ABSTRACT

Effectiveness of Communication Devices Pertaining to Students with Communication Impairments

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Speech generating devices (SGD) allow individuals with verbal disabilities to speak through the use of an augmentative device. With the introduction of the iPad/iPod® devices, these individuals have greater accessibility to speech generating devices. This review evaluated the results reported in ten studies that used the iPad/iPod® with children or adults in need of augmentative communication. The results suggest that iPad/iPod® usage and the SGD most often employ the Proloquo2go® application. In addition, those children with a diagnosis of autism were most likely to show positive results from the use of these devices. Of the 31 subjects in the ten studies, 74% showed improvement. Eighteen of the twenty children diagnosed with autism were reported to have improved through the use of the iPad/iPod® SGD. Those studies that followed the children for the most contact time tended to have the most positive results.

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Effectiveness of Communication Devices Pertaining to Students with Communication Impairments

A Thesis Submitted to the Faculty of

Baylor University

In Partial Fulfillment of the Requirements for the

Honors Program

By

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Waco, Texas

May, 2015

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DEDICATION

To my parents, who have taught me to value education.

To Dr. Whipple, who has given me confidence in pursuing my goals.

To Mrs. Montgomery, who has given me a reason to teach.

CHAPTER ONE

Literature Review

The Individuals with Disabilities Education Act (IDEA) provides funds to states and assists in providing a free and appropriate public education (FAPE) in the least restrictive environment to children with disabilities who are in need of special education or related services (Justesen et al., 2006). A disability is defined as "an environmentally contextualized health-related limitation in a child's existing or emergent capacity to perform developmentally appropriate activities and participate, as desired, in society" (Wise, 2012, pp. 1). According to the IDEA law, there are thirteen types of disabilities. These disabilities include autism, deaf-blindness, deafness, developmental delay, emotional disturbance, hearing impairment, intellectual disability, multiple disabilities, orthopedic impairment, other health impairment, specific learning disability, speech or language impairment, and traumatic brain injury (Wright, 2007). In order to receive special education or specially designed services, a student must have a recognized disability and a documented need for specialized instruction (Crow, 2008). The term disability is the umbrella term for impairments at the body level, activity restrictions at the person level, and the participation restrictions at the person-in-society level (Halfon et al., 2012). A child or adult with a disability may or may not need special education services. However, in 2009, under IDEA, more than 6.5 million children, representing over 13% enrollment, were receiving special education services in public schools (Halfon et al., 2012).

Many children or adults with disabilities have limitations in communication abilities. The prevalence of people who have communication disorders is estimated to be from 5-10% (Ruben, 2000). In 2005, the American Speech-Language-Hearing Association reported that there were approximately two million people in the United States who can hear but who have limited or no skills in verbal communication (Wilkins & Ratajczak, 2009). Communication limitations may be relatively minor, such as difficulty with sound enunciations and slurring of speech, which affect the quality of speech production but typically do not impair the individual's ability to utilize verbal communication in functional life skills (e.g., Best & Butler, 2012). Communication limitations could have a significant impact on a person's daily life, such as having no verbal communication skills or a significant hearing impairment (e.g., Best & Butler, 2012).

Limited communication skills can have various negative impacts on an individual's life. These persons have fewer opportunities to participate in literacy activities (Wilkinson & Rosenquist, 2006), decreased opportunities social interaction, and decreased academic opportunities. Moreover, individuals with limited communication are likely to demonstrate increased problem behavior (Halfon et al., 2012).

Augmentative and alternative communication (AAC) is "an area of clinical practice …for the impairment and disability patterns of individuals with expressive disorders" (Bryant et al., 2003, p.93). AAC exists in two formats, unaided and aided methods of communication.

The unaided method of communication refers to a communication system that does not involve the use of external equipment or devices. This includes sign language, educational sign systems or gestural language code. The aided methods use equipment and/or devices to provide people with the ability communicate. Examples of these aided AAC devices include pictures and communication boards, enabling learners who have special needs to use pictures or sounds to describe their needs. When selecting an AAC aided method, individuals can select from either a non-electronic device, such as a non-electronic communication board or communication books, or an electronic device, also known as a speech generating device (SGD), utilizing various switches and producing voices of different pitches and quality. The types of electronic devices vary in terms of what kind of switches may be used to activate the buttons. The switches may include the direct selection, puff switch, single button or two button switches, eye gaze switches, or voice activated switches. Some devices allow for various scanning patterns in order to increase the speed of response. Devices also sometimes offer varying voices, both male and female, and varying arrays of picture symbol sets (Bryant et al., 2003).

