 1995). To further investigate research question #2, a single subject research design was used. Single subject research has been widely used since the 1960s. Horner et al. (2005) state, "single subject designs may involve only one participant, but typically include multiple participants (e.g., 3 to 8) in a single study" (165). Single subject design has an expansive history focusing on research in the areas of communication sciences and disorders (Byiers, Reichle, & Symones, 2012). Single subject research design is a useful design when the researcher is attempting to change the behavior of a person, or a small group of people, and document the change during the process. It is commonly used in special education classrooms (Siegle, 2015). Single subject research designs often study more than one individual person to allow for opportunities to generalize findings among other potential benefits. One important aspect of a single subject design is that each individual serves as his or her own control in the experiment. Horner et al. (2005) define single subject research as "a

rigorous, scientific methodology used to define basic principles of behavior and establish evidence-based practices. Single subject research has proven particularly relevant for defining educational practices at the level of the individual learner" (p. 165). Gillis and Butler (2007) report that single subject designs can be particularly useful when conducting research in applied settings, which is often the case in the evaluation for individuals with ASD. McMillan (2004) summarized five important characteristics of single subject designs that demonstrate the satisfactory nature of these designs. The five characteristics are reliable measurement, repeated measurement, description of conditions, baseline and treatment conditions, and single variable rule.

Single subject designs typically involve multiple measures of behavior; therefore, it is important for the instrumentation used to gather data to be consistent and reliable. This could include an observation log, frequency chart, or checklist. It also includes consistency on the time of day that the data is collected. Also in single subject designs, the same behavior is measured repeatedly. The researcher looks for clear patterns or consistencies in a subject's behavior over time. A comprehensive description of the study's measurement and treatment conditions are essential to enhance the study's validity. The baseline represents a period of time during which the dependent variable is recorded without any intervention. The treatment condition is a period time which treatment or intervention is introduced and dependent variable continues to be recorded. The single-variable rule focused on one variable being introduced to the study participants after the baseline phase and studied in the intervention phase.

Trials of repeated measure. Trials of repeated measure were utilized to determine the use of the AvaTalker® app to increase verbalizations in students with autism. The ABAB

(reversal) experimental design was employed during this phase of the research study. The design was structured as follows:

A- (Baseline) The students were observed prior to any intervention/treatment being introduced.

B- (Treatment) The students were introduced to the intervention/treatment.

A- (No Treatment) The intervention/treatment was removed from student use.

B- (Treatment) The treatment/intervention was reintroduced to the student.

Observations of the students were completed in the beginning to establish the baseline. Each student was observed three times a week for 30 minutes for a 3-week time period. The students in the research study demonstrated characteristics of severity levels Level II and III of the DSM for ASD. The students were either nonverbal or they would use attempts at a spoken word(s), though minimal in number. During the observation, the number of attempted verbal utterances with teachers and peers in the classroom was recorded. The interactions, which focused on attempts at utterance by the student, were recorded on a frequency chart that was included in the researcher's journal and was also included in the Appendix of the final copy of the research results.

The students were introduced to the AvaTalker® app on the iPad in the first treatment phase of the research. Each student had 3 weeks of daily classroom exposure to the app. The cooperating teacher used the app with the students during the instructional day. During this phase of the study, students were observed on the same schedule with attempts at verbal utterances between the student, teaching staff, and peers recorded on the frequency chart.

Following an introduction of the app and a time span to use it, the app was removed from the students' iPad device for a 3-week time span. The students continued to be observed

on the same schedule. Verbal utterance attempts between students, teaching staff, and peers were noted on the frequency chart.

After the 3-week time period expired, the app was downloaded onto the students' iPad device and they had an additional 3 weeks of exposure. During this time, the students continued to be observed on the same schedule. Verbal utterance attempts that took place between the students and teaching staff and peers were recorded on the frequency chart (see Appendix D).

Research journal. Notes scripted during observations were kept in a research journal. The notes aided in building an understanding of communication levels of the students, along with other information gathered through observations and interviews that took place during the research study. Information recorded in the research journal provided information, observations and data used for analysis. Willis, Inman, and Valenti (2010) stated, "it [the research journal] is an important source of data for you when you begin to analyze data and write up your results" (p. 304).

Method summary. Using the methods in this section, data was gathered through observations and measured trials with the Avatalker® app on the tablet. The collected data was placed into tables and charts to show trends in communication levels with the student. Analysis of the data showed trends in levels of communication in students with autism and the usefulness of the app in aiding growth in those students who struggle with communication in their daily lives.

Data Analysis

The following section describes the data analysis methods used to analyze data for this study.

Coding procedure. All data collected for the interviews and surveys were analyzed using coding. Saldaña (2013) defined a code in qualitative inquiry as "most often a word or short phrase that symbolically assigns summative, salient, essence-capturing, and/or evocative attributes for a portion of language based or visual data" (p. 3). Data was collected through several methods. For the research project, staff interviews; staff surveys; classroom observations; and measured trials were employed to gather data. Accordingly, Saldaña (2013) listed several ways that data can be gathered for future analysis: interviews, transcripts, participant observation, field notes, journals, documents, drawings, artifacts, photographs, video, Internet sites, email correspondence, literature, and so on (p. 3).

The researcher analyzed coding components of the research study. Coding software programs were not used. It was a deliberate choice to use 'human coding' because "the use of computer software programs has limited value for analyzing qualitative data. These programs are good for tabulating words and phrases, but the programs cannot substitute for your own ability to identify specific meaning units in transcripts that are concepts, ideas, and beliefs" (Wargo, 2013, para. 4).

Interpretation and Synthesis of Data

Once observations and repeated trials were completed, synthesis of the data began. As interview data was transcribed, coding of the data showed themes emerging. These themes aided in concluding what uses of the iPad app showed positive or negative influences in the growth of communication skills in students with autism.

Repeated measure trials also showed trends of verbal interaction increase or decline after using the app. During the synthesis of data, the percentage of nonoverlapping data of

the repeated trials was synthesized and charted to show the effectiveness of the intervention of an iPad app in increasing verbal interactions by students with autism.

Rationale for Methods Selection

A mixed methods approach was used in the research study. According to Ponce and Pagan-Maldonado (2015) "mixed methods studies are based on the belief that there are existing problems whose complexity cannot be fully researched when the combination or integration of quantitative or qualitative approaches are not undertaken as components of the study" (p. 115). The mixed methods approach has evolved from a conflict among the qualitative and quantitative paradigms to become a commonly used method of inquiry (Terrell, 2012).

A mixed methods approach encompassed data collection strategies common to each methodology. Wyse (2011) has defined qualitative research as "methods using unstructured or semi structured techniques. Some common methods include focus groups (group discussion), individual interviews, and participation/observations" (para. 2). The repeated measure analyses of quantitative research involved complex experiments with many variables and treatments (e.g. factorial designs and repeated measure designs. Creswell (2003) stated that this also included "elaborate structural equation models that incorporated causal paths and the identification of the collective strength of multiple variables" (p.13).

Trustworthiness

Trustworthiness of the data collection instruments was reviewed continuously throughout the study. Observations were used extensively for data collection, and they contained several different facets of trustworthiness that must be addressed by the researcher. DeMonbrun, Fellini, and Shekar (2015) reported "good reliability in an observation protocol

certifies that the observation will be consistent across time and observations. Good validity in an observation protocol ensures that the observation instrument actually measures what it is intended to measure" (p. 2). Students in the classrooms could react differently to the researcher during the observation due to their gender or ethnicity. The students could have a phobia of a male observer and could react differently during the study. The students could also react differently if they were aware of being observed. The researcher was as non-intrusive as possible while observing the students in the classroom. The researcher worked to ensure non-intrusive behavior by placing themselves out of eyesight of the students. By observing the whole class, but only focusing on the students in the study, the students did not know they are being observed as part of a research study.

Conclusion

With the influx of technology available for use in society, a critical eye for detail is needed when reviewing apps for student use. Through the findings of this study, teachers and school administrators can use the results to review app selections for use with students with autism. Not only will the results help educators when opportunities to review technology are present but also to develop methods of questioning the use of the apps--if the app is research based--and how the app will fit into the educational plan for students with autism. This task could be accomplished through the formation of an app review committee to review the apps from a critical standpoint and aid fellow educators in selecting appropriate, research-based apps for student use. As technology use continues to grow, the need for making sound decisions concerning technology and app use by students will play an enormous role in the success of an educational program.

Chapter Four: Findings

Introduction

Language development and communication with peers are a struggle for students diagnosed with ASD. Even though a child may be verbally fluent, he or she may still face trials with language and communication with peers (Vicker, 2009). Technology plays a large role in the manner in which students with autism gain the skills needed for communication and language development and is becoming a centerpiece in the education of students.

Technology is an integral part of the curriculum. Devices now offer many options for tailoring education to meet the specific needs of students (Herold, 2016). Handheld devices, such as an iPad, iPods or iPhones, are often loaded with apps that the teacher has chosen and are used to supplement instruction and provide more exposure to a concept. Overall, large numbers of apps are being submitted to online stores. App developers are submitting over 1,000 apps per day to online app stores (Mathew, 2015). The overwhelming number of apps available for student use can often lead to educators downloading apps that may or may not have been viewed with a critical lens, both at the development and the classroom levels. Due to this, it is imperative to determine a way to be more systematic about evaluating these apps.

Chapter Four is organized into distinct sections beginning with an introduction to the first research question and methodology. Next, the participants for the first research question are introduced, followed by a transition to the results. The results are organized under the following headings: Teacher Choice, Ease of Use, Student Engagement, and Student Motivation. Next, the second research question and methodology are introduced. This section begins with an introduction to the second research question and methodology. Then, the

participants for the second research question are introduced, followed by the results. The results are organized under the following headings: Results for William, Results for Shawn, Results for Eric, and Results for Bryan.

Research Question #1

When searching for apps that focus on communication to use with students diagnosed with autism spectrum disorder, what key elements must be encompassed in the iPad app in order for it to be chosen by the teacher of students with autism for the student's educational plan?

For this research question, teachers who work with students diagnosed with autism were asked to complete a survey (see Appendix A). The survey was divided into two sections. The first section employed a Likert-type scale to gather information concerning how teachers use technology and the app selection process for their school. The second section consisted of five open-ended questions that centered on describing the app selection process for the school, the key elements that an app must possess to be chosen for student use, the pros and cons of using apps with students diagnosed with autism, and the five most frequently used apps in their classroom. Following the completion of the survey, five respondents were interviewed. The interview questions concentrated on elaboration in several areas including the app selection process, use of research based methods, and pros and cons of student technology use. The participants for the survey and interview phase are introduced in the following section.

Survey Participants

Thirteen teachers at the school who worked with students diagnosed with autism were asked to complete the survey. Of the 13 identified staff members, 10 members

completed the survey resulting in a 76.9% return rate. The individuals surveyed included teachers of self-contained classrooms, teachers in an inclusion or pullout setting for exceptional children, instructional coaches with a focus on exceptional children, speech-language therapists, and Pre-K itinerant staff who work with students diagnosed with autism.

Interview Participants

Survey respondents were asked if they would be available for an interview follow-up. The interviews were completed to allow the educators to expand on questions from the survey. The educators who were part of this interview phase of the study are introduced in the following section under the headings of Interviewee A, Interviewee B, Interviewee C, Interviewee D, and Interviewee E.

Interviewee A. Interviewee A had 14 years of experience in the field of education. She holds a degree in K-6 Elementary Education, K-12 Special Education, and a Master's degree in Behavioral Emotional Disabilities and Autism. She was an instructional coach for the exceptional children's department at the time of the study.

Interviewee B. Interviewee B had 5 years of experience in the field of education. She had licensure in K-Elementary Education and 7-9 Middle School English Language Arts. She also had licensure in two areas of exceptional children's education: Mild to Moderate and Severe to Profound. She was a teacher of a 3-5 self-contained classroom at the time of the study.

Interviewee C. Interviewee C had 16 years of experience in the field of education. She had licensure in the area of Behavioral and Emotional Disabilities. She was a K-2 teacher of a self-contained classroom at the time of the study.

Interview D. Interviewee D had 30 years of teaching experience in the field of education. She had licensure in the area of K-6 Elementary Education and Birth to Kindergarten. She was a Pre-K itinerant teacher at the time of the study.

Interviewee E. Interviewee E had 3 years of experience in the field of education. She had licensure in Speech Language Therapy. She was a speech-language pathologist (SLP) at the time of the study.

Table 1.

Results of the teacher survey.

	Strongly Disagree	Disagree	Agree	Strongly Agree	Not Applicable
I use technology daily in my classroom	0 0%	0 0%	2 20%	6 60%	2 20%
I use Apple® iPads in my classroom	0 0%	0 0%	2 20%	6 60%	2 20%
I have my students use communication specific apps on the Apple® iPads in my classroom	0 0%	1 10%	3 30%	4 40%	2 20%
I understand the process the school has for selecting apps	2 22%	5 56%	1 11%	0 0%	1 11%
I have used the app selection process to identify apps to include on the iPad	1 10%	3 30%	2 20%	0 0%	4 40%
I have used the app selection process to identify communication specific apps to include on the iPad	1 10%	4 40%	1 10%	0 0%	4 40%

Results-Research Question #1

As shown in Table 1, ten members of the teaching staff responded to the survey. In each column, the numbers of survey responses for each scale are listed first. Underneath the number of survey responses, the percentage breakdown of responses for each category is listed. After analysis of the data, two themes emerged from the responses provided by survey participants.

Technology use and communication apps. As shown in Table 1, 80% of respondents are using technology in the classroom and 80% are using the Apple® iPad for instruction with students. To parallel the high percentage of teachers using technology in the classroom, 70% responded that they use some type of communication apps with students in the classroom. In each instance, 20% of respondents indicated that these three issues were not applicable to them, and only the third question received any active disagreement (10% of respondents). These data indicate that the respondents use technology devices and integrate apps into instruction.

As mentioned previously, the UDL principles were used as a framing device for the analysis of these results. The findings here, in terms of the classroom technology use by the teachers surveyed, align with the UDL objectives associated with the multiple means of representation:

- Offering ways of customizing the display of information
- Offering alternatives for auditory information
- Illustrating through multiple media
- Using multiple media for communication

In looking at the teacher surveys, their responses indicate that the teachers are endeavoring to provide multiple means through which their students can be presented with learning resources, which is the first principle of UDL.

