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iPads and Autism: The Impact of iPads on Social and Academic Development in Autism

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Background: Autism

In October of 1938, Dr. Leo Kanner, an Austrian native who had founded the first children's psychiatry clinic at Johns Hopkins University eight years prior, received a thirty-three page letter from a disgruntled and worried father about his son who he referred to as Donald T. The letter explained to Dr. Kanner several aspects of the child in gripping detail, stating that Donald T "was happiest when he was alone…drawn into a shell and living with himself…oblivious to everything round him. He had a mania for spinning toys and liked to shake his head from side to side and sprint around in circles while having routine tantrums when disrupted" (Fischbach, 2007). It was from this letter that Dr. Kanner initially realized that Donald T. was not at all like many of the other five year old boys with which he had been working. After reading the letter, Kanner requested a meeting with young Donald T., and his initial suspicions about the child were quickly confirmed. Donald T not only showed many of the symptoms that were explained earlier by his father but he also showed several explosive tendencies that included the use of irrelevant words and constant repetition of statements; he also almost always referring to himself in the third person. It was this very meeting with Donald T that led to Dr. Kanner's further research into the disorder, which would be later named Autism (Fischbach, 2007).

For the five years following Dr. Kanner's introduction to young Donald T, Kanner conducted a research study in Baltimore, Maryland on ten children, one being Donald T. Donald T's parents explained to Dr. Kanner that, at the age of one year, Donald T could hum and sing many tunes, and by the age of two, he had an unusual memory for names, faces, short poems, and song lyrics (Kanner, 1943). Donald had many of the abilities that were typical for children at that age and could even remember pictures of several of the past presidents. Donald learned the alphabet both backwards and forwards, and he could easily count to one hundred. However, at a

very early age, it became clear to Donald's parents that Donald preferred to be alone. Donald rarely cried to his mother and did not even notice his father during most attempts for interaction. Donald showed no emotion and refused to interact with another young child of his age that his parents looked after during the summer. Donald only was happy when he was entertaining himself. In an attempt to help their son, Donald's parents placed him into a tuberculosis preventorium in order to provide him with a change of scenery. However, no significant changes resulted. Donald returned home and began to read fluently, play piano, and respond to only yes or no questions. After some time spent with Kanner in the years following, Donald began to improve socially, referring to himself in the first person at times, and even began to form short sentences such as "I want to hug her around the neck" (Kanner, 1943). With this data and the data retrieved from the other nine children, Kanner published a paper entitled, "Autistic Disturbances of Effective Contact," in the year 1943. It was in this paper that Kanner diagnosed the first autistic child, Donald T.

At the same time that Kanner was performing his research study in Baltimore, Maryland, Dr. Hans Asperger, another renowned Austrian psychiatrist and scientist, was studying two hundred families with children who were seen to have many of the same symptoms that were being analyzed in Kanner's report: one major difference was that many of the children in Asperger's study did not seem to display any language delay. The two men had no contact with one another during their studies. The year following Kanner's paper, Asperger described what he called "autistic psychopathy" characterized by several characteristics that included lack of empathy, an inability to form friendships, individualistic conversations, absorption in oneself, and very clumsy or unnatural movements (The National Names Database, 2012). As Asperger's study observed individuals later into adulthood, he concluded that these "odd" children

developed into “overachieving adults and were invaluable contributors to society” (The National Names Database, 2012). As years passed, following the work done by Hans Asperger and Leo Kanner, several other scientists such as Bruno Bettelheim, Bernard Rimland, and Ole Ivar Lovaas began to delve into the newfound set of disorders that are referred to today as Autism Spectrum Disorders (ASD).

Autism Spectrum Disorder, as defined by the Centre for Disability Health (CDDH), is “a group of lifelong neurodevelopmental brain disorders or disabilities that onset typically before thirty-six months that can be characterized by impairments in reciprocal social interactions, impairments in verbal and non-verbal communication, and stereotyped behavior, interests, and activities” (CDDH, 2010). Children can have a range of symptoms from mildly impaired to severely disabled with no two children being affected in the same exact way. The National Institute of Mental Health currently defines five disorders that fall into the group of disorders known as ASD. These disorders include: a) Autism (classic autism), b) Asperger’s Disorder, c) Pervasive developmental disorder (PDD), d) Rett’s Disorder, and e) Childhood disintegrative disorder. Each of these disorders has its own set of distinct symptoms, but each is also recognized for having characteristics that have been defined by the CDDH. However, any sole cause for these disorders is still unknown.

Autism, which is commonly referred to as classical or childhood autism, is defined by the National Institute of Neurological Disorders and Stroke as a “series of neurodevelopment disorders, characterized by several classic symptoms such as repetitive actions or language, speech impairments, and difficulties in social interaction” (National Institute of Health, 2012). Males are four times more likely to be autistic than females, and the first signs of autism normally appear before the age of three, which is one of the most common characteristics seen in

all five autism spectrum disorders (National Institute of Health, 2012). Autism has become one of the most prevalent mental disorders across the United States with approximately 1% of children having some form of the condition across the country (Figure 1). This is a twenty fold increase from just three decades ago in the 1980's (CDC, 2012).

Due to the spectrum-like aspect of this disorder, every child with autism has a unique set of issues. The trademark feature seen in autism is impaired social interaction. As early as infancy, autistic children are seen to be unresponsive to light or movement with an inability to show any substantial amount of focus. These children are seen to be deeply withdrawn, and often times, do not show the ability to respond to their own name. Autistic children ultimately seem to perform no empathy, and they usually show many repetitive actions whether it is repetitive speech patterns or movements such as head bobbing or tongue movements (National Institute of Health, 2012). Children with autism also tend to start speaking at a much later age than children without the disorder, and in some of the more severe cases, the child will never develop the ability to speak whatsoever beyond incomprehensible language. In many typical social environments, such as a classroom, autistic children lack the ability to work in groups or truly interact with any individual there, including both teachers and students. To compound many of the most common issues seen with autistic children, all of the ASD disorders are seen to be at a higher risk for what are referred to as co-occurring disorders. Co-occurring disorders can be defined as disorders that are seen to commonly be found in individuals who also have been diagnosed with another disorder (in this case autism). These disorders include: a) Fragile X syndrome (a disease that often causes mental retardation), b) Tuberous sclerosis (genetic disease that often causes malignant tumors to the brain), c) epileptic seizures, d) Tourette syndrome, learning disabilities, and e) attention deficit disorder (ADD) (National Institute of Health, 2012).

With the compounding of autism with these disorders, the spectrum-like aspect of the disease is even further multiplied, leaving no one child with identical symptoms even in the case of identical twins.

The variance of symptoms that can be seen in autism makes diagnosis very difficult for even some of the most well-trained autism specialists. Often times, children who possess some of the mildest autistic symptoms will go undiagnosed throughout their entire lives. Due to the necessity for distinct guidelines for autism diagnosis, the Diagnostic and Statistical Manual of Mental Disorders IV (American Psychiatric Association, 2000) created a two-step process for autism diagnosis. The first stage of diagnosis simply involves the common early childhood checkups and screenings that occur with most young children. If the child begins to display some of the qualities that are seen commonly in one of the ASD disorders, further tests are done by a panel of specialists who have the ability to diagnose each child with having autism or any other developmental disorder (National Institute of Health, 2012). Many of the earliest indicators are the most common characteristics seen, which include poor eye contact, unresponsiveness to his or her name, and a lack of babbling by the age of one (National Institute of Health, 2012).

Unfortunately, at this time, no proven cure has been developed for any of the autism spectrum disorders. Therefore, when it comes to preventing many of the most common symptoms, early intervention is one of the most effective ways to increase an autistic child's ability to grow and learn many of the life skills that come more naturally to children not found to be on the spectrum. Techniques such as intensive behavioral therapy, "a variety of behavioral/educational interventions that seek to reinforce adaptive behaviors, reduce maladaptive behaviors and improve the mastery of functional age appropriate skills in people with ASDs," at a very early age can have a substantial effect on both cognitive and language

skills (National Institute of Mental Health, 2011). Even more manageable changes, such as lowering class sizes for more one on one interaction, consistent structured commands and visual cues, and using a specific curriculum that focuses on social skills, language and communication have all been seen as useful techniques to improve the social and academic development of children with autism.