An SGD is a form of electronic, aided device used for communication (Bryant et al., 2003). The child and or adult use direct access such as touching or accessing a switch device to activate a symbol, which will then speak whatever has been programmed into that space. Children with a variety of disabilities may benefit from an SGD, including individuals with a language delay, intellectual disability, autism spectrum disorder, cerebral palsy, traumatic brain injury, or stroke (Wilkins & Ratajczak, 2009). This SGD is also used as a speech aid that provides individuals

with severe speech impairments to meet their functional speaking needs on a daily basis. Such devices enable people to convey feelings or thoughts with others (Wilkins & Ratajczak, 2009). SGDs come in many shapes and sizes and with a varying degree of function. They can be anything from a hand-held pocket book to a lapboard keyboard. SGDs can serve a variety of purposes, such as specific requests for snacks and toys, collaboration with their peers, and reducing the impact of speech impairments. It has opened up a new era of autonomy, self-worth and most importantly, confidence for persons with special needs (Murray & Olcese, 2011).

As technology advances, so do the variety of SGD options. During the turn of the century, new technology has provided a new type of SGD. One particular advancement that may provide new, innovative SGDs are the iPod®, iPad®, and similar tablet devices. A tablet computer device is a general-purpose computer contained in a single panel (Freedman, 2013). Its distinguishing characteristic is the use of a touch screen as an input device (Freedman, 2013). These devices are also used as assistive technology, or to help a child function independently and to perform essential daily tasks, including those involving hygiene, mobility, and social interaction" (Wise, 2012).

Since the introduction to the iPad® in 2010, its use in schools has become prevalent (Murray & Olcese, 2011). This interactive, engaging technology has established a new generation of updated and speedy access to the world of communication. For example, the iPod® has a 4-inch touch screen (Official Apple Store, 2013). The iPad® mini is 7.9 inches in length (Official Apple Store, 2013). The iPad® is 9.5 inches in length, weighs 1.33 pounds and is 0.34 inches thick (Official

Apple Store, 2013). Both the iPod® and iPad® are lighter than previous dedicated devices such as the Dynavox V. As a result, these devices have increased portability in comparison to many traditional SGDs.

Since the release of the iPad®, over 250,000 applications have been created for students, teachers, and parents to use (Murray & Olcese, 2011). Many of these applications are useful for educational instruction, such as applications that teach and/or make available time, maps, calculators and weather information (Murray & Olcese, 2011). Of particular interest, are applications that serve to convert an iPad® into an SGD, in which the screen has a selection of icons that when touched, emit a prerecorded message to assist the user in communicating a message. Several SGD applications are available on the market today. Some of these applications for the iPad®, iPod®, and iPhone® include Proloquo2go®, Kurta Series 2, Assistive Chat, Scene Speak, New Oxford American Dictionary, First Then Visual Schedule, ArtikPix-Full, Tap to Talk, Sonoflex, L.A.M.P. and EyeNote (Official Apple Store, 2013).

Tablet devices with SGD applications may offer many potential benefits over the traditional SGDs. The wireless iPad® and iPod® have batteries that last for up to 10 hours and are energy-efficient. The iPad® ranges in expense from $300 to $700 (Enablemart, 2013). The iPod® ranges in expense from $100 to $800 (Enablemart, 2013). Other traditional SGDs range from $10 to $8,000 (Enablemart, 2013). Some additional, less stigmatizing benefits to the iPad® that serve additional purposes include enhancing academic skills in any domain and for any level needed. The iPad® also has music, photos, documents, internet, iBooks, and a

plethora of applications to use for games or even make flashcards (Official Apple Store, 2013).

The purpose of this paper is to summarize existing literature evaluating the effectiveness of digital tablet devices serving as AAC devices for persons with disabilities.

CHAPTER TWO

Methods

A methodical search was conducted to identify studies involving the use of iPads®, tablets, iPods®, eReader, iPhone, and other similar portable multimedia devices to promote communication among students with disabilities. In addition, many studies were identified from Kagohara and colleagues' (2010) literature review of iPods® and iPads® in programs for individuals with developmental disabilities.