School process for app selection. As shown in Table 1, 78% of the survey respondents indicated that they were uncertain of the process that the school has for selecting apps. When asked to respond to thoughts on using the school process, 40% did not use a school app selection process with 40% responding with not applicable. Further, 50% did not use a school selection process to choose communication apps for student use with an additional 40% responding not applicable. This percentage aligns with a response from the open-ended survey questions that app selection by teachers was mostly "trial and error".

The findings here, in terms of a school process for selecting apps, align with the UDL objective for providing multiple means of action and expression.

- Optimize access to tools and assistive technologies

In looking at the teacher surveys, their responses showed that teachers are using apps to instruct students with autism. They are eager to provide access to the tools and technologies to the students, which aligns with the second principle of UDL.

Data from the survey's open-ended questions were combined with responses from the teacher interviews. Ten teachers responded to the open-ended questions of the survey and five teachers were interviewed for further elaboration on the open-ended questions. The five interviewees were selected to ensure that the different areas (teachers of exceptional children, instructional coach, speech-language pathologist, and Pre-K) each had a representative for the follow up interview process. Once the data from the surveys and interviews were compiled, coding was used to sort and organize data. The coding procedure consisted of

assigning a keyword to the data and synthesizing the responses to use the keywords to build the evolving topics or themes that continued to emerge from the data synthesis. The following themes emerged from analysis of both the survey responses and interview data.

Teacher approach. Teacher approach to app selection was a theme that emerged during coding of the data. One survey respondent commented, "I think it's a trial and error process that the teacher can use individually." Another respondent stated, "I spend time on the app myself so I know if it is worth my student's time." Teacher choice of apps that met students' needs was at the forefront, and they would often work with the instructional technology facilitator to have apps they had found placed on the student iPads. One survey respondent indicated, "I look for relevancy of the app to meeting the student's needs." Another response asked, "Does the app meet the needs of the student?" Teachers also chose apps on the referral of experts within the school. Both the instructional coach for exceptional children and the speech-language therapists were noted as individuals who could assist in choosing developmentally appropriate apps for use by students with autism. Responses to support these results included "I look for good referrals from a knowledgeable teacher" and "Recommendations for apps from the SLP (Speech Language Pathologist)." Interviewee A stated that she would, "look for the experts in communication, such as the SLP."

The findings, in terms of the classroom technology use by the teachers surveyed, align with the UDL objectives associated with the multiple means of representation, multiple means of action and expression, and multiple means of engagement:

- Offer ways of customizing the display of information
- Offer alternatives for auditory information
- Offer alternatives for visual information

- Illustrate through multiple media
- Guide information processing, visualization, and manipulation
- Optimize access to tools and assistive technologies
- Use multiple media for communication
- Optimize relevance, value, and authenticity

Responses showed that teachers searched for relevant apps for use with students with autism. They looked for different options for presentation and searched for apps that optimized access to different tools. They responses also showed a willingness to collaborate with other in the building to choose apps that were beneficial for use with students diagnosed with autism, which aligns with the first, second, and third principle of UDL.

Ease of use. Teachers selected apps they believed were the appropriate level for students to use. One respondent asked, "Is the app easy to use and work well with the students?" Another teacher responded, "I look for targeted skills and ease of use." The students who are using the apps are at different levels of ASD so teachers focused on those that would provide the best experience for students and were easy for the students to navigate. One response tied this issue to the device itself by stating "a pro of the iPad is that it is visual. It is easier to use than a computer."

The UDL objectives associated with the multiple means of representation and multiple means of action and expression align with the analysis for these findings.

- Offer ways of customizing the information
- Offer alternatives for auditory information
- Offer alternatives for visual information
- Illustrate through multiple media

- Optimize access to tools and assistive technologies
- Use multiple tools for construction and composition

In looking at the teacher interviews, their responses, as previously noted, showed that teachers searched for relevant apps for use with students with autism. They looked for different options that provided an easy and enjoyable experience for the students with autism. They responses also showed that teachers preferred the iPad due to ease of use for the students, which aligns with the first and second principle of UDL.

Student engagement. During the coding phase of the interviews, student engagement was another theme that emerged. This theme focused on student engagement with an app that was targeted to provide practice with specific skills in an area in which the student might need more exposure. Interviewee C indicated, "one of the biggest pros is that if the student can't tell you their wants and needs, they can use the app with language to communicate." Interviewee B commented, "The iPad enables access to technology that increases verbal communication, especially if verbal communication is limited." Several respondents to the survey noted positive outcomes after student use. Responses focused on finding relevant apps that addressed skills in which the students needed more exposure and practice and finding apps that would assist in meeting the IEP (Individualized Education Plan) goals of the student. Interviewee D commented that iPad apps "help with focus and attention and relating things to the real world."

The findings here, in terms of the classroom technology use by the teachers surveyed, align with the UDL objectives associated with the multiple means of representation, multiple means of action, and multiple means of engagement:

- Offer ways of customizing the display of information
- Offer alternatives for auditory information
- Offer alternatives for visual information
- Illustrate through multiple media
- Guide information processing, visualization, and manipulation
- Optimize access to tools and assistive technologies
- Use multiple media for communication
- Use multiple tools for construction and composition
- Support planning and strategy development
- Optimize relevance, value, and authenticity

Teacher responses showed that they searched for apps that addressed targeted, specific skills relevant to the student's daily life. The opportunities for students to learn the authentic skills needed for success in their environment was evident in the responses. They also responded that the apps should align with the IEP goals (planning and strategy development) of the student and focus on increasing student verbalizations, which aligns with the first, second, and third principle of UDL.

Flexibility of design. Teachers surveyed and interviewed for this study were not only searching for apps for certain students in the classroom, but they also based judgments on the flexibility of using the app with several students. The educators were looking for beneficial apps that could be customized to meet the needs of several students in the classroom to keep them engaged on learning. Teachers also responded to the pros of iPad use with students diagnosed with autism with statements such as "[There is] flexibility to use the app with different age groups and development levels," and "The iPad provides them with an

opportunity to work independently, which is what they like." Teachers viewed the use of the app across different ages and ability levels as an integral factor when selecting apps for their classroom. Interviewee B commented, "How many students will the app reach?" and Interviewee E stated "I like the ability to use the app across multiple settings and with multiple children."

The findings, in terms of the classroom technology use by the teachers surveyed, align with the UDL objectives associated with the multiple means of representation, multiple means of action, and multiple means of engagement:

- Offer ways of customizing the display of information
- Support decoding of text, mathematical notation, and symbols
- Guide information processing, visualization, and manipulation
- Optimize access to tools and assistive technologies
- Use multiple media for communication
- Use multiple tools for construction and composition
- Support planning and strategy development
- Optimize relevance, value, and authenticity
- Promote expectations and beliefs that optimize motivation

While reviewing the teacher interviews, their responses showed that they not only searched for apps relevant to the individual student needs, but also those apps that could be customized for use across the classroom with other students. Through the use of the app, focus was also on apps that provided an opportunity to work independently and optimize opportunities for motivation. They also searched for apps that provided the students with an

opportunity for growth through a flexible session with the app. These objectives align with the first, second, and third principles of UDL.

Student motivation. Student motivation was another theme that became evident through coding of the survey data. When selecting apps for student use, teachers focused on apps that motivated the student. They indicated that it was important that students could use the app to increase skills for success, and gain motivation to use the outcomes of the app, as growth in communication could aid the student in the classroom and at home. Responses from the survey included, "The iPads are highly motivating," "the iPads increase participation to tasks," "most kids love the animation," and "a pro to using the iPad is high interest and high motivation to the students."

The findings here, in terms of the classroom technology use by the teachers surveyed, align with the UDL objective associated with multiple means of engagement:

- Optimize relevance, value, and authenticity
- Promote expectations and beliefs that optimize motivation

Teacher responses showed that student motivation was factor in choosing apps for use with students with autism. Student motivation begins with building on student interests and maintaining that interest. Teachers were also searching for apps that not only motivate the student in the classroom, but also in the home environment with parents and peers. These objectives clearly align with the third principle of UDL.

Research Question #2

Will verbal interactions increase in elementary-aged students with autism when using the Avatalker® iPad app?

The second research question focused on the effectiveness of the Avatalker® iPad app when used with students diagnosed with autism to increase verbal interactions. Verbal utterances of the student were tracked with a frequency data collection sheet during classroom observations. A verbal utterance for this study was operationally defined as a word or unit of words spoken by the student where the student ends the utterance by pausing or relinquishing the opportunity to speak to the teacher or peer. Each area of the DSM-5 Severity Levels for Autism was represented in the student sample.

The study was conducted across a 12- week period using an ABAB experimental design. This design was appropriate for this study in that the individual behavior of the student was being studied for change. Students served as their own control and baseline observations were recorded during two phases of the design. Sessions were conducted three times a week for 30 minutes. The first phase of the study was designated as the initial baseline. The treatment, or use of the Avatalker® app, was introduced in the second phase. The treatment was removed in the third phase. The treatment was reintroduced in the fourth phase. During the treatment phase, students practiced daily statements that were programmed into the iPad. Statements were constructed based on the IEP goals of each student. After reviewing the goals, the researcher collaborated with the teachers and specialists who served the child in order to establish appropriate and necessary statements. These statements were constructed with three outcomes in mind:

(a) building confidence to initiate and reciprocate general conversation with teaching staff / peers,

(b) increasing communication, and

(c) aiding students to communicate needs to staff and peers.

The statements were constructed based on literature focused on using scripts to increase verbalizations in students with autism. Scripts are often used with students with autism to improve communication skills. The Association for Science in Autism Treatment defines scripts as audio or written verbal statements that the student uses in social settings. In a study by Hernandez, Hanley, Ingvarsson, and Tiger (2007), scripts were used to teach students to interact with others. The end result of the study showed an emergence of untrained requests by students and, once one-word requests were in use, new untrained requests began to materialize.

Participants of the Study

As part of the research study, four students of elementary age were selected to participate. All students were male, currently enrolled in 2nd, 3rd, and 4th grade and diagnosed with ASD. Each of the DSM-5 Levels of Severity was represented. The students are introduced under the headings of William, Shawn, Eric, and Brian.

William. William was a 7-year-old male student in 2nd grade. He was served in a self-contained classroom for exceptional children in grades kindergarten through 2nd grade. William began to exhibit characteristics of ASD at 9 months when it was reported that he stopped crawling, babbling, and making eye contact. During the study, he was served in the self-contained EC (Exceptional Children) classroom and supported with speech-language therapy and occupational therapy. The ADOS (Autism Diagnostic Observation Schedule) was used for his diagnosis of ASD- Level II. In 2012 at 3 years of age, he was also diagnosed with Becker's Muscular Dystrophy, a degenerative disease that affects the legs, hips, thighs, and pelvis. William understood that language can be used to converse with others, make requests, and express humor, but he was not able to engage in verbal communication in a

natural, reciprocal fashion without the benefits of models and visual supports. He often communicated using one-word responses that were vocalized in a low pitch.

During the treatment phases of the study William was given four statements to practice saying with the Avatalker® iPad app for 15 minutes a day. The four statements were:

- I like to work on the iPad.
- The work goes in my box.
- I need to use the restroom.
- Please help me.

Shawn. Shawn was an 8-year-old male student in 3rd grade. Shawn was served in a self-contained classroom for exceptional children in grades 3-5 and for 1 hour a day he left the classroom to attend reading class in a regular education third-grade class. The ADOS-2 (Autism Diagnostic Observation Schedule-2nd Edition) was used to gather data to assist with the diagnosis of ASD-Level I. During observation using the ADOS, Shawn was identified as a student who lacks the rules of conversation to successfully implement a reciprocal give and take conversation. As a younger student in elementary school, he often communicated needs by crying and had behavioral concerns. On the social realm, he often intruded on the personal space of others and was unresponsive to greetings and inquiries made by other individuals. As with many students with autism, he was bothered by loud or unexpected sounds and would cover his ears. Shawn also showed deficits in social communication, social interaction and restrictive/repetitive behaviors. Shawn communicated using one-word and multi word responses, however, he was selected for the study due to his need for assistance in expressing needs to staff and peers. During a review of the student's IEP, previous observers

highlighted the need for growth in expression, reciprocal communication rules, and appropriate peer communication.

During the treatment phases of the study Shawn was given four statements to practice on the iPad for 15 minutes a day. The four statements were:

- I need to ask a question.
- I like to work on the computer.
- May I have a minute to think?
- Please help me.

Eric. Eric was a 9-year-old male in 3rd grade. He was served in a self-contained class for exceptional children in grades 3-5. The ADOS was used to diagnose ASD-Level III. He was also supported with speech-language and occupational therapy services. When Eric was 2 years old his mother expressed concerns with language development, behavior, and poor eye contact. He exhibited very limited social skills along with a need for routine and repetitive actions, and he exhibited communication through crying. By age 9, Eric had overall language skills of a 3-year-old child. It was also noted that he exhibited a strong resistance at times during the assessment, which often concluded in him using the word "No!" Assessments used to arrive at these results were the Preschool Language Scale, Expressive One Word Picture Vocabulary Test, and the Receptive One Word Picture Vocabulary Test.

During the treatment phases of the study Eric was given four phrases to practice on the iPad for 15 minutes a day. The four statements were:

- I like to work on the iPad.
- I like dinosaurs.

- It is too loud.
- Please help me.

Bryan. Bryan was a 10-year-old male student in 4th grade. He was diagnosed with ASD- Level II. He was served in a self-contained classroom for exceptional children in grades 3-5 and received speech-language and occupational therapy services. At age 5, Bryan was diagnosed with ASD. The ADOS was used to diagnose autism spectrum disorder. Based on results of the ADOS, Bryan was documented as having no eye contact and lacking interest in any type of social interaction. At age 8, the Preschool Language Scale-4th Edition was used to assess the student. Bryan had difficulty using sentence form to express knowledge. It was also noted that he still used sentences that were often incomplete, and he used short phrases in conversation.

During the treatment phases of the study Bryan was given four phrases to practice on the iPad for 15 minutes a day. The four statements were:

- I like to work on the iPad.
- I need to wash my hands.
- Please help me.
- I like to read with Mrs. (Teacher Name).