However, the most widely accepted form of autism treatment is referred to as applied behavior analysis (ABA). ABA uses a treatment that focuses on both verbal behavior and pivotal response training in order to mold proper behaviors, while also attempting to inhibit the improper ones. The verbal behavior aspect of this process attempts to guide each child, teaching him or her some of the simplest verbal behaviors, such as echoing, all the way to verbal communication without any instructor prompting. Part of this type of treatment is pivotal response training, which attempts to teach students about self-management and other crucial life skills that will be required when they are placed in situations where they are on their own (CDC, 2011). These skills could include using a microwave, washing one's hands or even using the restroom. While all of these types of treatments have shown positive results in some settings, no one treatment has been proven to improve social interactions universally.

One of the biggest factors that have made autism and its various disorders an extremely popular research topic is the lack of a defining cause of the disorder. Dr. Kanner proposed in 1943 that certain genetic markers may cause the disease. However, due to the lack of positive inheritance in all identical twins, it quickly became clear that the disorder was not being genetically passed on in a way defined by classical Mendelian genetics. Kanner believed that perhaps as many as fifty genes may play some role in inheriting the disorder, each of which increases the chance of inheritance if certain errors are created in the child's genetic code. Other

researchers have proposed alternate possibilities for the development of autism. For example, Dr. Bruno Bettelheim proposed that autism development occurred due to cold and distant mothers, which he later termed as “refrigerator mothers” (Pollak, 1998). This theory brought about the idea that certain environmental factors may also play a role in autism development. In the end, autism, to this present date, has no true cause, making it increasingly difficult to develop or discover any “cure” for the disorder. For now, researchers are focusing their efforts on containing the disorder and searching for new educational techniques that can improve both social and academic development in children with autism. One of the most studied additions to classical teaching methods for autistic students is the introduction of technology into the classroom as both a learning tool and a source of social interaction.

Background: Technology

Ever since the invention of the home computer and the cellular telephone, technology has played a very important role in the lives of people everywhere, and specifically, the lives of students within the classroom. As more and more pieces of technology were invented, the roles of both teachers and students quickly began to change. Certain classical teaching methods or techniques that included trips to the blackboard and printed worksheets soon became obsolete and new technology began to play an active role in how teachers planned to teach their students as well as how students began to learn (Morrison, 2013). Information started to become much more easily accessible, moving students out of the library in search of books and onto the Internet where one click could lead to countless pieces of information that may have been inaccessible in the past. Classrooms soon came equipped with desktop computers, virtual classrooms, Smart Board technology, and even Apple’s newest iOS operating systems in the

form of iPads. These new devices have completely changed the learning atmosphere in the classroom, and their effects can be noticed throughout much of the educational world.

The introduction of technology into the classroom has created a debate across academia about the effectiveness of devices within the classroom. However, literature shows that the incorporation of technology into the classroom has been proven to allow both students and teachers the ability to easily access the Internet, work in collaboration with one another, and enhance both academic achievement and classroom involvement. Teachers have the ability to steer away from the classical teaching methods, including verbal lecturing and classic blackboard displays, by incorporating many of the new devices and creating a more technology friendly environment (Morrison, 2013). The classical way of teaching has involved two main approaches: direct instruction and cooperative learning. Direct instruction involves a teacher directly presenting the information to the students followed by student-teacher feedback. Cooperative learning, on the other hand, provides students with the ability to work in small groups on certain activities. While both of these approaches have been effective at times, many students of the digital era, who have used technology throughout their entire lives, may enjoy lessons that incorporate aspects of the digital world into their teaching strategies (Morrison, 2013).

With the ever-changing roles of students and teachers in the classroom, it becomes very important to understand just how each role is changing. The Office of Educational Research and Improvement strongly supports the incorporation of technology into schools based upon its ability to promote increased academic cooperation in the classroom. The research has shown that when students have been allowed to use technology as a controlled tool to support communication with their peers, students are more active rather than passive in the classroom. By being able to take this active role in their own learning process, the student has the ability to

make his or hers own choices of how the information is being displayed and can actively think about the information by making choices and executing skills. These types of actions are not available in the more passive and classical teaching styles that involve teachers standing behind a podium lecturing to a class each and every day. With the proper use of technology in the classroom, students obtain the ability to make their own choices and define their own personal goals all of which can be viewed as positive actions within the classroom.

Whereas it may be easily noticeable how a student's role has changed with the induction of technology, in fact, the teacher's role has also encountered a somewhat drastic change. Teachers are no longer the main focus or placed at the center of attention when it comes to student learning within the classroom. The teachers are no longer the sole dispenser of information, but rather, they act more as facilitators to assist students by creating project goals, guidelines, or group assignments that can be completed with the assistance of technology (Singh & Means, 2002). The teacher no longer has to act as a universal knowledge figure forced to provide large amounts of information in bulk to entire classes without the ability to provide increased focus on each student. Instead, teachers have the ability to use various aspects of technology as tools that can easily dispense the intended learning material to the students. With technology, the teacher can focus on supervising and assisting those students who may not understand the material in full, allowing the students who understand the material the freedom to make their own decisions and come to their own conclusions. In no way does technology have the ability to take the place of teachers or even provide information in a manner preferable to that received directly from teachers. However, technology does provide with a very useful tool to improve student performance. By allowing teachers the ability to take a step out of the spotlight

during certain lessons, students will benefit from an increase in individual instruction that can come about from the insertion of technology into the classroom.

Many teachers and instructors have noted an immense increase in student motivation when it comes to technology-based learning. It was not uncommon in many cases that students who did not show initiative or high academic accomplishments during normal classroom activities did indeed display increased motivation as well as other accomplishments while participating in technological based activities. One anonymous teacher cited a specific example of one student who he or she had the opportunity to have in class the previous year:

> The kids that don't necessarily star can become the stars when it comes to technology. My favorite is this boy . . . who had major problems at home. He figured out a way to make music by getting the computer to play certain letters by certain powers and it changed the musical tone of the note and he actually wrote a piece. He stayed in every recess. . . . When I asked him what he was working on, he wouldn't tell me. Then he asked if he could put his HyperCard stack on my computer because it was hooked up to speakers. I said "sure" and at recess . . . he put it on my computer and played his music and literally stopped the room. And for months he had kids begging him at recess, every recess, to teach them how to make music. And for that particular kid it was the world because he really was not successful academically and was having lots of problems. . . . This really changed him for that school year. (Singh & Means, 2002, 1-5)

This excerpt is just one of many examples that display how technology can provide students with increased academic success as well as show positive outcomes in the student's life outside of the classroom. Students who may struggle during classical teaching methods may show increased abilities in new age technology-based lesson plans.

Background: Autism Intervention Technology

The positive outcomes and opportunities that have come about in classrooms settings using technology have quickly expanded into the special needs classrooms. ASD researchers

were immediately intrigued how the implementation of technology into special needs classrooms would affect the social and academic achievement of their students. In order to test this, researchers began implementing several types of assistive technologies into autistic and other special needs classrooms worldwide. According to the Technology-Related Assistance for Individuals with Disabilities Act, assistive technology can be defined as "any item, piece of equipment, or product system, whether acquired commercially, off-the-shelf, modified or customized, that is used to increase, maintain**,** or improve functional capabilities of individuals with disabilities" (Stokes 2002). The main motivation for the implementation of technology into autistic classrooms is that children with autism have the ability to process information in the form of images much more easily than auditory information that would be seen in classical learning environments (Porayska-Pomsta et. al, 2011). Therefore, by providing autistic students with visual information, focusing on their strongest sensory area, promotes an increased likelihood of success in the classroom. For this reason, visual technology that has come about through several different medias that include virtual classrooms, Smart Board technology and most importantly Apple's iOS technologies have all been analyzed for their usefulness within special needs classrooms.