Search Methods

An electronic database search was conducted using Education Resources Information Center (ERIC), PsycINFO, Education Research Complete, PsycARTICLES, Psychology and Behavioral Sciences, and PsycEXTRA. The following terms were entered into the keyword searcher using Boolean operators: *intellectual disability, communication disorder, expressive disorder, communication disability, speech impairment, learning disorder, learning disability, disability, autism, and retardation.* A total of 222 studies were identified in this search. Of these 222 studies, many of them dealt with things such as the doctor administering medication via a tablet or devices being used as an aid instead of a form of communication. Only six studies met the inclusion criteria.

Following the electronic database search, additional studies were identified from a recent review conducted by Kagohara et al (2010). An additional four

studies were found meeting the inclusion criteria. This made a total of ten studies that fit the inclusion criteria.

Inclusion Criteria

Studies were included in this review only if they met the following inclusion criteria. First, subjects must have been diagnosed with a disability. Second, an iPad®, tablet, iPod®, eReader, iPhone, or portable multimedia device was utilized. Finally, a direct observation and measurement of the effects of the tablet device on expressive communication skill(s) was conducted.

Data Extraction

Studies that met the inclusion criteria were analyzed. Data was collected on the following categories: number of subjects, subject diagnosis, subject age, setting, location, device, application software, communication function, study outcomes, and length of time subjects were followed.

Positive, Negative and Varied Results

The studies found for this paper either met the criteria of being considered "varied" or "positive". The studies that were evaluated as "varied" were Brewer & White (1994), Van der Meer et al. (2012a), Van der Meer et al. (2011), and Van der Meer et al. (2012c). For a study to be considered "varied" some subjects needed to have shown improvement and some subjects needed to have stayed consistent with their communication skills during the follow-up sessions. The studies that were evaluated as "positive" were Achmadi (2012), Flores et al. (2012), Hoover & Ladew (2012), Kagohara et al. (2010), and Van der et al. (2012b). For a study to be

considered “positive”, each of the subjects showed improvement in their communication skills. Improvement was documented through the follow-up session(s).

Improvement data was gathered in a variety of ways. Some studies examined how the subjects chose to answer questions. For example, did the subject choose to use the iPad® or did the subject choose to use a picture exchange system that had been previously used. Some of the studies documented the number of correct hits that were used on the device. Still other studies calculated the change in the ability to navigate the device. The specific documentation was difficult to compare since their methods were different. This researcher relied heavily on the reporting of the study as positive or varied, while, clearly, some subjects improved more than others.

CHAPTER THREE

Results

Table 1 shows a summary of the ten studies that were involved in the use of iPad®, iPod®, and tablet data used for communication purposes by persons with developmental disabilities. The studies are categorized by: the number of subjects, the setting, the length of study, the type of device used, software, diagnosis, and outcome. Table 1 shows the studies by the number of subjects, the device that was used and the software that was used. Table 2 shows the studies by the length of time that the subjects were followed, the diagnosis of the subjects and the outcome of the study.

In study one, Achmadi et al. (2012) conducted a study on two male teenagers with autism spectrum disorder over a period of 47 sessions. Each session lasted five minutes for a total contact time of four hours. Steven (17 years of age) and Sam (13 years of age) were receiving special services in a special education classroom for helping their communication skills improve. Using the iPod® Touch and the application Proloquo2go®, the two students were assessed on their ability to request preferred snacks and toys. From this group design, each student was able to make independent requests by their second intervention, which included turning on the iPod®, unlocking it, and requesting preferred snacks and toys.

Table 1: Summary of studies by number of subjects, device an application.

Study	*Subjects*	*Device*	*Application*
Achmadi (2012)	2	iPod®	Proloquo2go®
Brewer & White (1994)	6	Digitized Graphics Tablet	Kurta Series 2
Flores et al. (2012)	5	iPad ®	Unreported
Hoover & Ladew (2012)	1	iPad®	Unreported
Kagohara et al. (2010)	1	iPod®	Proloquo2go®
Shah (2011)	1	iPad®	Proloquo2go®
Van der Meer et al. (2012a)	4	iPod ®	Proloquo2go®
Van der Meer Kagohara, Achmadi & Green (2011)	3	iPod ®	Proloquo2go®
Van der Meer, et al. (2012c)	4	iPod®	Proloquo2go®
Van der Meer, et al. (2012b)	4	iPod®	Proloquo2go®

Table 2: Summary of studies by Length of time, diagnosis and outcome.

