8-19-2014

The influence a digital screen has on the learning process, for students with Autism spectrum disorder

George Gordon

THE INFLUENCE A DIGITAL SCREEN HAS ON THE LEARNING PROCESS, FOR STUDENTS WITH AUTISM SPECTRUM DISORDER

by
George Brandon Gordon

A Thesis

Submitted to the
Department of Education Services, Administration and Higher Education
College of Education
In partial fulfillment of the requirement
For the degree of
Masters of Arts in School Psychology
at
Rowan University
May 6, 2014

Thesis Chair: Terri Allen, Ph.D.

Dedication

I dedicate this manuscript to my family, friends and mentors.

Acknowledgments

I would like to thank Dr. Roberta Dihoff, and Dr. Terri Allen for their guidance and support throughout this research project.

Abstract

George Brandon Gordon
THE INFLUENCE A DIGITAL SCREEN HAS ON THE LEARNING PROCESS, FOR STUDENTS WITH AUTISM SPECTRUM DISORDER
Roberta Dihoff, Ph.D.
Master of Arts in School Psychology

The purpose of the this study was to explore the effect a digital screen (iPad) had on the learning process, of a vocabulary matching activity, of words to definitions activity, in a student with autism spectrum disorder, in comparison to learning on paper (flashcards). According to past research, digital based interventions are utilized more often in research settings, indicating a growth in its use in educational settings (Goldsmith & LeBlanc, 2004). Individuals with autism spectrum disorder are often given interventions using digital screen based technologies, in academic and other life and skill teaching settings (Ferguson, Myles, & Hagiwara, 2005; Gentry, Wallece, Kvarfordt, & Lynch, 2010; Mechling, Gast, & Seid, 2009; Myles et al., 2007). This study explored the learning mediums of paper and digital screen.

To test this these learning mediums, a student with autism spectrum disorder, was given a randomized, alternating treatments design, of paper (flash cards) or digital screen (iPad) to use in learning and testing in a vocabulary activity of matching words with their definitions. The classroom data collected for this vocabulary matching is done over ten trials daily, which show the percent in which the student has matched these words correctly, within each of these trials. The results of the data collected during this research process, indicate that the digital screens (iPads) in combination with paper (flash cards) positively influenced that rate this student mastered the vocabulary matching activity.

Table of Contents

Table of Contents (Continued)

List of Figures

List of Tables

Chapter 1

Introduction

Need for Study

The continuously growing implementation of technology-based interventions for disabled populations brings forth a need to investigate their usefulness. Individuals with autism spectrum disorder are one population that current research is emphasizing technology interventions for. It is important for research to understand the possible underlying influences that technology can bring about in the learning process for individuals with autism spectrum disorder. The goal of this study is to explore these possible underlying influences and learning enhancements, which may result directly from a technologies digital screen.

The importance of this study is to explore the potential of digital screen devices as an educational tool, it is important to see if the digital screens themselves increase learning speed and enhance the learning processes for individuals autism spectrum disorder. By exploring this aspect of technology, future research can take into account the possible direct influence that a digital screen may have on technology based intervention programs, which target individuals with autism spectrum disorder. Researchers can better assess the effectiveness of these educational tools used within the autism spectrum disorder population, by taking into account the screen's influence in the learning process.

Another goal of this study is to explore the influence of digital screen, by comparing the screen as closely as possible to paper based teaching methods. Comparing learning on digital screen directly to paper while controlling for possible confounding variables that an iPad might have such as visual, audio and video feedback, provides us

with direct insight in whether not learning on screen is better than learning on paper.

Purpose

The goal of this study is to test the effectiveness of digital screen (iPad) based vocabulary matching fluency activity for an individual with autism spectrum disorder. This study will explore the potential elements, that make using digital screen based devices an effective educational tool, by comparing the cumulative vocabulary scores and the rate vocabulary units are mastered by an individual with autism spectrum disorder, using a digital screen (iPad) vocabulary matching activity in comparison to a paper based vocabulary matching activity.