In order to accurately measure how and what types of roles these devices play in special needs classrooms, it is important to critically analyze past and present research. This analysis should not only examine the roles that each have played in specific research studies but should also analyze universal tools to improve the lives of autistic students. In what follows, I will analyze the relationship between iOS (iPhone operating system) and similar types of past technology in the classroom and social and academic development in autism. The analysis will take the form of a critical review in which I will examine each research study and its intended

learning objectives. I will then provide some anecdotal evidence that I have witnessed in my time at the Rich Center for Autism, a school for autistic children at Youngstown State University. This phenomenological approach will provide research in the "lived-experience" that enhances the information analyzed in each academic study. All of this evidence will be used to support the two main hypotheses that I have formulated: That iOS technology directly benefits social development in autistic students, and that without proper social development, these students will not be able to reach their maximum academic potential.

Literature Review

"Collaborative virtual environment technology for people with autism"

Technology has always been seen as a gateway into a world of imagination that prior to its invention was left solely to the mind. Technology allowed for the creation of a virtual world that originated with some of the simplest arcade games and has compounded to virtual avatars that have the ability to mimic the moves of its creator. One of the initial methodologies implemented into the special needs classroom was in the form of individual avatars living within their own virtual worlds. Moore, Cheng, McGrath, and Powell, researchers at Hammill Institute on Disabilities, delved deeper into past research that attempted to analyze incorporated collaborative virtual environments (CVEs) into special needs classrooms, in particular those containing students with autism. Moore and his associates attempted to expand upon this past research while also exploring possibilities for avatar interaction as a means to promote proper social interaction in autistic students who otherwise struggle in that area.

A virtual environment (VE) can be defined as "a computer-generated three-dimensional simulation of a real or imaginary environment" (Moore et. al, 2005) and have been split up into two distinct categories: single user virtual environments (SVEs) and multiuser, collaborative virtual environments (CVEs). In both cases, individuals, in this case autistic children, have the ability to create a type of avatar that can interact freely with its environment as well as simulate certain tasks or emotions on screen that can mimic those of real life interactions. The avatars can be created in a variety of different ways that range from simple shapes or faces, to cartoon characters, or even humanlike representations that mimic the qualities of the user. The user has the ability to see the virtual environment from the point of view of his or her avatar. The main

difference between each type of environment is that SVEs users are limited to interactions with the environment while in CVEs users have the ability not only to interact with his or her environment but also other avatars being controlled by different users. It is the multiuser, collaborative virtual environments that Moore and his associates examined their exploratory study.

Past research examined by Moore et al. presented many of the key features that have become available in some of the most recent collaborative virtual environments. These features include: navigation, communication, interaction, awareness of others, negotiation, as well as multiple and flexible viewpoints that are available to each user within the virtual environment (Moore et.al, 2005). Users have the ability to share the occupation of a given environment, opening new doors into interaction that does not necessarily have to take place in the vulnerable environment of face to face interaction. Users have the ability to instead take the form of their avatar within the virtual world in order to "simplify and facilitate the process of interhuman communication in the virtual world" (Moore et.al, 2005).

Moore et al. also cites some of the defining aspects of autism as the initial reason for the implementation of his exploratory study. He refers to autism as a "triad of impairments" with social impairments being one of the most difficult aspects to control. Many of these social impairments include a lack of empathy as well as communication impairments. The communication impairments often times take the form of difficulties in both verbal and nonverbal communication and can cause students to display rigidity in thinking, language and behavior (Moore et. al, 2005). For these reasons, children diagnosed as autistic generally have a difficult time interacting in a "socially acceptable" manner. In the end, Moore and his colleagues

argue that CVE technology can potentially benefit people in two ways: as an assistive technology as well as an educational technology.

The main argument that Moore et al. makes in terms of CVE as an assistive technology is that collaborative virtual environments allow for rewarding social interactions. When using these CVEs, autistic students do not have to worry about the social difficulties that come about from real-life communication. Instead, the CVEs allow for communication that is less threatening than prototypical face to face communication that would occur between two students or even a student and his or her teacher. The virtual world removes many of the road blocks that could come about in real life communication. Secondly, Moore et al. cites the ability of CVEs to remove some of the subtle social guidelines that autistic individuals have the hardest times understanding. Students, therefore, won't have to worry about breaking certain social rules that may result in awkward social interactions. Avatar-based interactions provide individuals with confidence as well as a sense of control to individuals who otherwise would feel out of control in normal social atmospheres. This technology provides autistic students with the ability to comfortably interact with human beings even if these interactions take place in the form of a virtual environment. A third aspect of CVEs that Moore et al. cites as exceptionally useful in correlation with autistic students is the ability of these devices to slow down the rate of social interactions. In real life communication, autistic students can become lost based on the fact that they fail to keep up with the social interactions in which they are attempting to engage. By using the CVE technology, students and their avatars have the ability to process the information that they are being given, which allows increased time for each student to think about possible ways to respond to the previous action.

The final aspect of CVEs that Moore et al. cites as instrumental for effective social interaction stems from the importance of proper emotional responses in social communication. Avatar based communication allows for accurate representations of emotions during certain social situations. Some examples include smiling or laughing during humorous conversation or the look of shock or fright in response to other social dilemmas. Many autistic students seem to lack the ability to utilize the proper emotional responses during these common scenarios, so emotions in Moore et al.'s opinion are vital for proper communication skills. CVEs allow for students to see appropriate emotional responses that are vital for proper communication tools visibly in the forms of his or her avatar. In sum, CVE technology can be used as assistive technology in the classroom setting and with their use, students with autism may learn to circumvent many of their social impairments leading to increased social development.

The second major use of CVE technology that Moore et al. cites is its use as an educational tool. While CVEs use as both an educational and developmental tool can frequently be seen to overlap in this disorder, there are still certain aspects of the technology that can promote CVEs as educational tools rather than simply autistic assistive technology. For example, virtual technology created to simulate the "real world" can be an opportunity for autistic students to rehearse real world events and experience many diverse scenarios prior to actually facing such events. Students now have the ability to get a firsthand look at life scenarios in order to prepare them for the future. CVEs also can be utilized as beacons for group work and group play; two school related activities that are rarely seen in most special needs classrooms. With CVEs, students have the ability work with one another, making CVEs a valuable tool for group settings. Moore et al. states, "VE technology is powerful partly because it can support social interaction around the computer. Similarly, social skills programs are also often advocated partly on the

grounds that social impairments can affect general educational processes" (Moore et. al, 2005). This technology not only provides a new type of learning tool in autistic classrooms but it also has the ability to remove distractions, teach vital life skills, and create a group atmosphere; all of which would have been unseen in any one teaching tool prior to their invention. Virtual environments have been proven to be fun, interesting, and rather easy to use for teachers and students.

In order to verify past research as well as many of the theories that Moore and his associates formulated, they developed a simple computer system that had the ability to create avatars in order to further examine the ability of autistic students to understand emotional expressions and interact with an avatar. They created avatars that represented the four main emotions: happy, sad, angry, and frightened, and then they tested thirty-four students with autism. The researchers divided the study into three stages for the students. The first stage allowed the student to choose the proper emotion displayed by an avatar after all four were shown in isolation. Students were told a particular emotion that was being felt and were then asked to choose the display that corresponded to that emotion. Stage two attempted to "elicit the possible emotions in the context of a simple social scenario" (Moore et. al, 2005). Three of the four emotions (excluding fright due to ethical questions) were then tested in real life scenarios. Questions involved the feelings of the student as well as the feelings of others. Questions were asked in a manner that can be seen in Figure 2. To further the students understanding of the emotions, thought bubbles would appear and explain why the avatar may have been feeling that way during the social scenario. In the final stage, the student as presented with an avatar that displayed a certain emotion previously presented to the student. The student then was asked to choose possible scenarios that may have caused the emotion being displayed. All three stages

exemplified an educational rationale, involving the belief that an accurate understanding of some of the most common emotional expressions is beyond vital for proper social communication, and therefore, also vital for social development in autistic children.