Study	*Length of Time*	*Diagnosis*	*Outcome*
Achmadi (2012)	47 Sessions 5 min. each (4 hrs.)	Autism Spectrum Disorder	Positive
Brewer & White (1994)	200 trials	Intellectual Disability	Varied
Flores et al. (2012)	5 weeks 5 days a week 3 hrs a day (75 hrs.)	Autism Spectrum Disorder	Positive
Hoover & Ladew (2012)	Approx 1 yr	Autism	Positive
Kagohara et al. (2010)	10 weeks 1 hr. 40 min	Autism, ADHD, OCD	Positive
Shah (2011)	2 years	Down Syndrome & Autism	Positive
Van der Meer, et al. (2012a)	2 weeks 1 hr. 20 min	Autism Spectrum & Angelman Syndrome	Varied
Van der Meer, Kagohara, Achmadi & Green (2011)	10 weeks 1 hr. 40 min.	Autism, Klinefelter Syndrome & Seizure	Varied
Van der Meer, et al.(2012c)	10 weeks 5 min. – 3-5 per week 4 hrs. 10 min	Autism Spectrum Disorder, congenital myotonic dystrophy, Down syndrome	Positive
Van der Meer, et al.(2012b)	87 sessions 3-4 days weekly 7 hrs. 25 min	Autism, Epilepsy	Varied

Throughout study two, Brewer & White (1994) observed subjects over a period of 200 trials that involved six adults with intellectual disabilities. Time elements were not reported given the fact that the subjects were given 200 attempts to communicate. The two male and four female adults ranged in age from 22 years of age to 28 years of age. Each subject attended the adult training center in Australia for the intervention. Using a graphics digitalized tablet with the application Kurta Series 2, the subjects were assessed on their communication skills through writing on the digitalized graphics tablet. The study resulted in a varied outcome for this review. Subjects A, B, C, and D all showed improvement through the program after the intervention. Subjects E and F did not show any signs of improvement.

In study three, Flores et al. (2012), five students participated in an iPad® intervention over a period of five weeks. Each subject was given three hours of instruction per day, five days a week. This resulted in a total contact time of 75 hours. The subjects were as followed: Max (9 years of age), Sam (11 years of age), Al (9 years of age), Nick (8 years of age), and Len (8 years of age). Each of the subjects was diagnosed with autism spectrum disorder and an intellectual disability. After the subjects attended a university summer program in the southeast part of the United States of America, each subject showed improvement. Each subject was able to make simple requests at home and school and able to communicate with adults. From this mixed group design, each child showed improvement in picture communication and verbal vocabulary.

Pertaining to study four, Hoover & Ladew (2012) developed an intervention for Matthew, twelve years of age, who was diagnosed with severe autism. The study

was conducted following the subject for over a year. While attending a Jewish school and temple in Massachusetts, Matthew participated in an intervention involving an iPad® tablet computer. The goal of the intervention was to help him express his needs more clearly and enhance his communication skills with peers and adults while at school and at temple. This study did not specify the number of contact hours that were devoted to this intervention. This study was a single subject design. It resulted in a positive outcome. By the end of Matthew's intervention, he was able to read, write and speak in complete sentences.

In another study (Kagohara et al. ,2010), one subject was involved over a period of ten weeks in an intervention using an iPod®-based SGD. The sessions lasted approximately five minutes, two mornings per week. Steven, 17 years of age, had been diagnosed with obsessive-compulsive disorder, autism, and attention deficit hyperactivity disorder. Attending a specialized high school classroom, Steven used the application Proloquo2go® on the iPod®-based SGD to work on his communication skills and to request various snacks. After the intervention ended, this single subject design resulted in a 100% success rate with activating speech output and following up with what Steven had learned in the intervention.

In the sixth study, Shah (2011) implemented a study over a period of 2 years that involved one subject. Sloan Brickley, a 4th grader, had been diagnosed with Down syndrome, autism, and apraxia disorder. Upon attending a public school in Massachusetts, the subject used an Apple iPad® with the application Proloquo2go® for the intervention. The overall goal with the intervention was to help Sloan communicate with peers and adults without garbled speech. The actual time spent

in the intervention was not provided. At the end of the intervention, Sloan's speech become smoother and gave her more independence and confidence to communicate with others.