Results-Research Question #2

Verbal utterances in this study were defined as a word or unit of words spoken by the student that ends by pausing or relinquishing the opportunity to speak to the teacher of peer and interactions with staff and peers were recorded for a total of 36 sessions using an ABAB research design. Interactions were defined as verbal utterances that occurred throughout the setting with teachers and peers within the classroom. Baseline data was collected for nine

sessions. Following the baseline data collection, the app was introduced (treatment) and data was recorded for nine more sessions. Next, the app was removed (no treatment) and data again collected for nine sessions, and for the final nine sessions, the app was reintroduced (treatment) and data was recorded. The percentage of nonoverlapping data (PND) analysis was used to calculate effectiveness of the treatment. PND is interpreted as the percentage of Phase B data exceeding the single highest Phase A data point (Parker, Vannest, & Davis, 2011). For a measure of nonoverlapping data, the proportion of data observed in the treatment phases that did not overlap data observed in the baseline phases was calculated (Scruggs & Mastropieri, 2013). This study incorporated an ABAB design with two baseline phases (initial baseline and no treatment phases). Scruggs and Mastropieri (2013) have recommended for calculation of percentage of nonoverlapping data, merge the overlap across the two phases of the design. The following interpretational guidelines of the data are used in conjunction with PND analysis: PND greater than 70% = highly effective, 50% - 70% = questionable effectiveness, and less than 50% = unreliable effectiveness (Scruggs & Mastropieri, 2001).

Results for William. Figure 1 displays results for overall utterances for William. Williams's number of overall utterances averaged 5 in baseline, remained the same with an average of 5 during intervention, averaged 4 in the return to baseline, and finally, increased to an average of 6 when the intervention resumed. During both intervention phases, William's overall utterances averaged 5 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

Figure 2 displays results for one-word utterances for William. Williams's number of one-word utterances averaged 2 in baseline, increased to 3 during intervention, averaged 3 in

the return to baseline, and finally remained the same with an average of 3 when the intervention resumed. During both intervention phases William's overall utterances averaged 3 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

Figure 3 displays results for multi-word utterances. William's number of multi-word utterances averaged 1 in baseline, remained the same with an average of 2 during intervention, averaged 1 in the return to baseline, and finally increased to an average of 2 when the intervention resumed. During both intervention phases William's multi-word utterances averaged 2 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

Figure 4 displays results for number of verbal interactions between the student and the teacher. Williams's number of verbal interactions with the teacher averaged 5 in baseline, decreased to 3 during intervention, averaged 3 in the return to baseline, and finally increased to an average of 5 when the intervention resumed. During both intervention phases William's teacher interactions averaged 4 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

Figure 5 displays results for number of verbal interactions between the student and peers in the classroom. Williams's number of verbal interactions with peers in the classroom averaged 0 in baseline, remained the same with an average of 0 during intervention, averaged 0 in the return to baseline, and finally remained the same with an average of 0 when the intervention resumed. During both intervention phases William's overall utterances averaged 0 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

It is important to note that there are two outlier data points in Figure 3 and Figure 5. The data point in Figure 4 was the result of the student working on the Avatalker® iPad app and later working one on one with the teacher. The outlier point on Figure 6 was the results of the William telling a student to "listen" when the teacher was talking at group time at the SMART board.

Figure 1. Overall verbal utterances for William.

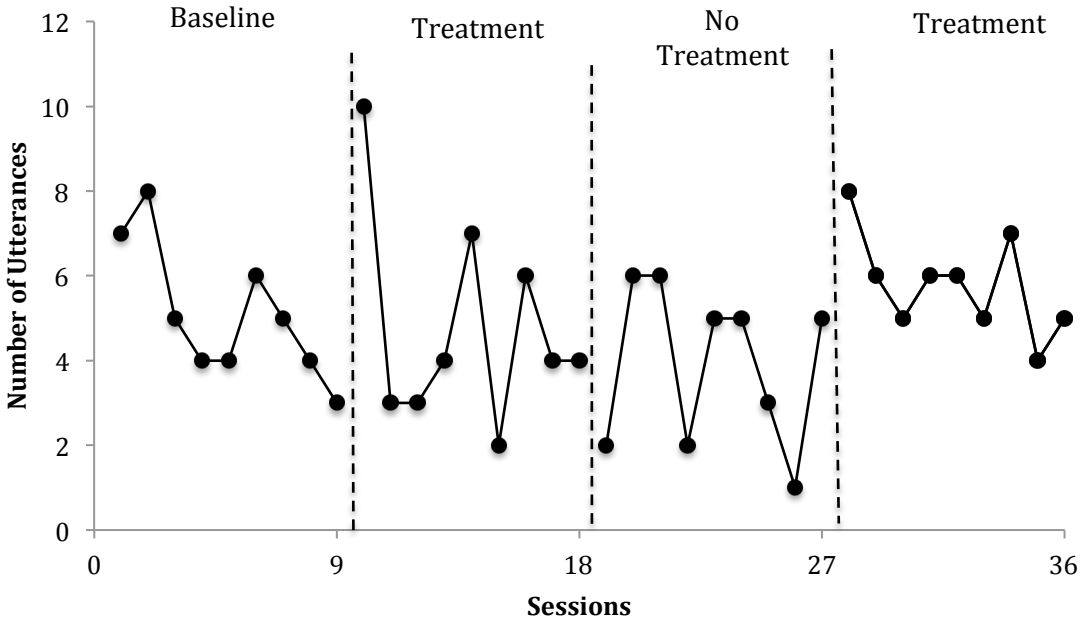


Figure 2. One word utterances for William.

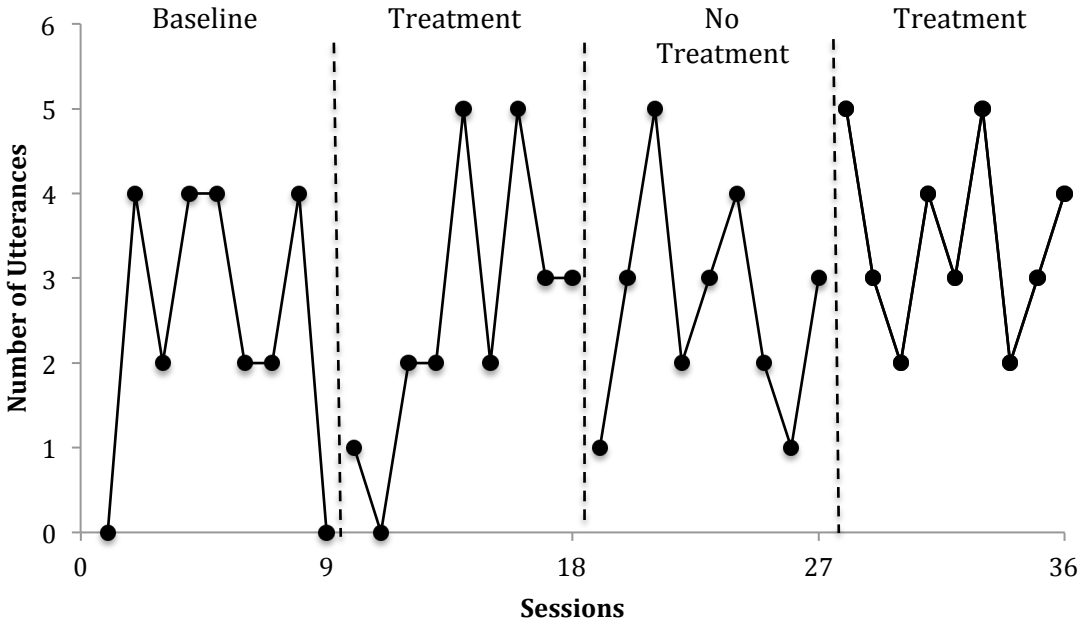


Figure 3. Multi word utterances for William.

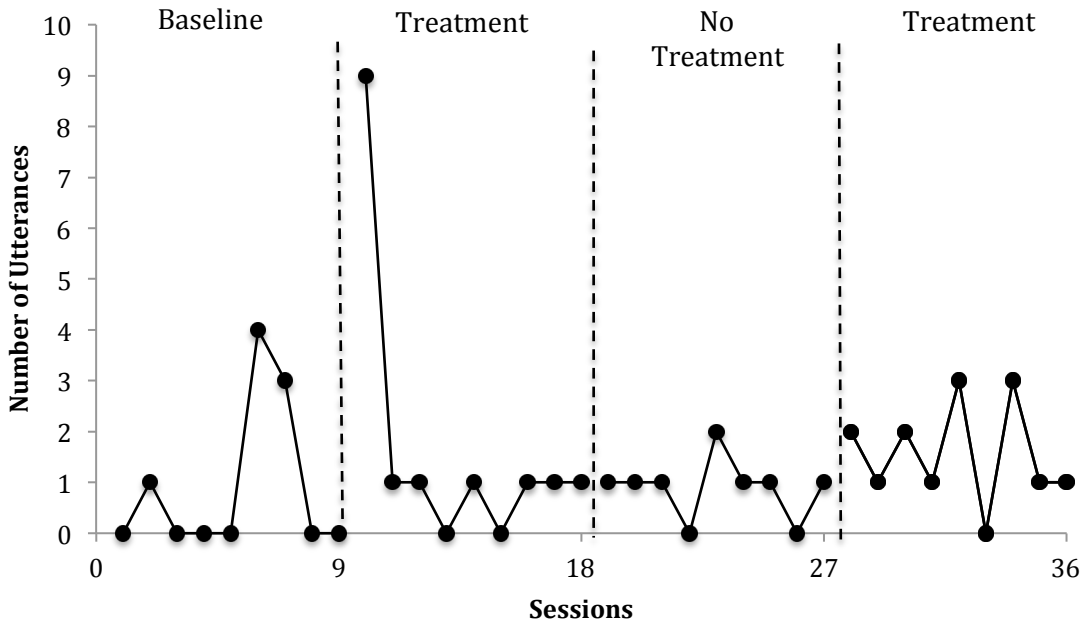


Figure 4. Teacher interactions for William.

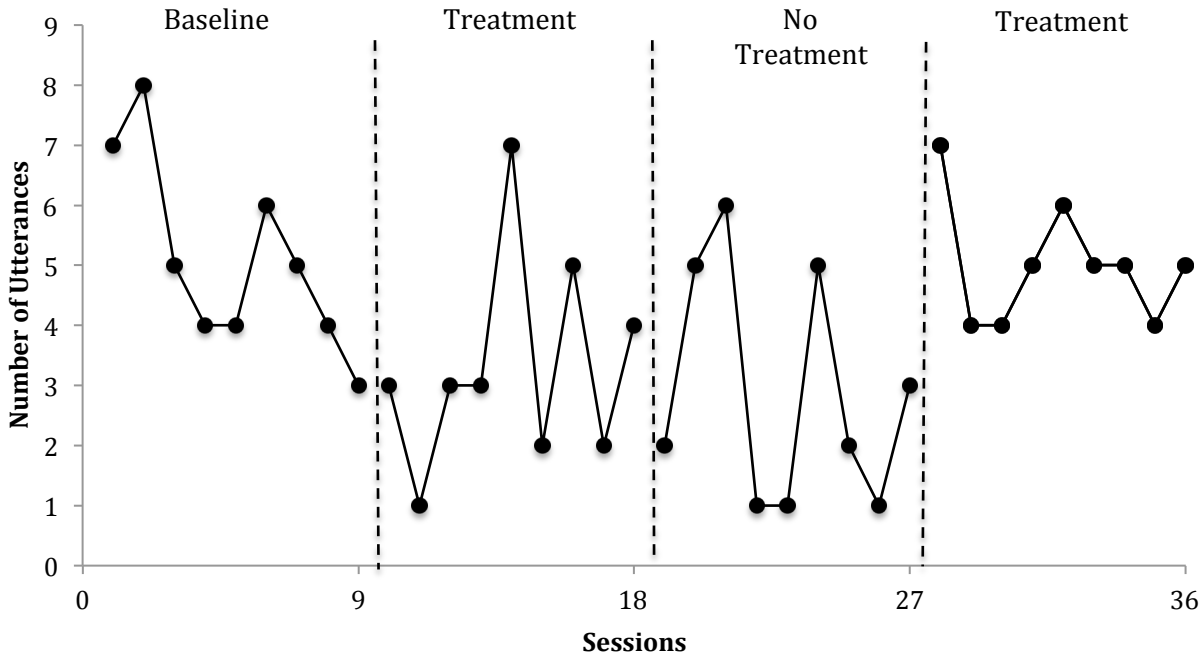
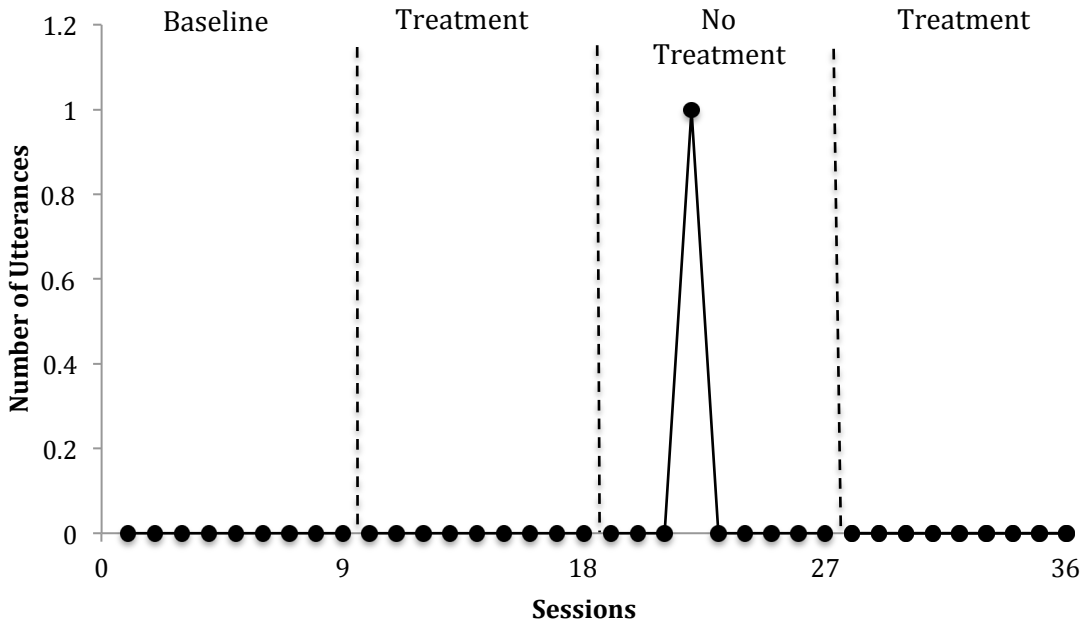


Figure 5. Peer interactions for William.