Moore and his fellow researchers found a relatively high success rate for the thirty-four The results showed that thirty of the thirty-four students were able to effectively use the avatars at levels that could not be explained simply as chance and answer the questions they were asked in each of the three stages. With these results the researchers were able to conclude that their study supported past studies as well as offered evidence that the students understood the different emotions that were being analyzed. This conclusion supports the viewpoint of the usefulness of CVEs and provided some of the initial support for the use of technology in special needs classrooms

"Developing technology for autism: An interdisciplinary study"

The introduction of virtual environments, similar to those studied by Moore and his associates, may not have been the first evidence of technology's usefulness in the classroom; however, it did indeed create an increased interest on the subject matter. Shortly after Moore et al. published his paper on CVEs and their role in social development in autism, Porayska-Pomsta, Frauenberger, and Pain began working on a similar virtual environment study on a different type of technology: SMART Boards. SMART Boards, similar to virtual environments, provide autism specialists the ability to create complex environments that can be manipulated by touch, voice, text, and even touch. Porayska-Pomsta provides two main reasons for the increased interest in the potential for technology in the special needs classroom: 1) the recognition that users are naturally drawn and may have an affinity for computers and 2) a rapidly growing need

for an alternative intervention to provide more effective results in the classroom (Porayska-Pomsta et. al, 2011). With the diverse needs that are apparent in students who are diagnosed with autism, technology that has the ability for diverse actions, such as target face recognition, emotional recognition, and increased understanding of how to cooperate with others is in great need. In the past, devices may have only been able to perform one of these tasks, such as the robotic creations that were created for autistic students who shunned all human contact and communication (Porayska-Pomsta et. al, 2011). With the incorporation of SMART Board technology into the classroom, teachers have the ability to perform multiple types of tasks; all of which are aimed to improve specific needs of each student with which they are working. In order for teachers to be able to effectively use the system design that Porayska-Pomsta calls human computer interaction (HCI), teachers must understand and utilize the necessary components of the device to fine tune it for each student.

Porayska-Pomsta and her associates conducted an "interdisciplinary research methodology" in order to analyze and develop technology enhanced learning in the form of the ECHOES project. The main goal of this project was to support young developing students with autism, while also aiming to develop new tools for research in this area. The project focused on children between the ages of five and seven, who Porayska-Pomsta believed were at the peak age of emotional development; a belief shared previously by Moore and his associates. In ECHOES, students interact with virtual characters that could be placed in realistic social situations. A 3-D virtual "sensory garden" (Figure 3) filled with interactive objects could become the focus of the student. The environment is displayed on a multi-touch LCD screen that each student can manipulate in any way that he or she pleases. Students are tracked by computer vision, a set of three small cameras on the top and sides of the device, allowing for accurate representation of

their movements on the screen. Teachers have the ability to design certain aspects of the garden to focus on certain learning goals as well as allow students free access to the whole environment for personal exploration (Porayska-Pomsta et. al, 2011). The ECHOES project, through the use of Smart Board technology, creates a real-time child model that can measure the cognitive and affective states of each student, using a variety of learning techniques that all are based off of Smart Board technology. In connection with cognitive tracking, the vision component provided by the computer provides teachers with the ability to detect head and eye gaze directions, while also providing 2D screen coordinates of the child's attention, track head pose, detect a child's smile (Porayska-Pomsta et. al, 2011).

Fifty-three ASD students were studied using aspects of the ECHOES project in a series of academic workshops in order to examine the effectiveness of the technology. The rationale behind the study stemmed from a major theory of childhood development that states that, "atypical development is a lens which the norm can be better understood. Viewed broadly, development involves the transition from understanding physical causality (interaction with physical objects) to psychological causality (understanding a person's mind)" (Porayska-Pomsta et. al, 2011). By being able to understand and reason about one's mind and the mind of others, individuals began to formulate many of the social, linguistic, and perceptive skills that are seen in normal child development. Many of the workshops that were created for student analysis involved the creation of the proper environment for use as well as a better understanding of how interactive and visual aspects of the SMART Board technology should be utilized in a real classroom setting. With the information found in one workshop, researchers were able to improve the software and ask further questions, leading to a better understanding of the effectiveness of the software in a special needs setting.

After much time and analysis, the researchers in the ECHOES project found that their academic approach for social development in autism was an exemplary instance of how technology could be used in the classroom. They state that, “not only can it serve as a means of delivering interventions in situ but it also can provide an extension to human-human intervention that is adaptive, intelligent, and engaging” (Porayska-Pomsta et. al, 2011). The technology employed in the ECHOES project continued the breakthroughs that had been seen in the autism community. The researchers attempted to create a type of research design of this type of software that could display positive benefits in proper emotional and social development in the five to seven year old autistic child. In order to serve the diverse needs in traits and behaviors seen in autistic children, the ECHOES project created a personalized AI (artificial intelligent) technology that could emulate real life social behaviors and personal interactions. While some challenges still exist and further research is required, virtual technology, including CVEs and the Smart Boards, opened doors to even more advanced devices created by one of the largest digital corporations in the world, Apple.

On April 3, 2010, Apple released its newest and most state of the art technology, the iPad, a handheld, touchscreen device with practically all the capabilities of a laptop computer. The iPad’s interface was based around a home screen that contained a number of applications. Each and every iPad comes equipped with Wi-Fi capabilities that allow users to access the internet as well as download new applications from the Application store or download music. Within the first eighty days of availability, over three million iPads were sold around the world. As autism specialists began to look deeper into technology as a learning tool, the iPad immediately became their main focus. Several recent research and observational-based studies identify the usefulness of this new invention in the field of autism development.

"Teaching caregivers to implement video modeling imitation training via iPad for their children with autism"

One of the many capabilities of the iPad that autism researchers took interest in was the video modeling application. Cardon (2012) performed research on the functional correlation between the use of Video Modeling Imitation Training (VMIT) and improved imitation skills in young autistic children via the iPad. Cardon (2012) also attempted to analyze how and whether iPads could effectively be placed into a special needs classroom setting. Cardon's rationale behind this type of research was a result of the common inability of autistic children to properly imitate his or her parents, siblings, or even his or her teacher (Rogers, Hepburn, Stackhouse, & Wehner, 2003). Often times, the severity of a child's diagnosis can be linked back to their lack of imitation skills. Some researchers claim that a lack of imitation skills at a young age is one of the first signs of autism as well as a "diagnostic marker" for the disorder (Cardon, 2012). Past research has found that increased imitation skills training for students with autism frequently correlates directly with improved language and academic performance, play skills, and social skills (Lord et. al, 2000). Prior to the incorporation of Video Self Modeling techniques made possible by the iPad, most teachers were forced to teach imitation skills in face to face interactions in controlled settings. This classical technique was found to have limited effectiveness with minimal acquisition of skills as well as lacked the ability to promote drastic improvement or the generalization of skills.

Video Self Modeling technology has been on the market for over fifty years, but it was not until technology such as the iPad was introduced that this technique was utilized with students on the autism spectrum. Past research studies performed Ayres and Langdon (2005) and Charlop-Christy and Freeman (2007) attempted to investigate whether video self- modeling (VM) could, in fact, improve certain skills in children with autism. Their results indicated "that

children in the VM condition indeed acquired skills faster. Children also indicated the ability to generalize target behaviors with VM but not during live modeling" (Charlop-Christy et al., 2007). Research also showed that creating personal models from individuals close to students such as parents, family members, friends, or teachers were more effective than commercially bought videos lacking that "personal touch." Indicators have shown a probable connection between the results seen in past research and the possibility of similar results for the iPad. These findings led to the implementation of Video Modeling Imitation Training (VMIT) and Cardon's analysis of this type of training as an effective tool for teaching young autistic children to imitate certain gestures. While it has been believed that this type of technology will be immensely useful for imitation training, it is still unknown whether this technology can be easily taught to teachers and caregivers. Without research into both how and whether these devices can be useful to perform VMIT as well as whether these tools can be taught to caregivers and autism professionals for effective use in the classroom or home setting, Video Modeling Imitation Training via the iPad can never be implemented properly into special needs classrooms.

Cardon (2012) attempted to answer some of the previously stated questions dealing with the incorporation of VMIT technology into special needs classrooms. Cardon used a small sample size that included two boys, ages twenty-four and fifty months, and two girls, ages twenty-six and forty-two months, all who had been previously diagnosed with autism as well as their caregivers. Cardon attempted to solidify her study by making sure the four children chosen had never received any type of imitation training in the past. Also, Cardon made sure each child spent at least one hour per day watching television or another piece of virtual technology in order to guarantee familiarity with videos and associated technology used in VMIT. All tests took place in a controlled setting in a research lab at Washington State University. Each child was

tested separately, requiring actions chosen for them by their caregivers, and used videos created by their caregivers or siblings on second generation iPads equipped with standard video camera software and iMovie.