In another set of studies, four studies were connected to one another involving the iPod® touch and SGDs. Van der Meer et al. (2012a) implemented a study involving four subjects over a period of two weeks. Two to four session per week that lasted approximately ten minutes were conducted. The subjects are as followed: Joe (12 years of age), Sam (6 years of age), Saskia (10 years of age), and Nicky (13 years of age). Joe had been diagnosed with autism spectrum disorder, Sam had been diagnosed with disintegrative and an intellectual disability, Saskia had been diagnosed with Angelman Syndrome, and Nicky had been diagnosed with pervasive developmental disorder. Upon attending a Dutch childcare center, the subjects were taught how to communicate preferred snacks or choose types of play using the application Proloquo2go® on an SGD. The study resulted in a varied outcome with Joe and Sakia progressing, although Sam and Nicky did not show improvement.

A second study that involved an iPod® touch was Van der Meer et al. (2011). In this study, the researchers intervened over a period of ten weeks with three subjects, including Sam (13 years of age), Jim (14 years of age), and Zoe (23 years of age). The sessions were five minutes in length and occurred two times weekly. Sam was diagnosed with autism, Jim was diagnosed with Klinefelter Syndrome, and Zoe was diagnosed with a seizure disorder. Each of the subjects had also been diagnosed with a severe intellectual disability. While attending a public school

classroom setting in Texas, the goal of the intervention was to help the subjects to request snacks and toys by communicating with individuals in their environment. Each subject used the application Proloquo2go®. From this intervention, Sam and Jim showed improvement using the iPod® Touch while Zoe reportedly did not improve.

A similar study, Van der Meer et al. (2012b), used an iPod® SGD to intervene with four subjects over a ten-week period in New Zealand. The sessions occurred three to four days per week and lasted approximately five minutes. The subjects were: David (10 years of age), Tom (5.5 years of age), Zac (7 years of age), and Eli (5.5 years of age). David was diagnosed with autism spectrum disorder, Tom was diagnosed with multi-symptom developmental disorder, Zac was diagnosed with Down syndrome and autism spectrum disorder, and Eli was diagnosed with congenital myotonic dystrophy. The goal of this intervention was to enhance the subjects' expressive and receptive skills when communicating preferred snacks and choosing toys. Using the application Proloquo2go®, all students were able to benefit from this design. Each subject improved on their communication skills and had good maintenance during the follow-up.

A final study known as Van der Meer et al. (2012c) used an iPod® touch to help enhance communication of preferred stimulus among snacks and toys. The four subjects were followed for ten weeks. The sessions occurred three to five days per week and lasted approximately five minutes each time. The subjects were as followed: Jason (4 years of age), Jack (4 years of age), Ian (10 years of age), and Hannah (11 years of age). Jason was diagnosed with autism and global

developmental delay. Jack was diagnosed with autism. Ian was diagnosed with autism, moderate intellectual disability, developmental coordination disorder, and epilepsy. Hannah was diagnosed with autism, global developmental delay and an intellectual disability. At the conclusion of the study, Jason and Ian chose to use the SGD most frequently when answering questions. They chose the SGD over the PE, or picture exchange, and the MS, or the manual signing. Jack and Hannah chose to use the PE most frequently when making requests. Although all children improved, for the purposes of this review, it was considered to be varied due to the fact that the SGD was not preferred by all of the subjects.

The studies that were evaluated as "varied" were Brewer & White (1994), Van der Meer et al. (2012a), Van der Meer et al. (2011), and Van der Meer et al. (2012c). The studies that were evaluated as "positive" were Achmadi (2012), Flores et al. (2012), Hoover & Ladew (2012), Kagohara et al. (2010), and Van der et al. (2012b).

Subjects

A total of 31 subjects were identified across the ten studies in this review. Of these 31 subjects, 22 were male (71%) and nine were female (29%). Across the ten studies, subjects' age ranged from four to 28 years. The average age of a subjects was sixteen years of age.

Twenty of the subjects (65 %) had been diagnosed with autism or autism spectrum disorder. Eleven (35 %) were diagnosed with an intellectual disability, also known as mental retardation. Two subjects were diagnosed with Down

syndrome (0.06%). One subject was diagnosed with Angelman syndrome (0.01%). Overall, twelve subjects had been diagnosed with two or more disabilities (38%).

Settings

Most of these studies (70%) took place in a school or a classroom. Three of the studies took place elsewhere (30%). For example, Brewer & White (1994) implemented a communication device with an adult subject in an adult training center. Flores et al. (2012) conducted the study at a university summer program. Van der Meer et al. (2012a) conducted their study at a Dutch childcare center. Out of the ten studies, four (40%) took place inside the United States. On the other hand, one study was conducted in New Zealand and one was conducted in Australia. The remaining four studies did not explicitly identify the location in which the study was conducted.