Results for Shawn. Figure 6 displays results for overall utterances for Shawn. Shawn's number of overall utterances averaged 4 in baseline, remained the same with an average of 4 during intervention, averaged 3 in the return to baseline and finally, remained the same with an average of 3 when the intervention resumed. During both intervention phases, Shawn's overall utterances averaged 3 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

Figure 7 displays results for one-word utterances. Shawn's number of one-word utterances averaged 0 in baseline, increased to 1 during intervention, averaged 1 in the return to baseline, and finally, remained the same with an average of 1 when the intervention resumed. During both intervention phases, Shawn's one-word utterances averaged 0 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

Figure 8 displays results for multi word utterances. Shawn's number of multi word utterances averaged 2 in baseline, remained the same with an average of 2 during intervention, averaged 2 in the return to baseline, and finally, decreased to an average of 1 when the intervention resumed. During both intervention phases, Shawn's multi word utterances averaged 2 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

Figure 9 displays results for number of teacher interactions between the student and the teacher. Shawn's number of interactions with the teacher averaged 2 in baseline, increased to an average of 3 during intervention, averaged 2 in the return to baseline, and finally, remained the same with an average of 2 when the intervention resumed. During both intervention phases, Shawn's interactions with the teacher averaged 2 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

Figure 10 displays results for number of verbal interactions between the student and peers in the classroom. Shawn's number of peer interactions with the teacher averaged 1 in baseline, remained the same with an average of 1 during intervention, averaged 1 in the return to baseline, and finally, remained the same with an average of 1 when the intervention resumed. During both intervention phases, Shawn's interactions with the teacher averaged 1 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

It is important to note that there are two outlier data points in Figure 7 and Figure 8. The outlier data point in Figure 7 was the result of the Shawn initiating conversation during small group work and the outlier data point on Figure 8 was the result of questions being asked between the teacher and Shawn.

Figure 6. Overall verbal utterances for Shawn.

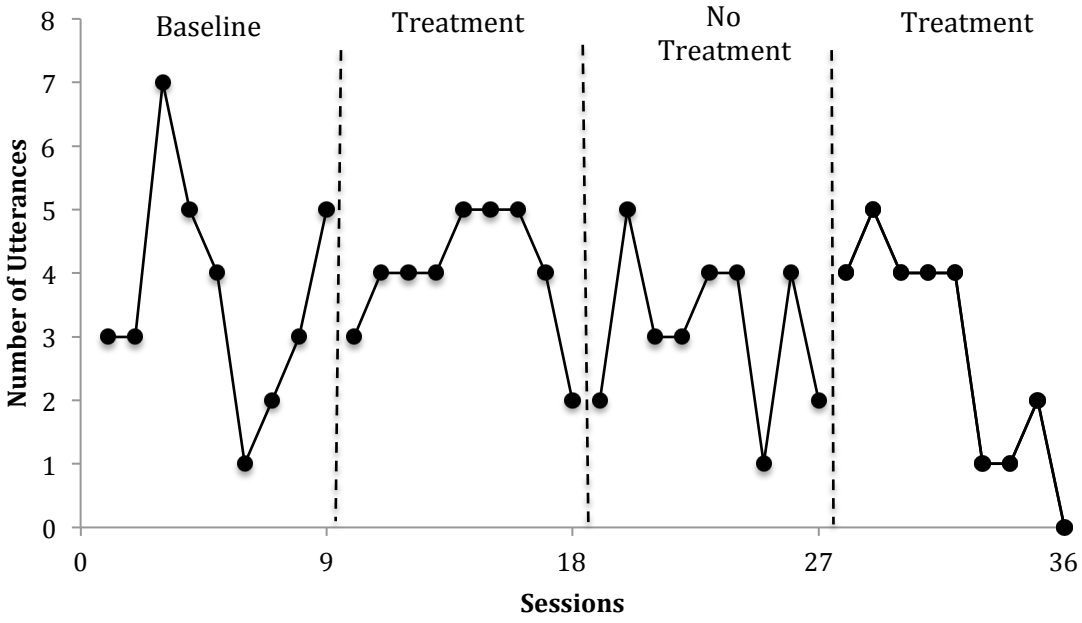


Figure 7. One word utterances for Shawn.

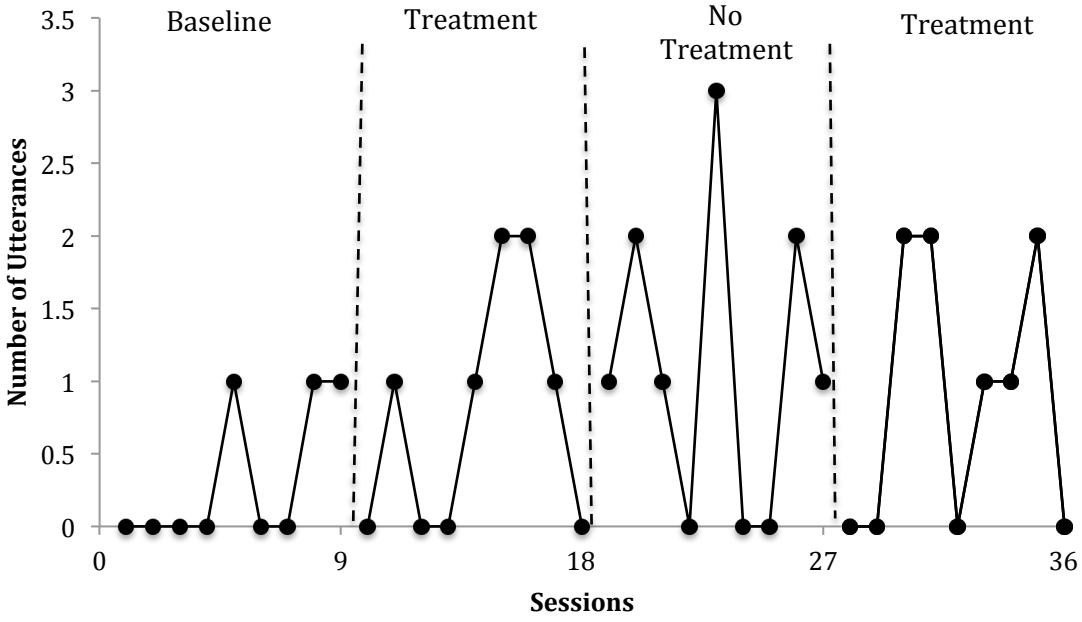


Figure 8. Multi word utterances for Shawn

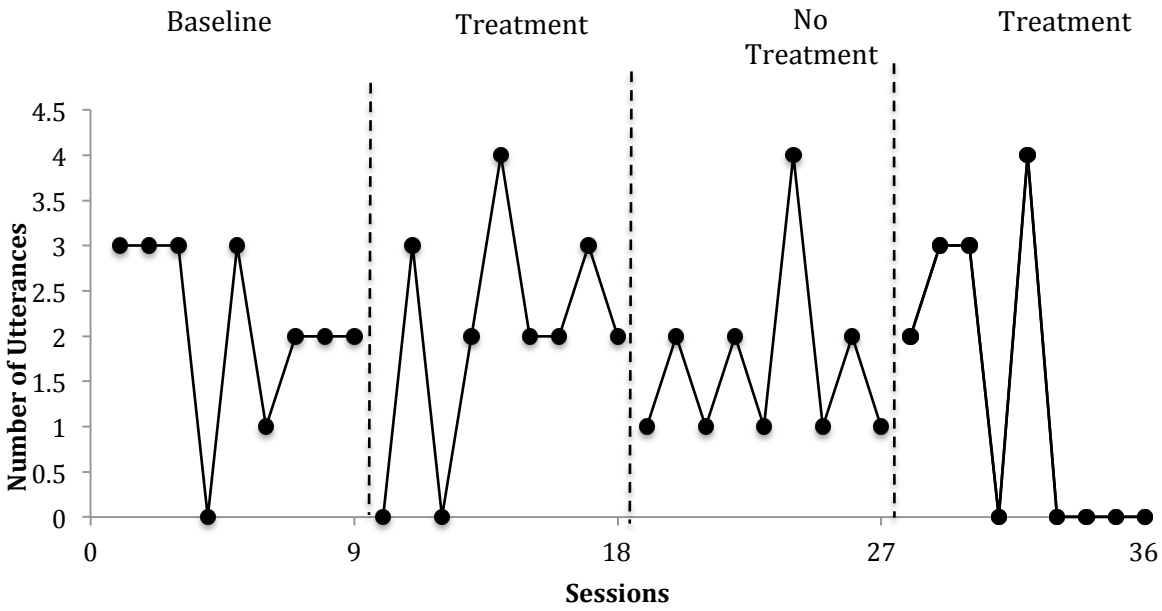


Figure 9. Teacher Interactions for Shawn.

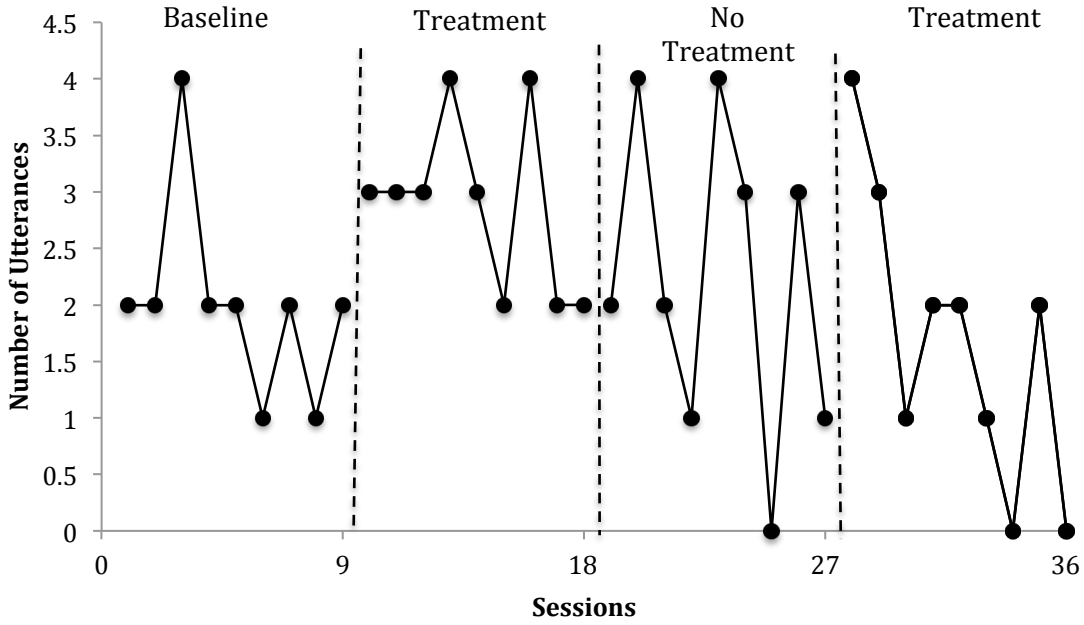
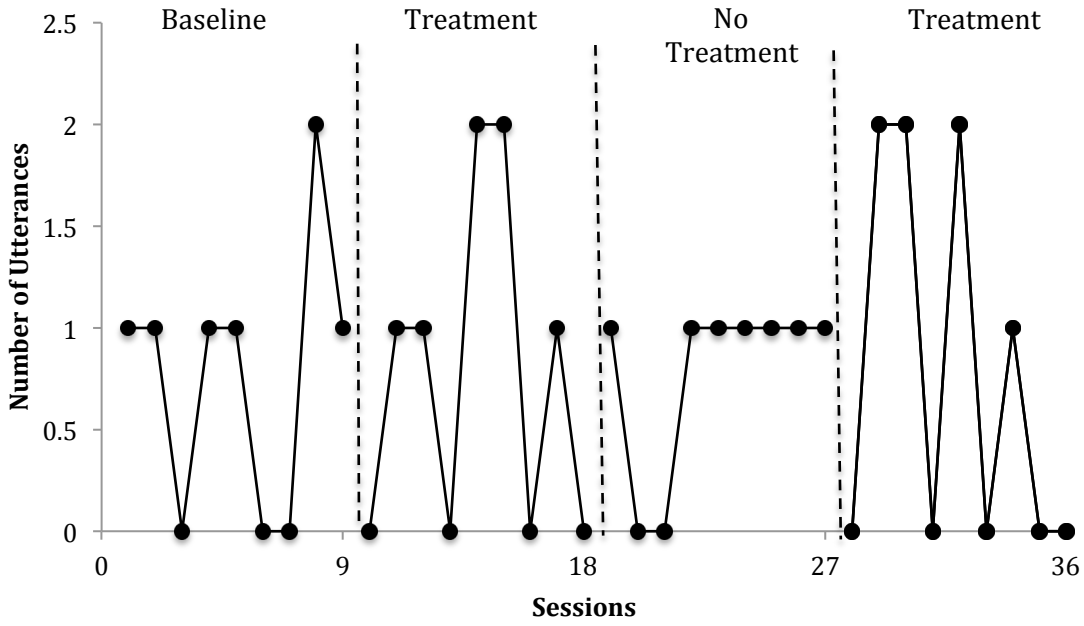


Figure 10. Peer Interactions for Shawn.