Each child was provided with a video that showed specific actions performed by his or her family members. Some of these actions included waving hi or bye, wiping one's face, gripping a pencil or pair of scissors, handing over objects, cleaning up toys, and even making one's bed. Each child participated in multiple sessions at the University that took place three times a week for a total of twelve sessions (four weeks). Each session lasted for around forty minutes. During each session, each child would be shown a video clip of an action and then would here a verbal cue from his or her caregiver such as, "Let's Play" or "Let's Clean Up" (Cardon, 2012). Following each cue, the child would have ten seconds to imitate the action they saw on the iPad. If imitated properly, the child would be verbally praised and a new clip would be shown. However, if the action was not imitated, the clip would be shown again. The procedure continued like this for all of the desired clips during each session. In subsequent sessions, videos would be displayed in random order as a means to account for possible order effects seen due to common exposure of each video clip. A child was seen to meet the desired criteria when eighty percent of the desired actions were imitated over four consecutive sessions.

After analyzing the results of all four students, Cardon found that all four displayed "positive gains in expressive communication as measured by increases from pre and post treatment" (Cardon, 2012, 1396). Another correlation was found based upon the diagnosed severity of each child's autism. The results showed that students diagnosed with lower levels of autism were seen to show greater gains in proper imitation than students who were placed more

severely on the spectrum. However, even with this correlation both sets of students seemed to show substantial gains in proper imitation skills.

The second aspect of Cardon's (2012) research analyzed the ability for VMIT to be easily understood by caregivers, allowing for an easy transition of the technology into the home setting. In order to test this, each caregiver attended a two hour training session where he or she was instructed on how to properly create the video models used in the study and received a handbook and instruction manual that included picture descriptions on proper use of the iPad and the iMovie application. Each training session provided step by step instructions for video creation recorded on his or her iPad. Caregivers then chose the five actions they wished their child to learn during each of the future training sessions. After creating a baseline for proper iPad usage, Cardon analyzed how effectively each caregiver was able to create video models for his or her child for several different categories. Some of these categories include steadiness of videos, lack of distractions, clearness of desired action, and appropriate rate for the visual display. All of these actions Cardon believed to be vital for the most effective videos, and therefore, also the most effective therapies for each child. The results showed greater than ninety percent fidelity across all categories, pointing to a high possibility for positive and effective implementation based on the relative ease seen in creation of the video modeling. Both results provided in this study display important contributions to the field of autism intervention research. Cardon's results show "that caregivers and teachers of children with autism can be taught to utilize iPads to effectively create video models with very minimal training. Also, iPads can be effective tools to support imitation development in young autistic children" (Cardon, 2012).

"Mobile learning technology based on iOS devices to support students with special education needs"

iPads and the iOS technology that each is installed with provides users with countless options for available applications that can be used for a variety of desired goals. Some researchers in the field of autism intervention technologies have even gone as far to create their own applications specifically designed to support the needs of an autistic child using the device. One of the best examples of this comes from a study by Fernández-López, Rodriguez-Almendoros, and Martinez-Segura (2013) where they create an application named *Picaa*. *Picaa* is available in the Apple App Store and is specifically created to cover three of the main phases of the learning process: preparation, use, and evaluation. Similar to much of the research already explained, Fernández-López et al. cites the importance of proper communication strategies such as conveying feelings and emotions as well as requesting objects or activities as vital to social development. In order to teach these skills, Fernández-López et al. believes alternative techniques such as picture displays can be effective tools for these students to incorporate proper communication skills into their daily routines (Fernández-López et al., 2013). *Picaa* is one application available on the iPad that provides autistic children with the opportunity circumvent some of their communication problems.

Picaa is a mobile learning platform designed in order to create educational activities for special needs users. It can be run on a variety of entertainment mobile devices such as the iPod touch, iPhone, or iPad. *Picaa* allows for personalization and customization by each teacher based upon the needs ort his or her students. *Picaa* attempts to break through some of the major limitations in major areas including visual, hearing, mobility, and cognitive skills by creating a unique interface with a wide variety of options. Fernández-López and her associates created *Picaa* in a fashion that allowed it to be easy to use for both students and teachers unfamiliar with

technology with the intent to keep the attention of the students who have struggled to remain attentive during classical teaching styles. *Picaa* incorporates spoken language as well as sounds to provide reinforcement of actions to students who may be nonverbal or display other communication impairments. Finally, *Picaa* provides students with the ability to improve skills such as association of ideas and pictures, sorting, and the promotion of proactive interactions not normally seen in autistic students.

These goals are components of four different types of activities that are available within the *Picaa* application. Exploration activities allow users to explore the multimedia system that can allow for personal arrangement of elements, or multimedia reinforcement of images based upon teacher prerogative (Figures 3,a-b). These activities allowed for alternative modes of communication. Association activities provide students and users with the ability to indicate relationships between images and are used to improve both math and language skills by joining words or numbers with pictures (Figure 3c). Puzzle activities simply allow students to complete puzzles of some of the previously viewed images and are fully customizable from image type to number of pieces (Figure 3d). Finally, sorting activities can be performed to place a list of elements into a certain sequence and allowed students the opportunity to reinforce some daily skills by placing actions in a certain order, like brushing one's teeth or making a bed (Figure 3e).

Fernández-López et al. created a research design that tested two main hypotheses: H1. "The use of the learning platform *Picaa* promotes the development of learning skills in children with special needs" and H2. "The repertoire of types of activities provided is suitable for learning purposes with children with special education needs." (Fernández-López et al., 2013) Student's skills would be measured prior to and following use of the application. Researchers also would observe each student during the time he or she was using the device, collecting comments in

order to identify trends. The study lasted for six months with four of the six months being set aside for actual work sessions with students. Thirty-nine students with special needs were analyzed and both iPads and iPods were used to display *Picaa*. Prior to implementation into the classroom, each teacher took part in a short instruction session to learn how to properly use *Picaa* and each device.

The results of the study by Fernández-López, Rodriguez-Almendoros, and Martinez-Segura (2013) were analyzed by examining five basic skills categories: Language skills, math skills, environmental awareness, autonomy skills, and social skills. By comparing pre and post questionnaires provided to each teacher, it was observed that there was an average increase of greater than four percent in all five skills categories with the largest increases, being seen in environmental awareness (Fernández-López et al., 2013). In sum, Fernández-López found that the *Picaa* platform showed to be "beneficial for their application with special needs students" (Fernández-López et al., 2013). Based on the positive increase in all five skills categories *Picaa* can and should be implemented into classrooms worldwide for educational purposes. Finally, *Picaa* should continue to be used on iOS devices based on their ability to increase interest in learning and create a mode of universal usage anywhere or anytime. The devices and applications are easy to use and can be learned quickly, two important factors when analyzing autism intervention technology. Teachers can personalize the platform to focus on individual student's needs and can easily supervise students while on the devices. All of the findings by Fernández-López support further implementation of iOS technology into special needs classrooms in the future to promote social and academic development in students with autism.

"Especially social: Exploring the use of an iOS application in special needs classrooms"

The *Picaa* platform is just one of several examples of applications that have been created uniquely for children diagnosed with autism or one of the other ASD syndromes. A study performed by Rachelle Campigotto and her associates studied another groundbreaking application available on iOS devices, in particular the iPad, known as *MyVoice*. The *MyVoice* application was created with the purpose of being used as a "cognitive support tool" that could assist in communication purposes for individuals who present certain special needs issues that prevent them from normal facets of communication. The *MyVoice* application can be run on a dual interface that includes an iOS interface that can be run on iPods, iPhones or iPads as well as a computer interface available to instructors. The combination of these two interfaces allows for students to control the iOS interface wherever they are while teachers can use the computer interface to upload information or track student activity and progress. The tracking ability of *MyVoice* was one of the first applications of its kind opening new possibilities for connective learning outside of the classroom and into student's daily lives.