Device

Across the ten studies, three studies (30%) assessed the effects of an iPad® serving as an SGD, another six studies (60%) assessed the effectiveness of an iPod® Touch. Finally, one study (10%) assessed the effectiveness of a digitized graphic tablet.

Application Software

Across the ten studies included in this review, seven studies (70%) utilized Proloquo2go®, an SGD application. One study (10%) implemented the Kurta Series

2 application, and the remaining two studies (20%) did not specify which application was utilized.

Communication Function

Across the studies, a variety of communication skills and functions were measured. Eight of the ten studies (80%) used the tablet devices to teach subjects to make requests. An additional study (10%) utilized a tablet device to teach subjects to communicate needs through writing. In addition, one out of ten (10%) studies conveyed an improvement in communication across conversations.

Length of Study

The amount of time spent with subjects was also analyzed in the various studies. The amount of time that the subjects were observed in these studies ranged from two weeks to two years. Altogether, studies followed and observed subjects from a range of fourteen days to 730 days. Subjects were followed for an average of 372 days. Eight out of the ten studies (80%) had a certain number of trials or sessions that subjects had to complete in order to fulfill the study. It was difficult to determine the exact amount of contact time that was used for intervention in two of the studies. Some of the studies were not clear regarding how long the sessions lasted or the extent to which they used the device during the day.

The longest studies were one and two years in length. Both of these studies had positive outcomes. Four of the five longest studies had positive results. The shortest study was only two weeks in length and had varied results. Some of the studies were rather short in length but spent some intensive time with their

subjects. For example, Flores, et al. (2012) spent only five weeks with their subjects but worked each day for three hours. This is a total of 75 hours of contact time.

Study Outcomes

Of the ten studies identified in this search, six studies had a positive result (60%) and the remaining four reported varied results (40%). No studies reported negative results.

CHAPTER FOUR

Discussion

This methodical review evaluated the use of iPods®, iPads®, and other technology devices with children and adults with special needs. The studies in this methodological review were evaluating children between the ages of four and 28 years of age. The majority of the subjects had a diagnosis of autism, or autism spectrum disorder. The results of these ten studies imply that these devices can be positively used for enhancing communication with others at school, at work, and in public venues.

One interesting finding through the review was that half of the ten studies used the application Proloquo2go®. The educational application Proloquo2go® was the first application to provide voice output (Official Apple Store, 2013). It was one of the earliest augmentative applications offered and this likely explains the frequency of the use of Proloquo2go® in these studies.

The studies that had the most amount of contact time (Achmadi et al. (2012), Kagohara et al. (2010), and Shah (2011) had positive results. Those studies that were shorter (including van der Meer et al. (2012) (A)) and Van der Meer et al. (2011)) had varied results. One of the longer studies (van der Meer et al. (2012) (C)) did report varied results. Although all four children improved, only two chose to use the tablet for communication.

The amount of time the subjects were followed was varied for each study. It did appear in general that the studies with the greatest contact hours had the more positive results. Unfortunately, some of the studies did not appear to have adhered to strict time periods for each intervention. This is understandable given the fact that so many of the children in the studies had severe disorders. These children are inconsistent in their ability and willingness to focus. It may have been that the times varied from session to session, making it difficult to document the exact time.

The diagnosis of the subjects was examined, too. Most of the subjects diagnosed with autism showed positive results. Of the 31 subjects, twenty were diagnosed with autism, or autism spectrum disorder. Some of these children had additional diagnoses. Of those twenty subjects with autism, eighteen (90%) improved or had positive outcomes. Of the other subjects, eleven of the 31 subjects (35%) had a positive result. A comparison of various diagnoses was not always possible. Many children had more than one diagnosis. What did come out of this examination was that those children with a diagnosis of autism had the most positive results. This fact may be related to the fact that children with autism commonly are described as having a high interest in visual things. The iPad®/iPod® tablets have vivid visual colors and are interactive in a way that computers before them were not. The icons are easy to manipulate with the touch screen. The children with autism appear to be particularly drawn to the visual effects on these digital devices.