Results for Eric. Figure 11 displays results for overall utterances for Eric. Eric's number of overall utterances averaged 5 in baseline, increased to an average of 6 during intervention, averaged 5 in the return to baseline, and finally, remained at an average of 5 when the intervention resumed. During both intervention phases, Eric's overall utterances averaged 5 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

Figure 12 displays results for one-word utterances. Eric's number of one-word utterances averaged 1 in baseline, increased to an average of 3 during intervention, averaged 2 in the return to baseline, and finally, an average of 2 when the intervention resumed. During both intervention phases, Eric's one-word utterances averaged 3 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

Figure 13 displays results for multi word utterances. Eric's number of multi word utterances averaged 1 in baseline, increased to an average of 2 during intervention, averaged 2 in the return to baseline, and finally, remained the same with an average of 2 when the intervention resumed. During both intervention phases, Eric's multi word utterances averaged 2 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

Figure 14 displays results for number of verbal interactions between the student and the teacher. Eric's number of interactions with the teacher averaged 4 in baseline, remained the same with an average of 4 during intervention, averaged 3 in the return to baseline, and finally, increased to an average of 5 when the intervention resumed. During both intervention phases, Eric's interactions with the teacher averaged 4 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

Figure 15 displays results for number of verbal interactions between the student and peers in the classroom. Eric's number of peer interactions averaged 0 in baseline, remained the same with an average of 0 during intervention, averaged 0 in the return to baseline, and finally, remained the same with an average of 0 when the intervention resumed. During both intervention phases, Eric's peer interactions averaged 0 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

It is important to note that there are four outlier data points in Figure 15. The data points on Figure 16 were the result of interaction of Eric with his older brother, who was also a student in the classroom.

Figure 11. Overall verbal utterances for Eric.

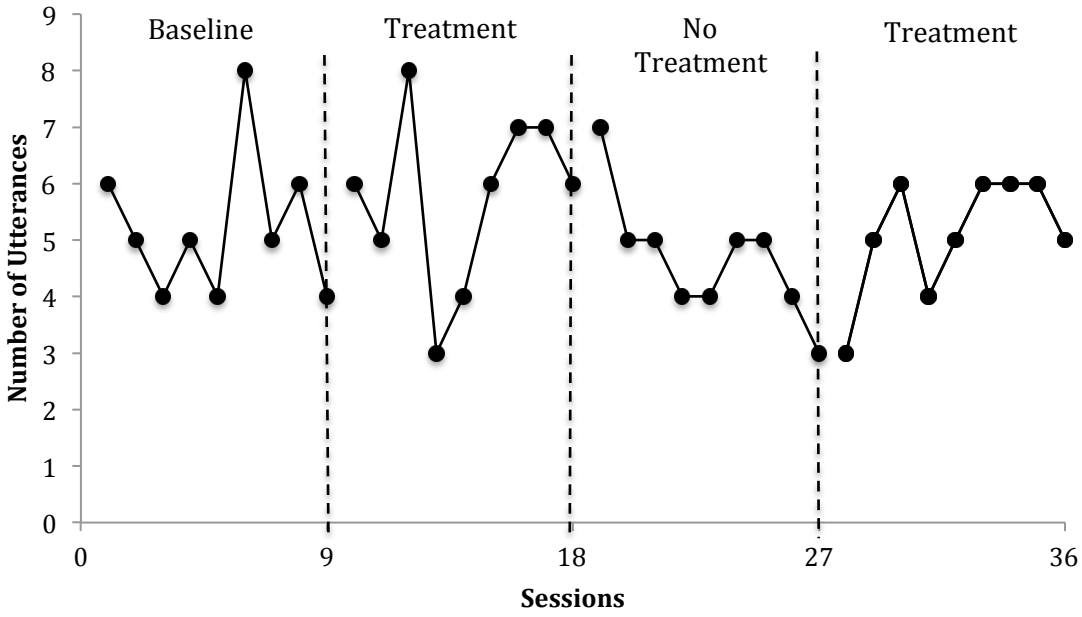


Figure 12. One word utterances for Eric.

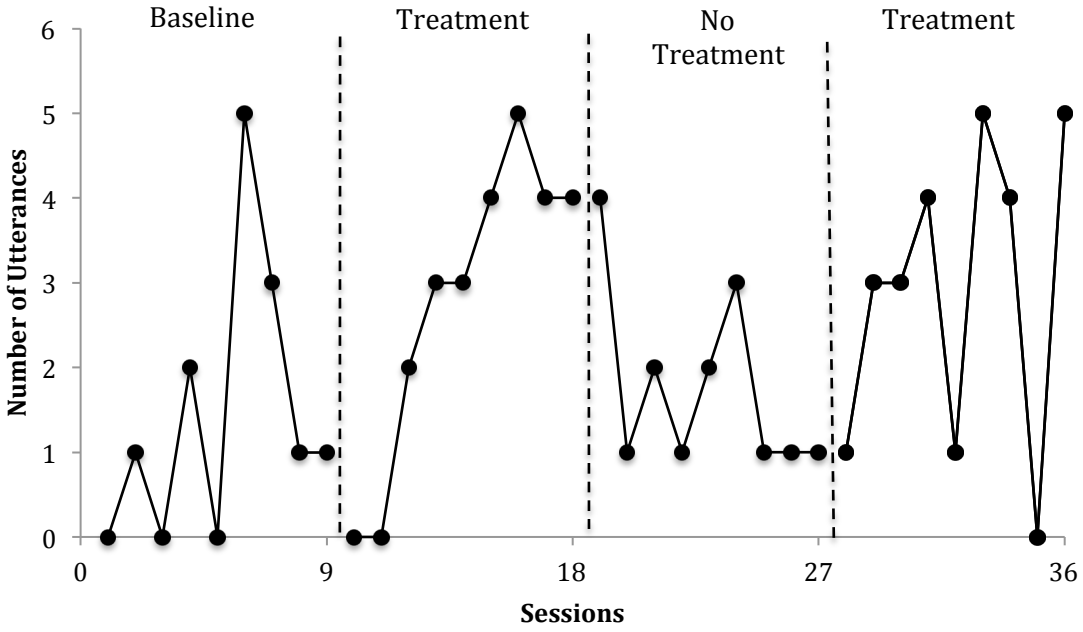


Figure 13. Multi word utterances for Eric.

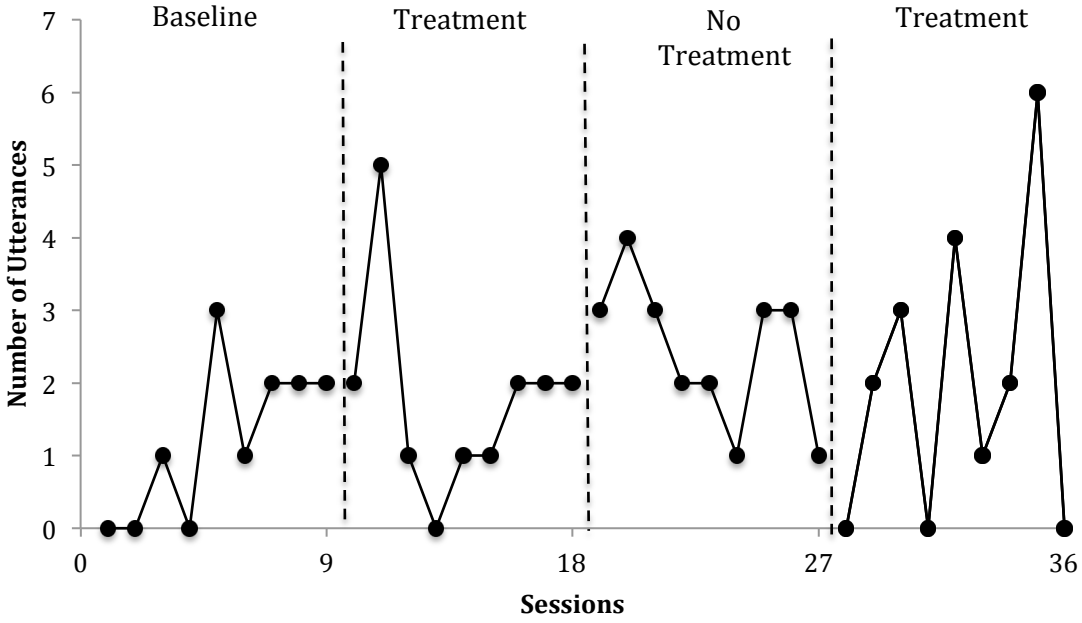


Figure 14. Teacher interactions for Eric.

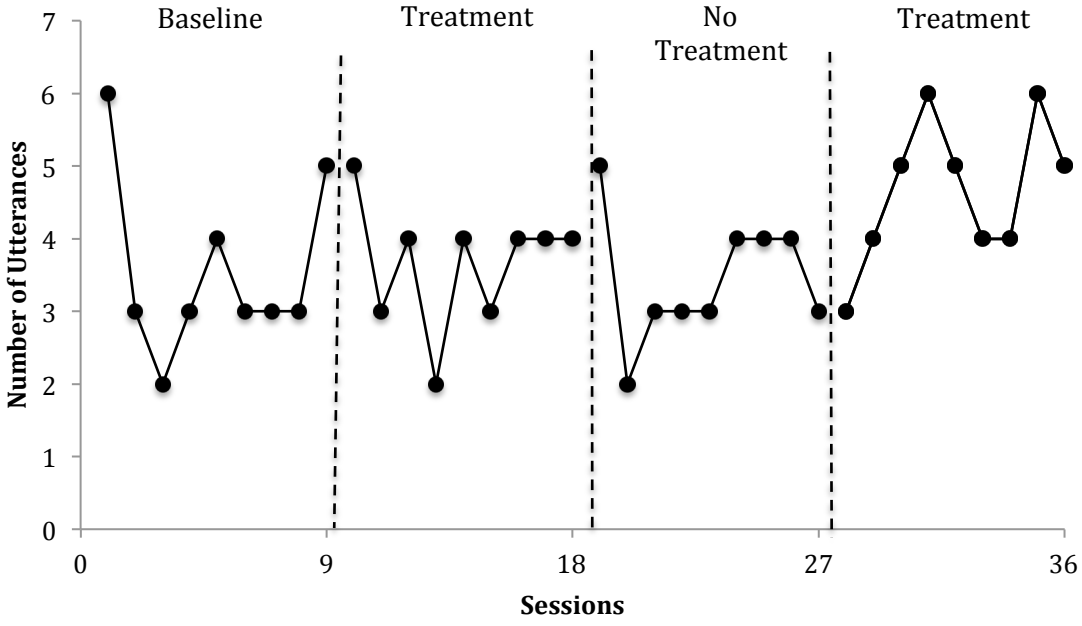
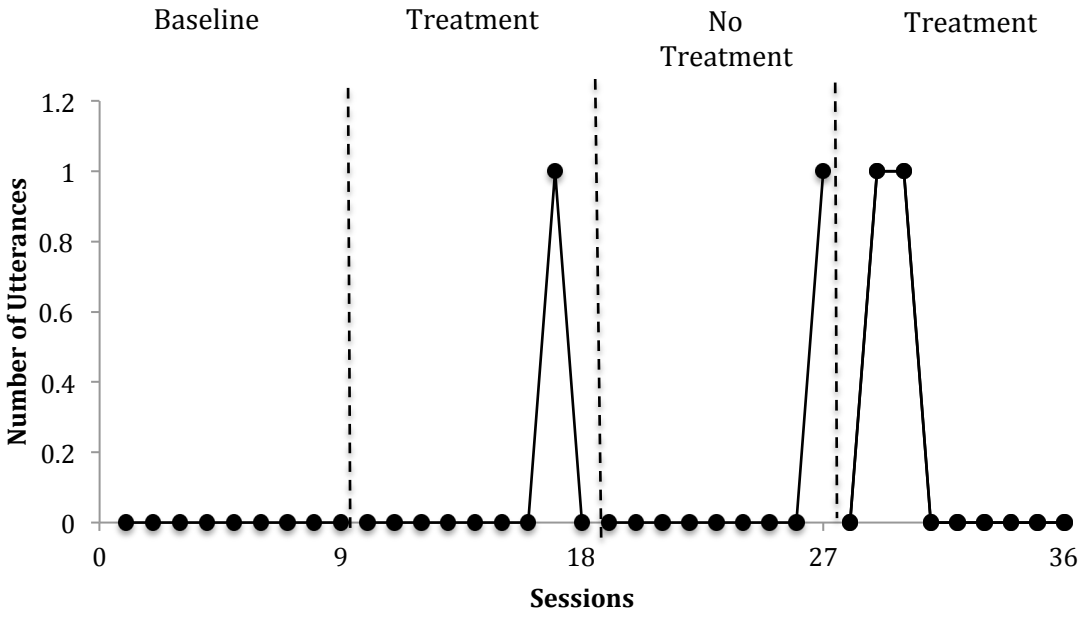


Figure 15. Peer interactions for Eric.



Results for Bryan. Figure 16 displays results for overall utterances for Bryan. Bryan's number of overall utterances averaged 5 in baseline, remained the same with an average of 5 during intervention, averaged 4 in the return to baseline, and finally, remained the same with an average of 4 when the intervention resumed. During both intervention phases, Bryan's overall utterances averaged 4 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

Figure 17 displays results for one-word utterances for Bryan. Bryan's number of one-word utterances averaged 1 in baseline, increased to 2 during intervention, averaged 2 in the return to baseline, and finally, remained the same with an average of 2 when the intervention resumed. During both intervention phases, Bryan's one-word utterances averaged 2 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

Figure 18 displays results for multi word utterances for Bryan. Bryan's number of multi word utterances averaged 2 in baseline, decreased to an average of 1 during intervention, averaged 2 in the return to baseline, and finally, decreased to an average of 1 when the intervention resumed. During both intervention phases, Bryan's multi word utterances averaged 1 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

Figure 19 displays results for number of verbal interactions between the student and the teacher. Bryan's number of interactions with the teacher averaged 4 in baseline, decreased to an average of 3 during intervention, averaged 4 in the return to baseline, and finally, decreased to an average of 3 when the intervention resumed. During both intervention phases, Bryan's interactions with the teacher averaged 3 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

Figure 20 displays results for number of verbal interactions between the student and peers in the classroom. Bryan's number of peer interactions averaged 0 in baseline, increased to an average of 1 during intervention, averaged 0 in the return to baseline, and finally, increased to an average of 1 when the intervention resumed. During both intervention phases, Bryan's peer interactions averaged 0 with less than 50% nonoverlapping data, which indicates unreliable effectiveness of the intervention.