With *MyVoice*, users have the ability to create "books" that include pictures either taken from the device itself or off of the Internet. Each picture is then associated with a word or phrase that is then recorded by an instructor or family member. When a student chooses a picture by simply touching the screen, his or her parent's or teacher's voice will play the recording of the word or phrase. The opposite is possible as well. *MyVoice* also allows users to undergo word picture association, where each student has the opportunity to select a picture when hearing a word or phrase. It is in this way that application developers hoped to increase word association

as well as provide alternative routes of communication. This type of application will allow nonverbal students to gain the ability to communicate with others. Before these devices, this type of verbal communication would have been impossible for many special needs students, including those with autism; thus, making these applications one of the most useful aspects of these types of devices.

A study performed by Autism specialists, Campigotto, McEwen, and Epp (2012), used mobile devices with iOS in two Toronto-area schools with special needs students in grades seven to twelve. The researchers in this study attempted to not only test academic development of these students but also certain behavioral or social issues, including attention span, focus, motivation, and collaboration while students used the devices (Campigotto, McEwen & Epp, 2012). The researchers aimed to assess to what degree using the iOS devices, especially the My Voice application, can be utilized in the classroom setting, while also identifying certain factors that can have the greatest impact on the use of these technologies with current academic curricula in special needs classrooms.

Campigotto et al. employed a series of different techniques that included interviews of teachers (from both Toronto schools), interviews with students, direct observations of the students while on the devices, and numerical data which was directly logged and tracked by the devices (Campigotto et al., 2012). In total, twenty-five special needs students between the ages of twelve and twenty-one were observed in connection to their usage of the *MyVoice* application. None of the students involved in the study had used iOS devices for any academic purpose in the past. The results of their study indicated an incredibly high potential for the implementation of iOS devices in special needs classrooms as well as the potential to improve classroom experiences that include more influential lessons for many of these students. However, mixed

results also occurred due to the possible difficulties of universal implementation of this technology into classrooms. For example, inconsistencies in combined results and recorded data occurred when dealing with different individual students. Not every student was the same with the exact same needs. This fact resulted in Campigotto and her colleagues receiving mixed results which points to a requirement for further examination in larger sample pools in order to find a more universal conclusion.

The results of Campigotto et al.'s study showed a high probability and high potential of implementation of these types of devices and mobile technology as a whole into special needs classrooms. Campigotto states "the use of iOS devices by special needs students appeared to afford them with feelings of importance within the school, increased self-confidence, and fostered a sense of community for this group." (Campigotto et al., 2012) While often times autistic and other special needs students struggle with the learning of new materials, Campigotto noted the relative simplicity and increased confidence that was seen when it came to learning how to use and work with these mobile devices. Campigotto and her associates also concluded that while these devices are indeed very useful, they must be implemented in a manner that utilizes their strengths, including improving group play in certain interactive games as well as certain academic applications that go beyond the pencil and paper work seen in classical lesson plans. Findings also showed that successful integration of these devices into classrooms depends on a device's ability to be able to serve the needs of students at different levels and learning styles. In the end, the study performed by Campigotto and her associates delved even deeper into the field of intervention technology for autistic and special needs students. With the proper incorporation of these devices into special needs classrooms, students have the ability to strive and learn at higher levels that have ever been seen before. Students have shown an increased

perception of success and have even displayed qualities that have allowed them to participate in community or group based activities that have never been seen before.

Critical Analysis

In order to critically analyze any collection of research, it is vital to understand exactly what is being examined as well as why. In the case of intervention technologies and autism, the importance is clear. Only fifty years ago, autism was practically unknown. Often times, children were misdiagnosed or even undiagnosed. As time went forward, however, autism slowly began to be recognized as a legitimate psychological, medical disorder. However, even with today's technology and research no singular cause has been associated with causing the disease, which makes the need for intervention technology all the more important. Researchers continue to find ways to control the disease that has continued to increase significantly. While many aspects of autism remain unknown, one thing is clear, the need for new intervention technologies are at high demand. For this reason, research will continue into the future in order to improve the lives of the ever-growing number of autistic students.

The remaining aspect of my thesis will take the form of my personal analysis of the research that was explained previously within this paper as well as an incorporation of phenomenology, research in the "lived experience," that I have obtained over the last eight years during my time at the Rich Center for Autism at Youngstown State University. It is my goal to attempt to not only identify whether iOS technology is the best technological option for implementation into special needs classrooms but also decipher exactly what aspects of iOS technology provide the highest probability of both social and academic development in autistic children. I will conclude with a final analysis that examines whether the research examined here supports or rejects my two initial formulated hypotheses. These hypotheses state: (a) that iOS technology directly benefits social development in autistic students, and (b) that without proper social development, these students will not be able to reach their maximum academic potential.

The first aspect of the iPad that I will analyze can be based off of the question: Why choose to implement an iPad into the classroom rather than another type of device? Fernández-López et al. (2013) study provides some support for Apple's iOS devices. Prior to the creation of Picaa for Apple's iOS operating system, Fernández-López et al. (2013) looked into other devices such as computers for their application. However, they found several advantages of the iOS system over other devices. First, the touch screen capabilities found on all three products (iPod, iPhone, and iPad) allowed for easy, natural interaction that does not involve a stylus or pencil, which would not be able to be used by individuals with certain cognitive disabilities. Second, iOS devices are fully mobile and fully connective to Wi-Fi or Bluetooth systems which promote portability and allow access at all times. This further allows for communication between parents and teachers as well as other supporting groups. Third, iOS technology is equipped with motion sensors within the interface that allow students to rotate the device and visibly see a change in the display. This ability can allow for secondary activities that could be created based upon movement of the device. Finally, all three iOS devices are easily accessible worldwide and have shown enormous success thus far which facilitates continued popularity of these devices into the future which has been unseen for many past devices.

Fernández-López et al. (2013) accurately illustrate the advantages of iPads and iPods over previous devices such as the computer. Apple's iOS devices have created a brand new world for autistic students. For instance, CVEs and other virtual technologies that have been used in classrooms prior to the invention of the iPad gave students the ability to use both of these devices in the classroom during daily lessons. However, when students go away for a holiday break or during summer, students cannot use this technology. During the time I have spent working with students with autism at the Rich Center, it has become evident to me that when

students are away from school for extended periods of time regression is almost inevitable. The progress that had been made during the previous school months will decrease. It can take the student a week or even one month to even return to a level of focus that promotes any type of growth in the classroom. By being able to bring home a device that contains many of the applications and programs that have been used in the classroom, students can continue to make progress even when they are not in the classroom. Not only will this allow for continued development in the home environment but it will also allow students to return to the classroom focused and ready to learn with their teachers who specialize in teaching students with their disabilities.

The ability to prevent academic regression is not the only reason why the iPad and its associated iOS devices are preferred to those of past technology. Apple and its products also provide thousands of available applications that can be downloaded and quickly installed on each device. These applications range from educational applications such as Grade 4 Math, Stack the States, and FW Animals, play time applications such as Angry Birds and Cut the Rope, or the previously described applications created for children with special needs such as *MyVoice* and *Picaa*. A diverse variety of applications is vital when it comes to creating a device for children with autism. Each child diagnosed is so different, which makes it important to create a device that has available resources for every student, regardless of their unique symptoms.

The iPad is one of the only devices that possess an ample number of applications that are needed to promote equal opportunity growth for all students. This would mean that no matter what symptoms or disabilities a child displays, there would be some type of application that can be utilized in social and academic development. When comparing the iPad and other iOS devices to previous technology, past technology was built with only one main focus that each device was

centered around. For example, while students could effectively learn proper emotional displays from avatar-based virtual environments, such as those in the study by Moore et al. (2005), the technology has distinct limitations. First, avatar-based virtual environments lack the ability to improve autistic children's math or reading skills, and they cannot effectively assist in all aspects of a special needs curriculum due to a limited reach of the technology. Avatar-based virtual environments do allow students to enact in certain aspects of social interaction that are also available on the iPad. However in comparison to the iPad, these specific virtual technologies don't promote the same opportunity for the improvement or as effective applications. Due to the various applications and abilities of the iPad, an entire special need's curriculum can be effectively centered on one central device.