It was particularly intriguing that the Proloquo2go® application was being evaluated with a variety of subjects from ages four to 28 years of age. From each of

the studies, there was not a pattern indicating positive results with a larger population of subjects and varied results with a smaller population of subjects. Each subject gained knowledge of the technology device in one way or another by receiving an intervention that taught communication skills. Also, since the applications were being evaluated in a few different countries other than the United States, it was intriguing to see that the ones that were being conducted in other countries were similar in terms of population size, age of subjects, applications being used and the outcome.

Four of the ten studies resulted is some subjects improving while others did not. Although the majority of these study outcomes were positive, it should be noted that the use of a tablet-based SGD might not always been entirely successful. The results that were varied were a result of different outcomes for subjects. Either most subjects improved and others did not or only some subjects improved and the others sometimes did not maintain their newly learned skills. There were four studies that contained varied results, including Brewer & White (1994), Van der Meer et al. (2012a), Van der Meer et al. (2011), and Van der Meer et al. (2012c).

There was a pattern spotted in these studies: three of the four studies used an iPod® and the other one used a digitalized graphics tablet. From these 4 studies, none of the results gave a positive or negative result. The study that utilized the digitalized graphics tablet showed that four of the six of the subjects (66%) improved their communication by using the tablet and two of the six subjects (34%) did not show any improvement. The three studies that used the iPod® also had the most subjects improve while a few did not show improvement in their skills. The

Van der Meer et al. (2011) study showed that two out of the three subjects (60%) improved. The Van der Meer (2012a) study showed that two out of the four subjects (50%) improved. The Van der Meer et al. (2012c) study showed that two out of the four subjects (50%) improved.

Also noted was the fact that the three studies that used the iPad® as their device, all had positive results. (Flores, et al. 2012, Hoover & Ladew, 2012, and Shah, 2011) Only three of the six studies that used the iPod® had positive results. The iPod® is a small, easily portable device but does not have the interest of the iPad's® larger screen. It is comparable to the way in which everyday individuals are flocking to buy larger television screens. The larger images are just more life like and possibly more interesting. This finding suggests that the larger screens may be more likely to yield positive results in developing communication in these children.

Some limitations of this review should be noted. The first limitation is that with quickly changing technology the author may have been unaware of particular forms of technology, specifically newly released technology, which may have been relevant to this review. Therefore, the author may unknowingly be excluding some potentially successful search terms simply due to a lack of knowledge of specific devices compatible with a communication application. In other words, with the popularity of iPods® and iPads®, these specific brand names were utilized as search terms; however, several other tablet devices were not used, such as the Samsung Galaxy Tablet, the Samsung Galaxy Note, Microsoft Surface, Amazon Kindle Fire, Asus Transformer Pad, and the Google Nexus (McCann & Roth, n.d.). It is possible that these device names and additional device names, in which the author

was unfamiliar with, would have identified additional relevant studies. Another limitation is based on the size of the subject pools in these studies. There were small numbers of subjects per study because large numbers of children with these severe disabilities are difficult to find in one area.

Future research should focus on like studies in terms of length of time and diagnosis, as well as examining other applications. In addition, a focus on documenting the ways in which positive or negative results are determined would be helpful. The amount of time spent with subjects in the study was an important determinant for improvement or maintenance of communication skills. Looking at more specific diagnoses will help the field of individuals with special needs because it can identify specific needs for populations of individuals who exhibit similar challenges. Even exploring other specific applications on devices like the iPad® will open up more opportunities for specific needs in terms of communication.

In addition, teacher training largely contributes to making interventions successful among younger individuals and students. As our world of technology keeps developing and emerging with new devices and applications, there should be an emphasis on teaching educators how to use these different devices in order to support individuals. Communication is a basic need of which no individual should be deprived, and educators should make further strides to assist the growing population of student with communication impairments and other special needs.

Summary

In summary, all of the studies showed some improvement in communication skills when using the iPad® or iPod®. Most of the children diagnosed with autism had positive outcomes through the use of SGDs (90%). In addition, Proloquo2go® was the most widely used SGD among the studies, likely, because it was the first program to offer voice output. The iPad's® larger screen may be a better device to use due to its' interest level. Teachers and others attempting to help individuals to use SGDs should consider increasing the number of contact hours in instruction in order to have more positive outcomes.

Overall, this review conveys excitement regarding the potential benefits of iPod®, iPad®, and similar tablet devices to serve as SGDs. SGDs will be important to consider in supporting and educating struggling learners and helping them to realize that they can learn, too.

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