It is important to note that there are several outlier data points in Figure 20. The data points in Figure 20 were the result of Bryan interacting with his brother, who was also a student in the classroom.

Figure 16. Overall verbal utterances for Bryan.

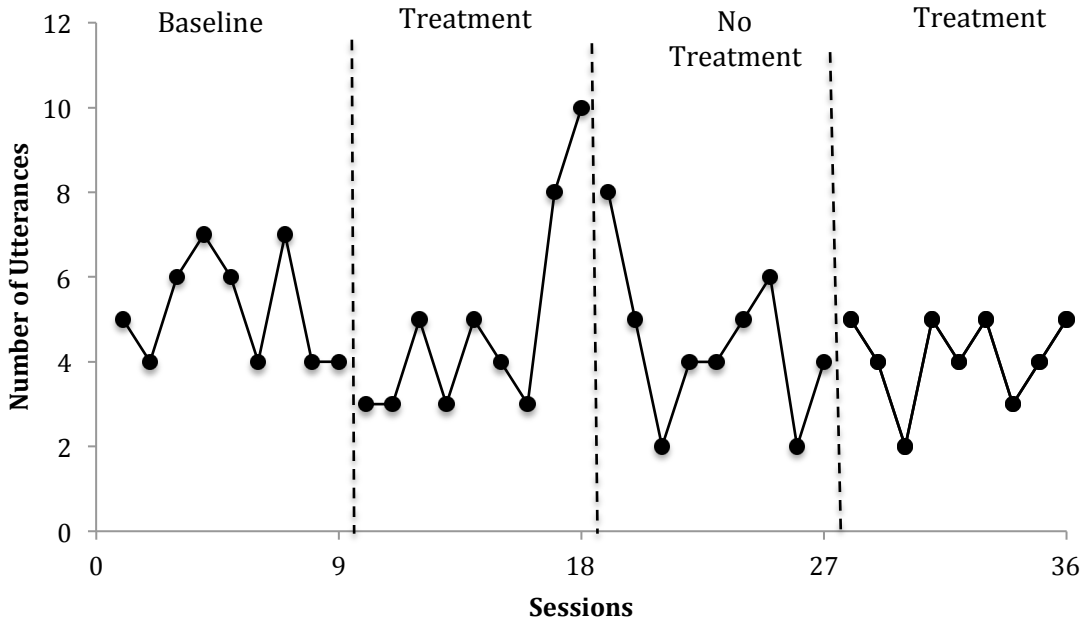


Figure 17. One word utterances for Bryan

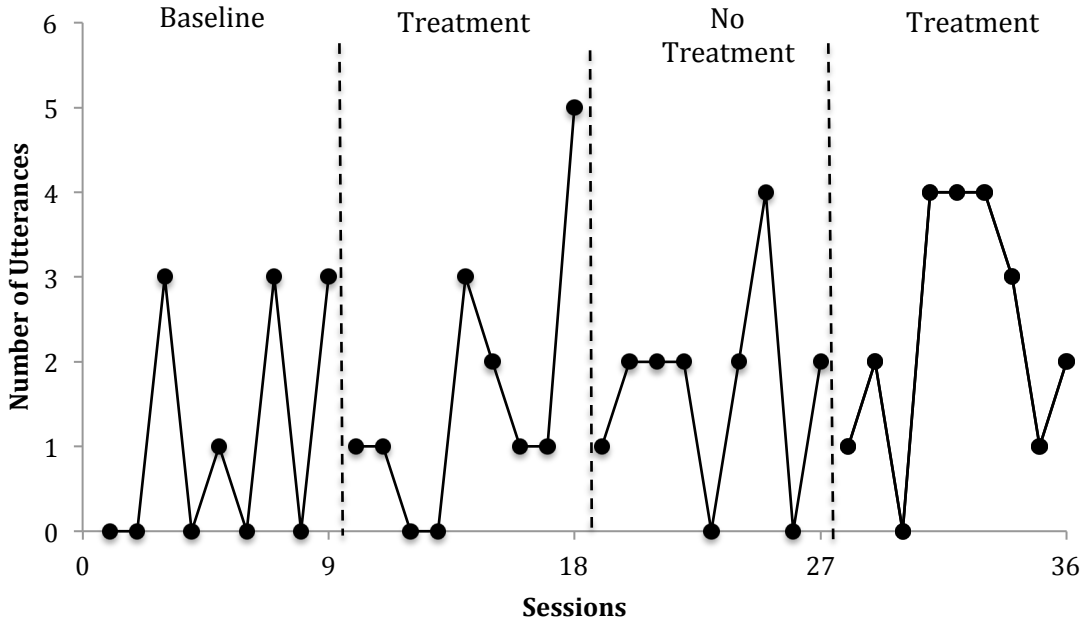


Figure 18. Multi word utterances for Bryan

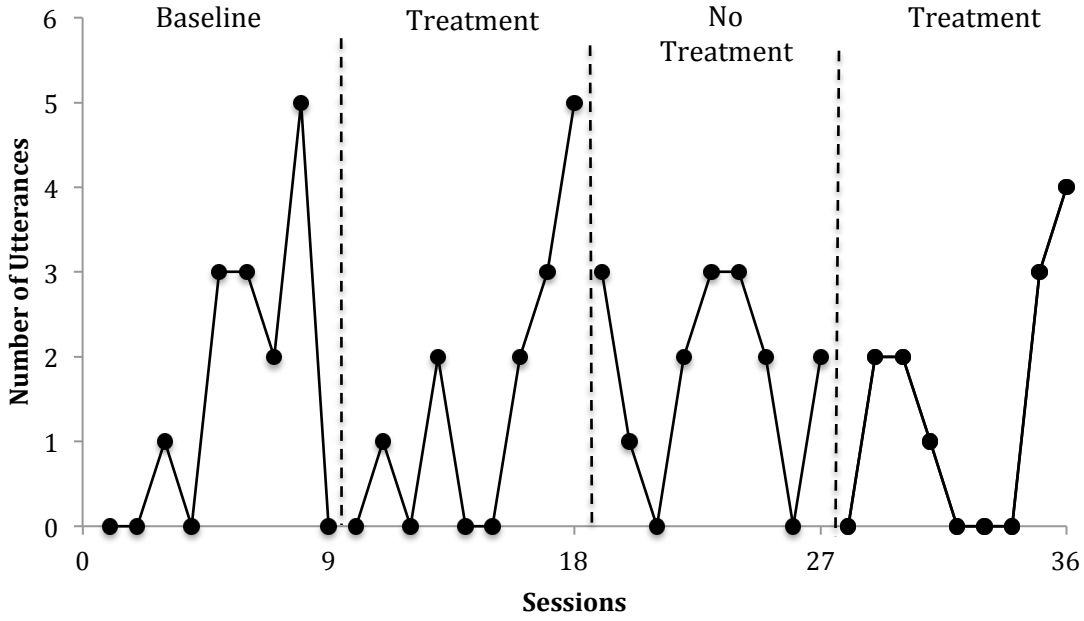


Figure 19. Teacher interactions for Bryan.

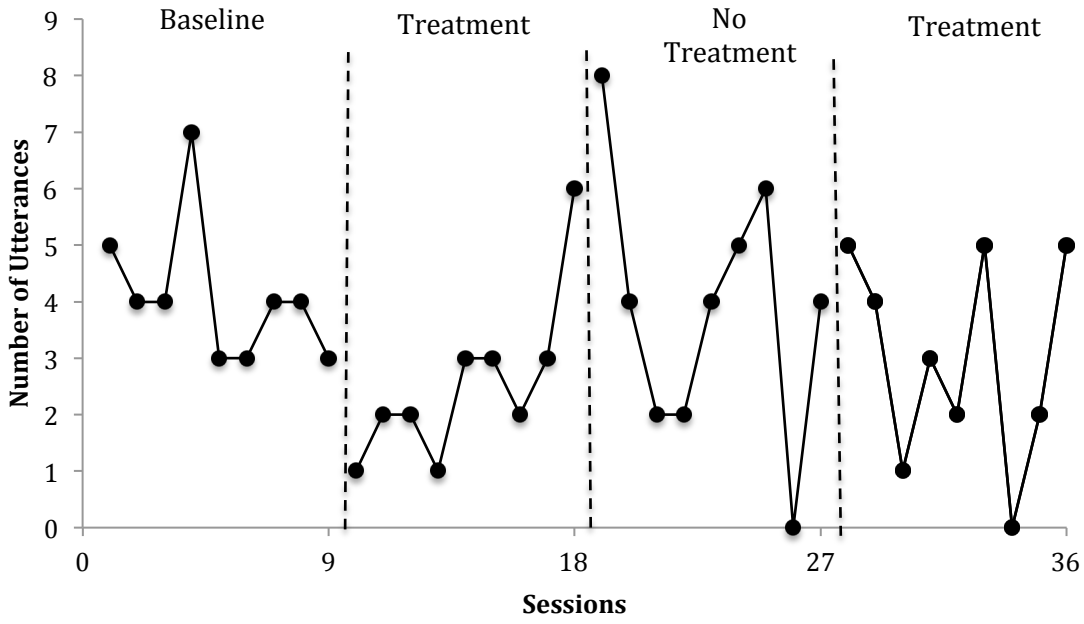
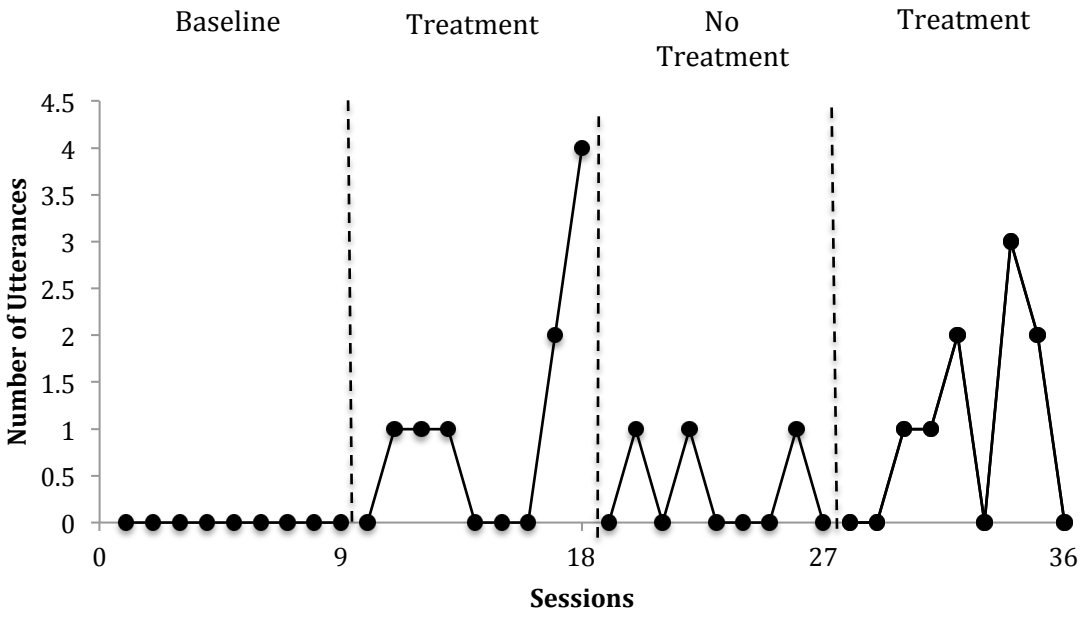


Figure 20. Peer interactions for Bryan.



Conclusion

During this study, each student participant accessed the Avatalker app on his or her iPad. The students were observed for 12 weeks throughout the study as they moved through the different phases of the trials of repeated measure. In terms of the observation of the student's general use of the Avatalker app on the iPad, the objectives align with the UDL objectives associated with the multiple means of representation, multiple means of action, and multiple means of engagement:

- Offer ways of customizing the display of information
- Offer alternatives for auditory information
- Offer alternatives for visual information
- Guide information processing, visualization, and manipulation
- Optimize access to tools and assistive technologies
- Use multiple media for communication

- Optimize relevance, value, and authenticity
- Promote expectations and beliefs that optimize motivation

In terms of the data analysis of the four student participants' verbal utterances, each student showed little to no improvement in increasing verbal utterances. Using percentage of nonoverlapping data (PND), each student had less than 50% (PND), which related to an unreliable effectiveness of the intervention.

Chapter Five: Interpretation, Conclusions, and Recommendations

Introduction and Purpose

Chapter Five discusses the findings from the surveys, interviews, and quantifiable data The analysis of the data will connect findings from the present study to current literature, present opportunities for future research, and recommendations for school leaders and classroom teachers to make critical technology decisions. Findings will add to available supports for teachers and professionals choosing technology to support students with ASD.

Infusion of technology into the classroom is happening at a rapid pace and continues to change the world of education. The devices do not change the way a student access assignments and resources, it is transformative in that it helps education match a transformed world (Burg, 2016). The process that teachers use for app selection is an important aspect leading to the successful integration of effective apps into instruction. Cumming, Rodriquez, and Strnadova (2013), researchers in mobile technologies, assert that teachers have a duty to collect data on the effects of the use of the iPad in the classrooms and use the data to make the best instructional decisions possible.

The present study focused on two specific inquiries. First, what key elements must an iPad app possess in order for teachers to select it for use in their classroom? Farrall (2013), expert in AAC and assistive technology, notes that "very few articles, tweets, or blogs can be found that focus on the selection of AAC apps and even fewer on implementation of the AAC" (p. 158). This research is a step in the right direction for ensuring that school personnel make informed decisions about their app selections. Second, this study focused on the effectiveness of an iPad communication app when used by students with autism.

O'Malley, Lewis, Donehower, and Stone (2014) confirm that the effectiveness of iPads used by students with disabilities is an area that needs further research. After implementing the survey, interviews, and quantitative observational research methods, the results provide a blueprint for reviewing, selecting and integrating technology choices.

Interpretation of Results- RQ #1

When searching for apps that focus on communication to use with students diagnosed with ASD, what key elements must be encompassed in the iPad app in order for it to be chosen by the teacher for the student's educational plan?

To answer RQ #1, data from Part I and Part II of the teacher survey, along with data from the teacher interviews, were analyzed to determine the selection process teachers use for selecting apps and what elements an app must possess to be selected for student use. The following interpretations were made after an analysis of the data was completed.