Hypotheses

A prediction of this study is that a digital screen (iPad) vocabulary matching activity will be a more effective learning tool, in comparison to a paper-based vocabulary matching activity. More specifically, this study will predict that digital screen (iPad) will increase learning speed and the percentage of mean scores during a vocabulary matching trials. While, in comparison, the paper based (flashcards) vocabulary matching activity, will result in a lower late of learning, and lower percentage of scores, in comparison to an (iPad). The hypotheses for the current study, first, is the total daily percentage scores of the vocabulary matching activities will be higher on the digital screen (iPad) vocabulary matching activity, in comparison to the flash card matching activity (paper) during the intervention phase (alternating treatment of paper and iPad vocabulary matching activity). Second, the scores during the intervention phase (combination of both paper and iPad) will be higher than the baseline phase (paper only) vocabulary matching activity. Finally, this study hypothesizes that the student will learn

vocabulary units at a higher rate during the intervention phase (randomized alternating treatment of paper or iPad vocabulary matching activity), than in comparison to the baseline phase of paper only vocabulary matching activity.

Operational Definitions

Digital screen: The screen on a digital device, in the case of this study, an iPad's screen.

Paper: The use of paper based educational tools, in the case of this study, flash cards.

Vocabulary matching activity- A learning activity in which a student matches a word and it's definition to each other using either scattered flash cards (paper) or the "scatter" feature on the application Quizlet (iPad).

Vocabulary matching percentage score: The mean score of a single days worth of vocabulary matching practice (3-4 trials performed on one day).

Limitations

The current study used a single subject case design. This means, this research may only be effective with the small population used, and might not cause the same effects in other individuals with autism spectrum disorder. For results of this study to become more useful, future studies using larger populations will be needed to further prove what is found in the current study.

Assumptions

The current study uses a single-subject, alternating treatments design. It is assumed that the teacher correctly collected the data and followed the alternating treatments of iPad or paper. It is also assumed that the use of a vocabulary matching activity on a

digital screen (iPad) and a paper based vocabulary matching activity (paper) was completely randomized throughout the experimental process.

Summary

Data related to the classroom activity of vocabulary matching was collected, over 30 classroom days. "Paper only" data was collected for the first 15 days. Data collected for days 16-30 was an alternating treatment of either a paper or iPad (intervention) vocabulary matching activity. The primary diagnosis of the student participating in this study was that of Autism Spectrum Disorder. The student, in this single subject study, attended a specialized program, for educating, supporting and meeting the needs of individuals with autism spectrum disorder. Previous teacher collected data related to vocabulary matching activities was obtained in order to collect baseline data, and in order to formulate the hypotheses for this investigation.

Hypothesis 1: The total daily percentage scores of the vocabulary matching activities will be higher on the digital screen (iPad) vocabulary matching activity, in comparison to the flash card matching activity (paper) during the intervention phase (alternating treatment of paper and iPad vocabulary matching activity).

Hypothesis 2: The scores during the intervention phase (combination of both paper and iPad) will be higher than the baseline phase (paper only) vocabulary matching activity.

Hypothesis 3: The student will learn vocabulary units at a higher rate during the intervention phase (randomized alternating treatment of paper or iPad vocabulary

matching activity), than in comparison to the baseline phase of paper only vocabulary matching activity.

Chapter 2

Literature Review

Autism Spectrum Disorder Definitions and Background Information

According to the DSM-V the following diagnostic aspects are used to define individuals with autism spectrum disorder; an impairment in socialization, communication, and restricted or repetitive interests or behaviors (American Psychological Association, 2013).

Individuals with autism spectrum disorder also are commonly deficient in "work, self-help, leisure, and hygiene skills…." (Matson, Hattier, & Belva, 2011, p. 271). autism spectrum disorder have a much higher occurrence rate in the male population (Pillay & Suniti-Bhat, 2012). It is also believed that autism spectrum disorder occurs approximately at a rate of 30 to 60 cases per 10,000 individuals (Rutter, 2007).

Theory of Mind

Theory of mind theory of mind is used to explain the "mind-blindness", which is often found in individuals with autism spectrum disorder. Theory of mind explains a person's ability to predict an/or even consider someone else's thought, feelings and individualized perspective (Baron-Cohen 1995; Baron-Cohen, Leslie, & Frith, 1985). Mind blindness is the inability to see another person's individualized thoughts and feelings. Mind blindness explains the social and communicational deficits these individuals often have. This "mind-blindness" causes individuals with autism spectrum disorder to find other peoples actions and behaviors to be unpredictable, confusing, and even overwhelming/frightening (Baron-Cohen, 2009). This deficit in theory of mind is even apparent in individuals diagnosed with lower functioning autism and as early as the

age of four years old (Cole, Baron-Cohen, & Hill, 2007).