An excellent example of this took place in a classroom that I spent time in during the last eight years. The classroom utilized iPads in various aspects of students' daily routine. While the iPad did not replace all teacher student activities, at certain times during the day, students had the ability to complete math work or vocabulary terms on applications found on the iPad. This allowed the instructors to provide more focused attention on the other students who were not participating in iPad based activities, which has created a new dynamic within special needs classrooms. In the past, one or two teachers would be responsible for whole classrooms filled with five to seven students. While this may not seem like an issue compared to student-teacher ratios in regular elementary school classrooms, students with autism require increased attention in order to not only keep them on task but to also enact effective teaching methods for each student's development. Special needs teachers have long yearned for a device that could keep their students focused while also providing them with educational activities proven to promote social and academic growth. The iPad has thus far been this device. Teachers now have the

ability to place their full attention on individual students while also helping the remaining students by providing them with activities centered on the iPad.

Possibly the most influential aspects of the iPad stem from two of the most common developmental issues that occur in students who are diagnosed with autism: an inability to communicate as well as a the lack of "group play" mentality. Group play is understood as a student's ability to properly initiate and engage in group activities or group work. The iPad, up to this point in time, is the only device that has promoted group play in autistic students. Campigotto et al. (2012) states "differentiation enabled by the multi-modal features of this device has fostered a more robust sense of community among special needs students." (Campigotto et al., 2012) Evidence of the group play dynamic also became quite evident in my own personal experiences in autistic classrooms. During my initial years at the Rich Center no iPads were available to students. Teachers used classical teaching methods as well as Smart Board technology in most of their lessons. Students were observed working alone even during play time. When attempting to get several students to work together, teachers would have to provide incentives such as candy or free time in order to get each student to participate in the group. Even with the incentives, often times students still did not interact with one another and quickly lost focus. When you compare these observations to what I saw over the last two years, students have been witnessed taking turns on the iPad or playing games such as Angry Birds together. This type of "joint attention" is rare as almost all levels of autistic classrooms. However, I witnessed students in the preschool classrooms watching over one another's shoulders while one student would be playing with the iPad. These observations were rare in the past and before the implementation of iPads.

When analyzing iPads as communication devices for both verbal and nonverbal students, the best application to analyze is the *MyVoice* application that was studied by Campigotto and her associates. The *MyVoice* application has broken the speech barrier for many students who in the past were forced to communicate through nonsense language or hand motions. *MyVoice* is an application whose interface allows teachers and students to select pictures from various locations and place each photo into categorical books such as foods, colors, games, etc. Whenever a child would like one of these items, they simply have to go into that book, select the item of interest, and the iPad will play a recording of a teacher or parent's voice stating aloud the selection. This type of technology has opened many doors for autistic students, especially those who are nonverbal. In the past, many parents of autistic children found it difficult to bring their child to public locations such as restaurants because it was often difficult for the child to make meal selections.

With the creation of the *MyVoice* application, autistic children have the opportunity to make their own selections from the various lists created within the application. Parents have found this to be an incredible change that has allowed their children to live increasingly "normal" lives. Another example of the usefulness of this application takes place in the classroom setting. One classroom I observed during my last summer at the Rich Center contained four nonverbal students. These students struggled to communicate their needs to their teachers on a daily basis. One day, one of the teachers approached me and asked if I could help create a book within the *MyVoice* application titled snack time. The list found within this book contained several options such as Doritos, Oreos, milk, orange juice, pudding, etc. For the remainder of the session, the iPad was used during each and every snack time. The teacher would pass the iPad around to each student so they could choose their snack for that day. Teachers no

longer had to choose snacks based on past preference; instead they could empower the students and providing them the opportunity to make decisions dealing with their own lives.

With all of the evidence provided by the various research groups detailed here as well as the observations I have seen, it is clear that the iPad and other iOS technologies have some type of positive influence in the classroom. However even with these likely benefits, opponents of iPad implementation into special needs classrooms exist. Opponents to this new age teaching style have cited three key complaints to questions that they believed have still not been answered with past and present research. The first question deals with the ability of teachers to control what types of media are available to students. The second complaint questions the relative ease of implementation as well as the amount of training required to effectively use iPads as teaching tools. The final flaw concern is that iPads can never replace the interactions that occur between teachers and students in the classroom.

A rebuttal to the first question is relatively easy. Each iPad comes equipped with the ability to lock or filter which applications can be used by each student. If a teacher wants a student to only work in one of three educational games; then he or she has the ability to lock other applications, such as the Internet, in order to prevent students from opening them. Thus, the iPad provides teachers with the opportunity to completely control which applications each student can use at any time. The second complaint is rebutted by several of the research articles examined earlier in this analysis. The studies performed by Campigotto et al. (2012), Cardon (2012), and Fernández-López et al. (2013) provide distinct evidence supporting the idea that proper training is quick and easy. For example, Cardon states, “Caregivers require only minimal training to implement VMIT effectively with their children in their home environment.” (Cardon, 2012, 1397) All three research studies concluded that there was a “strong potential for

successfully integrating mobile technology within special needs classrooms." (Campigotto et al., 2012) The final flaw cited by opponents of intervention technologies cannot be refuted based on the fact that supporters do not wish to remove all classical teaching methods. Supporters of this type of teaching style look to simply connect classical methods with technological methods to create a new age curriculum that provides the most efficient teaching style to promote the highest level of academic and social growth ever seen in the autistic community.

While in a perfect world the decision to provide every student with an iPad for universal use would be plausible, in the real world this is not the case. Several barriers, both economical and personal, are encountered when it comes to introducing iPads in the home and classroom environment. The first and most obvious issue is the cost of the iPad and its associated applications. The cheapest iPad that is available for purchase is approximately two hundred dollars while the newest version costs no less than five hundred dollars. These prices do not even account for the cost of several of the most useful applications available. The *MyVoice* application for example costs fifty dollars while many of the popular games cost between one and five dollars. These prices can add up and many families cannot afford to purchase these types of devices. Even schools struggle to supply a sufficient number of iPads for entire classrooms. The economical limitation due to the high cost of each device definitely plays a role when analyzing the ability for iPads to be the best intervention technology option. A second issue is a more personal one. Many parents do not allow their children to spend substantial time on technology while they are at home. It is common for all parents to set limits on technology while at home. These parents often times also do not appreciate persistent technology use while at school. iPads, no matter how useful, are still considered technology, and for parents who may be against technology, the iPad may not be the best option.

Throughout this critical analysis, iOS technologies, as well as several other devices, have been analyzed for their possible implementation into future special needs classrooms. Many of these technologies have already begun to be implemented and have shown positive results. The research studies by Moore et al. (2005), Porayska-Pomsta et al. (2012), Cardon (2012), Fernández-López et al (2013), and Campigotto et al. (2013) explored different aspects of these devices with the common goal of attempting to decipher how and if these devices can effectively be used as intervention technologies in autistic and special needs classrooms. All four studies came to a common conclusion that each device that they analyzed has a high probability of being an effective and efficient tool in special needs classrooms. Researcher such as Fernández-López et al and Campigotto et al, go even further saying that the iPad and its accompanying iOS devices are the best options for these classrooms based on the immediacy, the variety, and the opportunities that are available to these students by using this particular device.

In conclusion, I believe that based upon the results found in each of the five studies critically analyzed as well as the personal observations I made during my time at the Rich Center, iPads and iOS technologies are by the far the best technological option for implementation into autistic and special needs classrooms. The iPad provides students with an ability to grow socially by improving communication skills, imitation skills, and creating a group play mentality. The evidence from these studies and my observations clearly show that iOS technology improves social development based upon its wide variety of applications such as *MyVoice* as well as the various video imitation modeling capabilities. It is only with proper social development that effective academic development can truly be obtained. The evidence provided throughout this project supports this statement, therefore also validating my second hypothesis. Moore said it best when he wrote “social skill programs are also often advocated,

partly on the grounds that social impairments can affect general education processes." (Moore et al., 2005) If a child cannot properly interact socially, the student is already put in a position that can lead to decreased academic development due to the student's inability to communicate his or her needs. Academic and social development must be taught hand in hand with social skills being taught at a very young age. The iPad has shown to be effective at teaching these social skills and with proper training, teachers and caregivers can start each and every child on the path to increased academic and social development and better lives.