Absence of a school process for app selection. Respondents to the survey used technology in the classroom; however, the process for selecting apps for students was still unclear to survey participants. Those responding represented the areas of instructional coaching, speech language therapy, teachers of exceptional children, and Pre-K itinerant services. By covering such a wide array of school-based personnel, it was possible to get a full picture of the knowledge base throughout the school setting.

Survey responses showed there was not a clearly defined app selection process for the school. Only 11% of the survey respondents agreed with an understanding of the process, whereas 78% disagreed or strongly disagreed, and 11% responded as not applicable. Although there were only 9 responses to the question focusing on the school app selection

process, this represents a cross-section of the staff of the school and a fairly comprehensive representation of the staff working with students with autism.

The lack of a clearly defined school app selection process was again demonstrated as 40% disagreed or strongly disagreed to using a process for selecting apps, 20% responded they had used the school's process, and 40% responded as not applicable. The trend pointed toward a lack of a clearly defined school process as participants responded to the question concerning their use of the process to select communications specific apps for their students. Only 10% responded to using the school's process, 50% disagreed or strongly disagreed, and 40% responded as not applicable.

As data analysis indicated, teachers were looking for effective apps for the iPads that would engage and motivate the students in their classrooms. They sifted through the apps available on the App Store and choose the apps that they feel would further advance the levels of the students. Survey responses indicated that teachers looked for "ease of use, good reviews from users, student motivation, student engagement, and price" when searching for apps. Others survey respondents stated they were looking for apps that are "skill targeted," "build independence," and would help the students get "more involved" with "great animation" and "colorful visuals." Responses from the survey stated they (teachers) looked for suggestions from the "experts within the school," "knowledgeable teachers," and "coworkers who had experience with an app." Interviewee C stated: "I look to the SLP (Speech Language Pathologist) or the instructional coach for exceptional children for suggestions" for apps that focus on communication. Glover, McCormack, and Smith-Tamaray (2015) state, "teachers and SLTs (Speech-Language Therapist) have different but complimentary skills in developing children's language and learning" (p. 365). Classroom

teachers bring expertise in the areas of curriculum and instruction, whereas the speech-language pathologist is focused more on linguistics, communication techniques, and speech disorders of students.

Technology rollouts are taking place much faster than research can be conducted and published. A possible approach for addressing the fast-paced changes associated with these rollouts would be for teachers and other professionals in the schools, working as a collaborative group to use action research to gather data about the benefits of apps and other technologies.

Credibility of app reviews. The unclear process for selecting apps led many teachers to choose their own apps to use with students. As teachers chose apps from the App Store, they often used reviews written by others who had downloaded the app as a basis for selection. Liang, Lin, Yang, and Wang (2016) reported, "apps are often distributed through app stores that allow consumers to post comments about apps. As a result, consumers often consult consumer reviews in making their purchases" (p. 237). Selecting apps based on app reviews, whether it is Apple® iTunes or Google Play, has elicited contradicting schools of thought. Maalej, Kurtanovic, Nabil, and Stanik (2016) argued, "recent studies have shown that reviews written by the users represent a rich source of information for the app vendors and the developers, as they include information about bugs, ideas for new features, or documentation of released features" (p. 311). Other authors have expressed different viewpoints. Schmidt, Paek, MacSuga-Gage, and Gage (2017) emphasized, "nonetheless, the prevalence of app stores in users' discovery of apps is troubling due to the problems associated with app stores, the overwhelming amount of apps available in app stores, and inadequate app evaluation mechanisms" (p. 13). Some of the app reviews are written by paid

reviewers to drive up the number of reviews to a higher number. Instead of using normal marketing campaigns, "shady" app designers often use fake means of driving up the ranking and manipulating the rankings of their app in the App Store (Zende & Gupta, 2016). Paralleling that theme, authors also felt app store reviews could be misleading. Maalej et al. (2015) noted, "unfortunately, there is also a bunch of useless, low quality reviews, which include senseless information, insulting comments, spam, or just repetition of star ratings in words" (pg. 312). As teachers move to the app store to select apps, choosing quality apps has proven to be a gamble not only due to the enormous number of apps available but also due to the app reviews being written by paid reviewers or those simply requesting technical support. With no formal app selection process in place in schools, teachers must decipher the myriad app store reviews, with all of the associated difficulties in determining what is credible information about the apps.

The need for more action research. The opportunity to look critically at app usefulness through the use of action research has the potential to allow professionals in academia to work in conjunction with educators at the school level to promote the use of research-based findings for programs. The current literature shows that research is not keeping up with the swift pace of technology integration into the schools. One problem is that humans cannot keep pace with all the technology that has been developed (Liedtke & Ortutay, 2015). Technology accelerates because the current generation of devices improves on the past, which results in a rapid rate of progress (Berman & Dorrier, 2016). Through partnerships with school districts, individuals at the university level can conduct research that needs immediate attention from the research community.

Based on the responses from the survey and interviews, teachers are looking to find the technologies that are needed to make students more successful. Teacher survey responses indicate that they aspire to find "what works with students." However, using surface level characteristics, they choose certain apps. Choosing an app on basic level criteria can lead to technology that is not utilized effectively. Gosnell et al. (2011) confirm:

> Surely, the greatest harm of a faulty clinical decision is the time wasted learning or attempting to learn to use an inappropriate communication technology. To this end, parents and many clinicians are part of the hype, making purchases of mobile technology and apps without clinical evaluations. (p. 87)

Another interpretation is that collaboration among the teachers and other experts in the school, using a critical lens to evaluate apps, would greatly alleviate the concerns of not having a process for selecting apps. This would allow for digging deeper into the technology choices, rather than using only basic selection criteria.

An exploration into iPad app usefulness can be accomplished through participation in action research. These opportunities allow teachers of exceptional children, speech language therapists, instructional coaches, classroom teachers, and others to test the usefulness of apps, technology, or programs associated with improving student communication. With the growth in technology usage in the schools, the time to look critically at apps is now. The prophetic statement by Woodward and Reith (1997), "research on the use of technology for students with disabilities has expanded considerably over the last few decades, resulting in an agenda that encompasses a diverse range of innovative instructional and assessment programs" (p. 503), reflects this sentiment. This statement provides support for the need for focused

research on the development of technology programs for use with student diagnosed with autism.

Implications

The results of research question #1 may contribute to the overall development of a school-based app review team, which would view app selections and possibilities with a critical lens. The team of professionals can critically evaluate an iPad app or other technology, to evaluate the internal design to ensure that it is appropriate and will be efficient for student use. Other implications include teachers designing their own action research, and taking ownership of the data collection and results. Not only will they add the element of critical inquiry but also provide research-based conclusions for colleagues. This covers all facets of the school, not just the area of exceptional children. Teachers from all areas could play a major role in improving decision making at the school level. The results of the study could also influence purchasing decisions at a local level, as apps that have been researched and found to be effective, could be purchased for use with students.

Limitations

The interpretations for Research Question #1 centered on the elements an app must possess to be chosen for use with students diagnosed with autism. Through analysis of the data, it was concluded that even though teachers used basic selection criteria (price, user reviews, possible benefit, visuals, animation, etc.), there is still a need for more in-depth, critical review of app downloads and purchases. Allowing teachers the autonomy to design and conduct their own action research will possibly solidify the results when data is used to support decisions. There are limitations, one of the most prevalent focusing on the element of time. Action research projects can be very time-consuming. Teachers have many duties to

complete each day and the time need to complete a complex research project many not always be available.

The methodology used for research question #1 used a small sample of the professional population (10), with a follow-up interview (5). This sample was small scale, but the data collected from the participants can be utilized at the school and county level. County level leaders who are searching for effective apps for use by students can use the data from this study to install in-depth app review processes, whether it be a school-based app review team or the use of an evaluation rubric, for selection of apps.

Recommendations for Future Research

With the results from Research Question #1, professionals at the school level can better employ methods to ensure that apps and other technologies for student use are research based. However, future research opportunities still exist. This study was conducted at an elementary school for Pre-K through 5th grade students. Further research could be conducted at a larger elementary school. Also, future research in this area could incorporate middle and high school participants.

Future research should also be undertaken in the usefulness of apps that are used with students in regular education classes. As shown by the results of the teacher surveys and interviews, teachers are using basic criteria for selection. Apps that are used for students in regular education classrooms also need evaluation to ensure quality supports are coupled with curriculum to promote growth.

Another area of future research lies within app reviews on the App Store. The literature showed a conflict between those authors who felt the app reviews provided valid feedback from users, whereas others concluded that compensated reviewers wrote reviews

and were employed to artificially inflate reviews and generate revenues for app developers. More research is also needed in the area of school teams assembled to review apps. The team approach versus an individual approach could be studied further.

The use of an evaluation rubric for app selection is another area for future research. Respondents to the survey were using various criteria to choose apps. Further research into the use of an organized selection rubric could provide more insight into processes and choices the teachers apply when selecting apps. There are several app evaluation rubrics available to teachers and other educational staff to utilize for evaluating the apps that children are using in the classrooms. Kathy Schrock, a leader in integrating technology and curriculum, designed one such evaluation rubric. The rubric (Critical Evaluation of Content Based iPad / iPod Apps) evaluates apps using criteria such as connections to the curriculum, differentiation, student motivation, and links to Common Core State Standards. Harry Walker of Johns Hopkins University designed another evaluation rubric. The rubric (Evaluation Rubric for iPad / iPod Apps) uses the categories of relevance, customization, thinking skills, usability, engagement, and sharing to evaluate apps used on the iPad and iPod. These app rubrics provide a great opportunity for future research into in-depth study of app selection processes by teachers.

Conclusions for Research Question #1

The results of research question #1 concluded that teachers are using technology in the classrooms at high percentages. When surveyed, 80% of the respondents stated they used technology, specifically iPads, in their classrooms. The high percentage of use among the respondents was supported with literature that focused on the large amounts of technology that has inundated the classrooms nationwide over the last decade. However, when choosing

apps for the iPads, teachers were using surface-level characteristics to choose an app for use with students diagnosed with autism. The topics of engagement, motivation, app reviews, and animations were mentioned on several occasions throughout the data collection when interviewing teachers and analyzing survey responses. When asked about the process for selecting apps for student use, most respondents were unsure of a school process but employed their own tactics for selection, which included choosing apps based on the criteria listed above, trial and error, and inquiring about possible apps with colleagues and other professionals in the building. The results of this study indicate the need for a collaborative effort to review and implement apps that were supported with research-based findings. One possible response to this need is the use of action research within the school, which could provide an opportunity to present research-based data to those individuals who are searching for apps to use with students.

Interpretation of Results- RQ #2

The following are interpretations for research question #2.

Research Question #2

Will verbal interactions increase in elementary-aged students with autism when using the Avatalker® iPad app*?* To answer RQ #2, the Avatalker® iPad app was implemented using an ABAB quantitative observational research design. Students were observed and verbal utterances were recorded on a frequency chart. Data on overall verbal utterances, one-word utterances, multi-word utterances, teacher interactions, and peer interactions were collected throughout the study. Two major interpretations were made after analysis of the data. The first interpretation centers on the use of framed scripts with students diagnosed with autism.

The second interpretation focuses on a deeper need for more social awareness and interaction programs for students diagnosed with autism.

Need for continued research on use of technology to increase verbalizations. The use of technology devices, especially the iPad, by students diagnosed with autism continues to gain momentum in the research literature. Technology use by students with autism connects to current literature through computer and iPad instruction. Bolte, Golan, Goodwin, and Zwaigenbaum (2010) state:

> As students with autism spectrum disorder may have difficulties automatically ignoring irrelevant stimuli and forming meaning gestalt perceptions, the computer may be a good medium to present optimal, adaptive learning contexts for each child, with the option to slowly and systematically increase levels of complexity. (p. 157)

The effects of iPad usage among students with autism have garnered positive reviews from current researchers. If individuals find success using the iPad for organization or communication, then it is a tool that will make a difference in the lives of the user (Hill, Belcher, Brigman, Renner, & Stephens, 2013). The continued increase in the volume of devices that students access will continue to pave the way for updated technological devices. Kagohara et al. (2013) write, "these devices appear to be making inroads into educational and rehabilitation programs involving persons with developmental disabilities" (p. 148). The broader literature supports the findings from current observational research, which indicates that the use of technology can lead to success for the student in increasing verbal utterances.

Need for social awareness and social interaction exists. Failure to maintain social interactions is an attribute of ASD. Students with autism and those with other developmental disorders are often characterized as having difficulty with social interactions (Graham et al.,

2016). In this study, exposure to the four framed statements aligned with an increase in verbal utterances for the students; however, the layer of progression for the students and their recorded utterances overwhelmingly happened during interactions with the teacher and teacher assistant in the classroom. It is important to note that the study was designed to take place in the classroom, where more teacher-student interactions would happen. The number of teacher interactions recorded indicated this. However, there were times for interaction with peers, though not in as large a quantity as the teacher interactions. During the times when students could have interacted with peers, many did not seize the opportunities, therefore; the data for peer interactions between students did not mirror the fruitful results for the increase in verbal utterances. The very small numbers of observed peer-to-peer interactions throughout the duration of the study (regardless of phase or treatment presence) made it difficult to draw conclusions about the effectiveness of the Avatalker® iPad app to impact peer interactions. The lack of consistent data in this area unveils a continued need for social awareness and interaction initiatives.

Using technology to build student socialization skills. Literature also points to not only the need for social problem-solving programs but also the use of technology to assist in training students with autism to interact socially in a positive manner with peers and other individuals. Bosseler and Massaro (2003) state, "strategies to promote generality across settings, people, and situations are necessary components of treatment programs for those with autism" (p. 654). Technology can be added to aid in instruction. Bernard-Opitz et al. (2001) emphasize "for children, adolescents, and adults with autism, computer programs modeling everyday conflicts and their solutions might be a positive avenue to reduce problem behavior in real life settings, teach divergent and consequential thinking, and

appropriate social scripts" (p. 384). Social interaction programs combined with technology-based delivery could positively aid individuals with autism in acquiring the skills needed for success.

Implications

The results of RQ#2 have several implications. Students in the study had access to current technological devices and apps. Access to these tools has major implications for the future of education. New devices and apps are constantly consistently entering the market and newer versions of devices and apps are continually being introduced. The results of this study have the capacity to aid school districts in developing strategies as curriculum and technology decisions are made concerning the purchase of apps for use with students diagnosed with autism.

Another implication is the need for continued focus on increasing the skills needed for successful peer interactions and social awareness. As the data shows, there was a substantial lack of peer interactions between students regardless of whether they were using AvaTalker® or not. Many times, students diagnosed with ASD find social awareness a major hurdle to overcome in the classroom. The student may feel comfortable approaching the teacher or teacher assistant; however, the awareness that the other students in the classroom have thoughts, feelings, and emotions is lacking considerably. As instructional decisions are made, the need to review a program that builds the capacity for peer level social awareness and theory of mind is warranted.

Limitations

The results for Research Question #2 centered on whether or not the use of the Avatalker® iPad app would increase verbal interactions in students diagnosed with autism.

Limitations centered on the fact that this was a small-scale study, which only involved four students. A larger scale study could have generated more data, however, the four students who participated in this study provided a wealth of data that was greatly utilized for data analysis. It is important to note that the nature of the research for this study focused on the individual needs of each of the four students and is not generalizable to all students with autism.

Prior to the completion of the study, manipulation of the iPad by the students, distraction, too much time spent with the technology, and connectivity issues were reviewed as possible limitations to the study. None of these factors played a role in the study, as students had no difficulty manipulating the iPad, technology times was well scheduled in the classroom, and connectivity to Wi-Fi was maintained.

Recommendations for Future Research

Technology continues to become a major tool in education and the manner in which those tools are implemented into the classroom will always be an area of continual investigation. This particular study has many potential branches for future research inquiry.

Even though the study using the Avatalker® app did not yield positive outcomes, the results provide several areas that warrant attention, most especially for future study using this app. The research opportunities using the Avatalker® app are present and ready for more inquiry.

The app has many different settings and topic areas, such as grammar and language arts, programming for instruction on the socio emotional areas, and a typing function that will read the students work aloud. These areas will need a more in-depth inquiry into the different facets that the app can address and its effectiveness. The students who participated

in this study were diagnosed with autism and were verbal in some areas of language. The use of this app with students other than those diagnosed with autism could be an area for future research. The app, and all that it encompasses, could be used by students who may have a developmental delay, those who do not use verbal language, or those who are struggling with some realm of communication disorders. The possibilities of research using the Avatalker® app are present and ready for more inquiry.

The results of the study also yield another area of research focusing on the setting used in the research design. The students in this study were observed in an instructional setting (classroom). Future research could focus on the student interaction in different settings such as the cafeteria; specialty area classes such as music, art or physical education; and on the playground with other students. The app could be programmed with phrases that could aid in social growth when working and interacting with groups of peers outside of the instructional setting.

The time span of the research study using the Avatalker® is another area for future research. This study was conducted over a 12-week period and involved collection of 36 data points, which proved to be ample in achieving conclusions on the usefulness of the app. A study that is designed to continue throughout the entire school year could result in more data, that when analyzed, could yield more focused results and conclusions.

Conclusion for Research Question #2

The results of the analysis of data for Research Question #2 showed that the Avatalker® iPad app when programmed with scripts for the students was ineffective when used to increase overall verbal utterances of students diagnosed with autism. The results also showed that teacher interactions and peer interactions were inconclusive. When opportunities

existed, often the student did not seize the opportunity to interact with a classmate. From observational data collected, it is evident that the teacher or teacher assistant represents the comfort zone for many of the students, and most do not wish to step out of that comfort zone and interact with others.

Overall Conclusion for Study

The students of today have the world at their fingertips. The technology available to them can transport them across the world with just a few clicks of a mouse or swipe of a finger. The creation of apps allow for supplemented lessons and give students the freedom to practice skills throughout the day and at home. As students progress and utilize technology more and more each day, the possibility for increasing skill proficiency needed for success continues to increase.

This study was designed with two distinct research questions that would show the significance of research-based decisions and how they impact children diagnosed with autism. Teachers are constantly bombarded with new initiatives, assessments, and curriculum. The overwhelming nature of having so many initiatives "thrown at them" often leaves many educators grasping at whatever data is available to make decisions, even if that data is weak or nonexistent. From the results of the first research question, teachers are using app reviews, the accolades that an app may have been awarded, and word of mouth from colleagues and experts within the building to make decisions on choosing apps to use with students. The term "trial and error" came up several times in the survey and interviews. This leads many teachers to choose an app, install it, and then wait for results that may or may not be what are expected. There is no research support for this method, just a "pick something and try it" mentality. A more formalized data collection and analysis process would be

beneficial for addressing the inherent weaknesses of such an ad hoc approach. One potential avenue for teachers and individuals in academia may be through action research, which can assist teachers and school districts to make the best decisions for the students. Postsecondary academia can assist in this area through partnerships with elementary and secondary schools and school districts. These entities, working together to employ experimental designs, can complete research in an area that is constantly evolving. Taking a closer look at this area of inquiry will add a plethora of research-based knowledge to the current literature.

The inquiry into the Avatalker® iPad app uncovered two distinct areas of impact: the use of communication apps to aid in growth of student verbal utterances and the need for more social awareness programs for students diagnosed with autism. This study adds to the research literature on this topic due to the fact that this area of inquiry is still relatively new, and the technology is quickly changing. As districts add technology and programs, such as iPad apps, to their curriculum planning, they should begin to look for research-based studies that focus on programs and how they relate to student growth and development.

We live in a time when technology is moving at an unbelievably rapid pace. The proliferation of devices and programs into classrooms is happening on a daily basis. The research opportunities to investigate these devices and the manner in which they are integrated into the curriculum can result in school leaders and educators making more informed decisions on the direction of instruction and supplemental decisions for children with autism. The decisions being made are for the most important piece of the educational puzzle in the forefront: the students who enter the school door each morning.

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Appendix A

Teacher Survey

Thank you in advance for your willingness to participate in the survey.

Please answer each of the following questions. Please return to Bob Acord in the envelope provided.

	Strongly Disagree	Disagree	Agree	Strongly Agree	N/A
I use technology every day in my classroom					
I use Apple® iPads in my classroom					
I have my students use communication-specific apps on the Apple® iPads in my classroom					
I understand the process the school has for selecting iPad applications					
I have used the app selection process to identify apps to include on the iPads					
I have used the app selection process to identify Communication-specific Apps to include on the iPads					

Please describe the app selection process used at your school (as you understand it):

Please describe what you look for in an app when determining whether to use it in your classroom:

What are the five most frequently used learning applications in your classroom use?

What are the pros to using iPad applications when working with students with autism?

What are the cons to using iPad applications when working with students with autism?

Appendix B

Teacher Consent Form

Teacher Decision Making Processes and An Analysis of the Avatalker Application When Used With Students Diagnosed With Autism

Principal Investigator:
Bob Acord
Contact Information:
Bob Acord at wacord@burke.k12.nc.us or 828-432-6935
Dr. Patrick O'Shea at osheapm@appstate.edu or 828-262-6044

Teacher Consent Form

Why are we doing this research?
In our research study, we want to focus on the process and procedures teachers use when selecting applications to use with students diagnosed with autism.

What will happen in the research?
I am asking permission to survey you on the processes and procedures that you use when selecting applications to download to the tablet that the students in your classroom use each day.

What are the good things that can happen from this research?
When we finish the research we hope we know more about the steps that educators use to select applications to use in the classroom.

What are the bad things that can happen from this research?
There is little to no risk of any negative possibilities during this research. Teachers will be asked to answer survey questions focusing on their use of technology and the processes they use for selecting applications for use on the students iPads.

What else should you know about the research?
You have a choice to be a part of the research study. You can say Yes or No. Either way is OK. If you say Yes now and change your mind later that is OK. You can stop being in the research at any time. If you want to stop, please tell Dr. O'Shea or me. If you decide to not take part in the survey, your employment status with Burke County Schools will not be jeopardized in any manner. School officials will not have access to any of your research data. All data will be identified as Teacher A, B, C, etc. There will be no identifying characteristics with the data and shredding at the completion of the research study will destroy all data collected.

Take the time you need to make your choice. Ask us any questions you have. You can ask questions any time.

If you would like to participate in the research, please read this statement and sign your name below:

The researcher has told me about the research study. I had a chance to ask questions. I

know I can ask questions or stop at any time. I wish to be a part of the research study.

_____
Print your name

_____ _____
Sign your name Today's Date

Appalachian State University's Institutional Review Board has determined this study to be exempt from IRB oversight.

Copies to: Teacher Participant

Appendix C

Teacher Consent Form

Teacher Decision Making Processes and An Analysis of the Avatalker Application When Used With Students Diagnosed with Autism

Principal Investigator: Bob Acord
Department: Education and Leadership
Contact Information: 828-432-6935 / wacord@burke.k12.nc.us
Faculty Advisor: Dr. Patrick O'Shea- osheapm@appstate.ed / 828-262-6044

Consent to Participate in Research
Information to Consider About this Research

I agree to participate as an interviewee in this research project, which concerns Teacher Decision Making Processes and An Analysis of the Avatalker Application When Used by Students with Autism. The interview will take place in the school conference room. The interview will last 15 minutes. I understand the interview will be about teacher decision-making and the usefulness of iPad applications when used by students with autism.

I understand that there are no foreseeable risks associated with my participation. I also know that this study may benefit the Exceptional Children's Program.

I understand that the interview(s) will be audio recorded and may be published. I understand that the audio recordings of my interview may be destroyed following the closure of the study if I sign the authorization below.

I understand if I sign the authorization at the end of this consent form, photos may be taken during the study and used in scientific presentations of the research findings.

I give Bob Acord ownership of the tapes, transcripts, recordings and/or photographs from the interview(s) s/he conducts with me and understand that tapes and transcripts will be kept in the researcher's possession until the study is closed. I understand that information or quotations from transcripts will be published, be published following my review and approval. I understand I will not receive compensation for the interview.

I understand that the interview is voluntary and there are no consequences if I choose not to participate. I also understand that I do not have to answer any questions and can end the interview at any time with no consequences.

If I have questions about this research project, I can call Dr. Patrick O'Shea (828) 262-6044 or the Appalachian Institutional Review Board Administrator at 828-262-2692, through email at irb@appstate.edu or at Appalachian State University, Office of Research Protections, IRB Administrator, Boone, NC 28608.

This research project has been approved on 6/23/16 by the Institutional Review Board (IRB) at Appalachian State University. This approval will expire on unless the IRB renews the approval of this research.

☐ I request that my name **not** be used in connection with tapes, transcripts, photographs or publications resulting from this interview.

☐ I request that my name **be used** in connection with tapes, transcripts, photographs or publications resulting from this interview.

By signing this form, I acknowledge that I have read this form, had the opportunity to ask questions about the research and received satisfactory answers, and want to participate. I understand I can keep a copy for my records.

_____

Participant's Name (PRINT) Signature
Date

[OPTIONAL] If you wish to waive the signature, remove the above items and use this wording:

By proceeding with the activities described above, I acknowledge that I have read and understand the research procedures outlined in this consent form, and voluntarily agree to participate in this research.

Photography and Video Recording Authorization

With your permission, still pictures (photos) and/or video recordings taken during the study may be used in research presentations of the research findings. Please indicate whether or not you agree to having photos or videos used in research presentations by reviewing the authorization below and signing if you agree.

Authorization

I hereby release, discharge and agree to save harmless Appalachian State University, its successors, assigns, officers, employees or agents, any person(s) or corporation(s) for whom it might be acting, and any firm publishing and/or distributing any photograph or video footage produced as part of this research, in whole or in part, as a finished product, from and against any liability as a result of any distortion, blurring, alteration, visual or auditory illusion, or use in composite form, either intentionally or otherwise, that may occur or be produced in the recording, processing, reproduction, publication or distribution of any photograph, videotape, or interview, even should the same subject me to ridicule, scandal, reproach, scorn or indignity. I hereby agree that the photographs and video footage may be used under the conditions stated herein without blurring my identifying characteristics.

_____

Participant's Name (PRINT) Signature Date

Appendix D

Student Observation Protocol

Student Name: _____

Date of Observation: _____

Time of Observation: _____

Verbal Utterance Frequency Chart for Observation

Total Number of Verbal Utterances for the observation: _____

Observation Summary:

_____

_____

_____

_____

_____

_____

_____

_____

_____

Vita

William Robert (Bob) Acord Jr. was born in Beckley, West Virginia. He attended Raleigh County Schools from Kindergarten through 12th grade and graduated from Liberty High School in Glen Daniel, West Virginia in 1990.

Bob attended The College of West Virginia in Beckley, West Virginia and graduated in 1993 with an Associates degree. He then transferred to Concord University in Athens, West Virginia where he graduated in 1996 with a Bachelors degree in Elementary Education (K-6).

In 1997, he accepted a position as an 8th grade Mathematics teacher at Table Rock Middle School with Burke County Public Schools in the foothills of western North Carolina. At the end of the year, he was named Sallie Mae First Teacher of the Year for Burke County Public Schools. In the fall of 1998, he accepted a position to teach 4th grade at Glen Alpine Elementary School, a feeder elementary school to Table Rock Middle School. During his time at Glen Alpine Elementary School, Bob continued his education and graduated from Gardner-Webb University in 2001 with a Masters degree in School Administration K-12.

In September 2001, he accepted an assistant principal position that split two elementary schools within the Burke County School system, Valdese Elementary in Valdese, North Carolina and Forest Hill Elementary in Morganton, North Carolina. In August 2002, he was named principal of Forest Hill Elementary School and in 2005 moved to Valdese Elementary School as principal. During this time, he graduated from Appalachian State University in 2006 with his Educational Specialist degree.

In 2011, he was named principal at Hildebran Elementary School in Hildebran, North Carolina. He started work on his doctorate at Appalachian State University in August 2011. In June 2013, Bob was named Assistant Director of Auxiliary Services for Burke County Public Schools. He received his Doctorate in Education Leadership from Appalachian State University in December 2017.

Dr. Bob Acord is married to Misty Acord, a former 4th grade teacher and current instructional coach for Burke County Public Schools. They have one daughter, Kinley, who attends Burke County Public Schools. They live in Morganton, North Carolina.