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Appendix: Figures

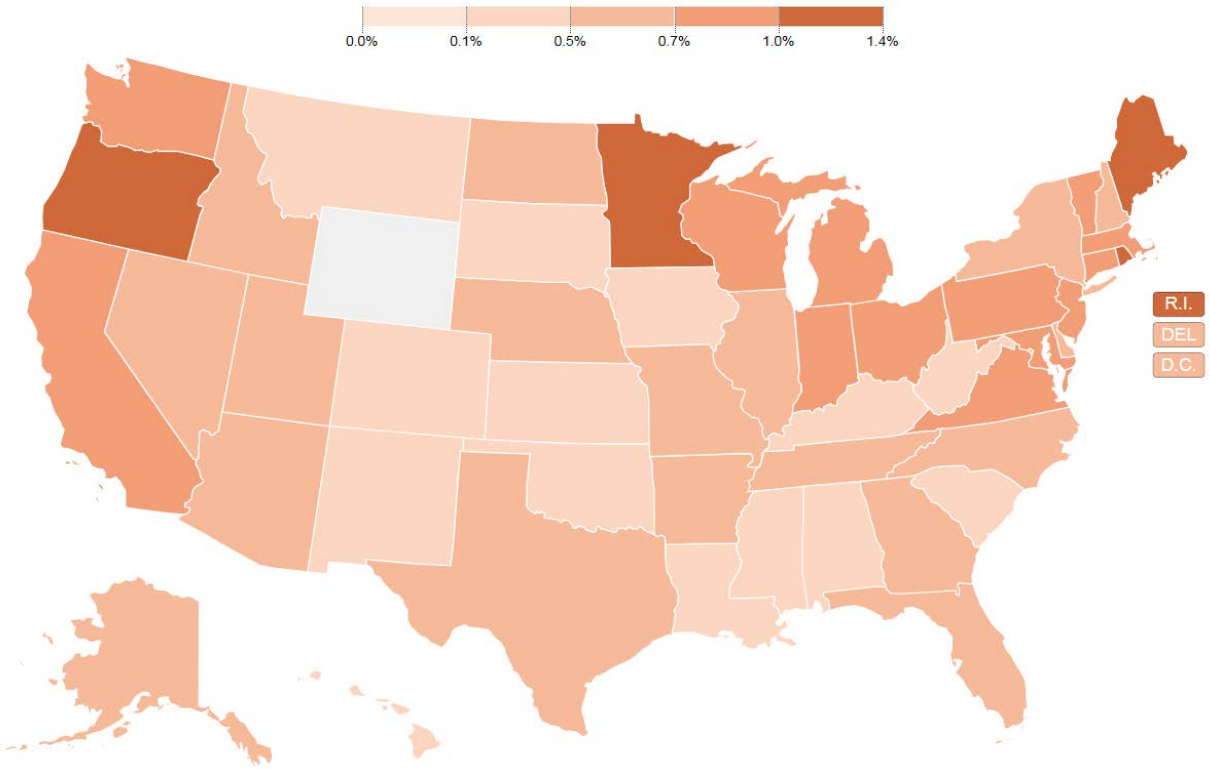

Figure1: Autism Rates across the US, *The LA Times*, 2011, Retrieved from http://www.latimes.com/news/local/autism/

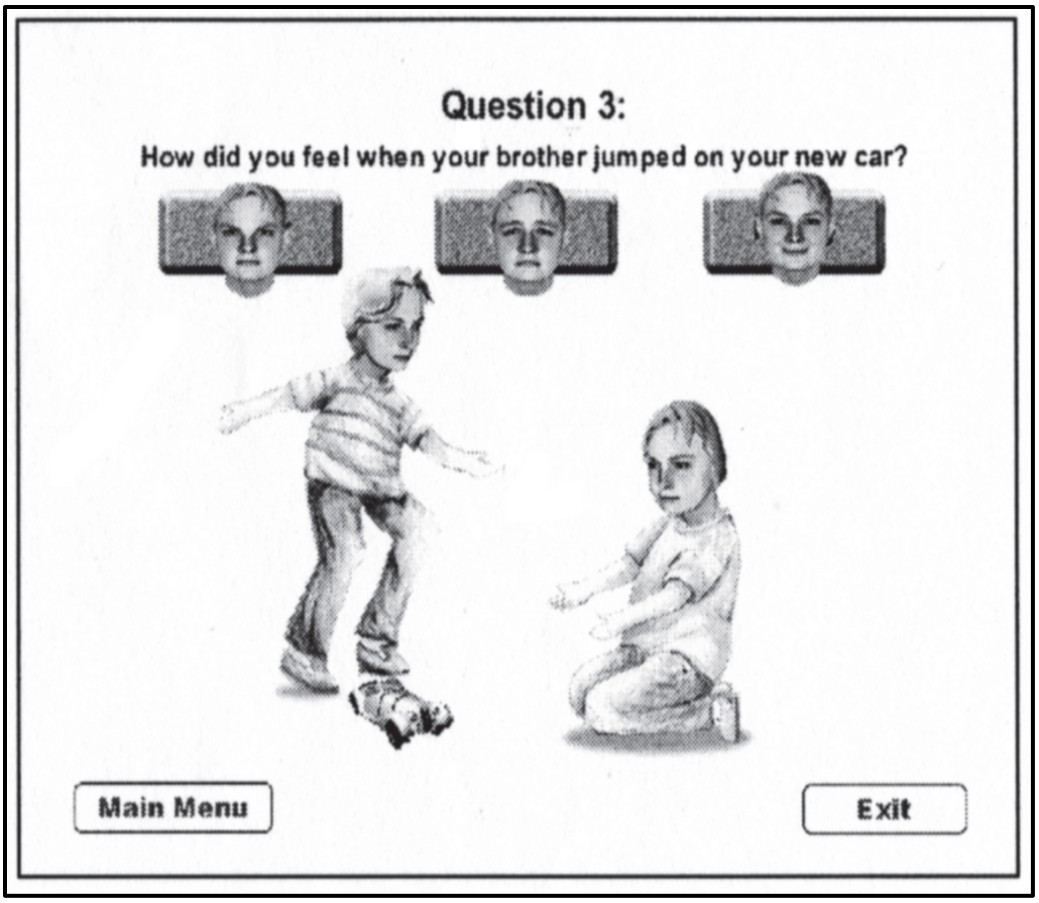

Figure 2: Question Asking Methodology during Stage 2, *Focus on Autism and Other Developmental Disabilities*, By Moore et al., 2005

Figure 3: ECHOES Sensory Garden. By Porayska-Pomsta et al., 2010

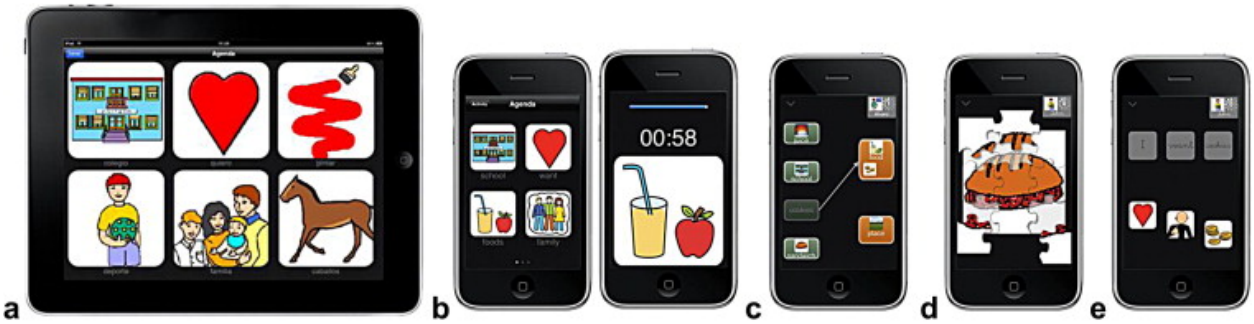

Figure 4,a-e: Examples of *Picaa* Activities, *Computers and Education*, By A. Fernández-López et al, 2012