However, mind blindness cannot account for the nonsocial features of autism spectrum disorder (Baron-Cohen, 2009). Davis (1994) discussed that; empathy in itself, is particular hard to us to completely explain theory of mind, empathy is not just the ability to "mind-read" another's emotional state, but also requires the ability to appropriately respond to another person's state of mind in an emotional context (as cited by Baron-Cohen 2009). This means that an individual with autism spectrum disorder can objectively interpret another person's emotional state (i.e. crying = sad), however, these individuals have a difficult time appropriately responding to others emotional states appropriately (Baron-Cohen, 2009).

Simon Baron-Cohen (2003) hypothesized that the male brain is more systematic in nature and according to this theory; an autistic brain is an extreme male brain. Meaning the autistic brain is a more extreme systematic thinker and sometimes even a superior systematic thinker, while being discrepantly deficit in empathic thinking (Baron-Cohen, 2009).

Empathizing/Systemizing Theory

In (2009) Simon Baron-Cohen developed a theory to build on top of his pervious works, the empathizing and systemizing theory, which explains some of what the theory of mind cannot explain about the deficits in individuals with autism spectrum disorder. Empathizing is defined as an individuals ability to (1) identify or recognize others (or their own) mental states and (2) to understand appropriate emotional reactions to another's thoughts and/or feelings. Systemizing is defined as a development of a formulaic understanding of systems (Baron-Cohen, 2006). Individuals with autism

spectrum disorder often have an intact ability to understand systematic thinking and sometimes even a superior ability, however, they display a deficit in empathic thinking (Baron-Cohen, 2002). An individual with a high to medium genetic risk in developing autism spectrum disorder was more likely to display the inverse relationship of being better at systemizing, in comparison to their ability to empathize (Grove, Baillie, Baron-Cohen, & Hoekstra, 2013). This discrepancy between the systematic and empathic ability is hypothesized to be an indicator of whether or not an individual will develop autism spectrum disorder.

Executive Function Skills

Executive function is a term to explain the functions of "planning, working memory, impulse control is a specific part of executive function skills. One study defines working memory as "…the ability to store and manipulate information for brief periods…" (Alloway, Rajendran, & Archibald, 2009, p. 372). Alloway, Rajendran, & Archibald (2009) found that, when compared to other disabled groups, individuals autism spectrum disorder have a stronger working memory in spatial tasks, in contrast, they have a deficit in selective verbal short term memory. It was hypothesized that these deficits may be linked in some way to the communication and language problems that are common in individuals with autism spectrum disorder. These problems would include the ability to continually remember a conversation as it occurs, so that they can be a successful participate in the conversation.

Everyday memory is memory skills relating to everyday tasks, which typically include social and communicative challenges (Jones et al., 2011). Jones et al (2011) found that autism spectrum disorder individuals were often deficit in everyday memory;

this deficit makes everyday organization, socialization and communication difficult for autism spectrum disorder individuals.

Individuals with autism spectrum disorder have been found to have a partial deficit in inhibitory control, specifically, in their ability to resist visual distractors that involves the ability to suppress irrelevant information (Christ, Kester, Bodner, & Miles, 2011).

Planning is an area that has been proven to be a weak area of executive function for individuals with autism spectrum disorder (Hill, 2004). Executive dysfunction appears to be central to autism spectrum disorder, especially, in the areas of response initiation and intentionality (Hill & Bird, 2006). autism spectrum disorder individuals difficulties with executive function skills, in areas such as working memory, initiation and organization; tend to worsen and become more problematic with age, while differences in flexibility remains unchanged across development (Rosenthal et al., 2013).

When executive function and theory of mind were tested for co-occurrence it was found that executive function impairment always correlated with theory of mind impairments (Pellicano, 2007). EF skills may play a role in whether or not an individual with autism spectrum disorderis able to develop a theory of mind and the level in which they develop theory of mind (Pellicano, 2007).

Vocational Skills and Work Placement

Despite the discrepancy that individuals with autism spectrum disorder have in vocational skills and work placement, the research in vocational skills is lacking, there is a need for it to be explored further, and effective treatments found, to increase vocational independence for individuals with autism spectrum disorder (McDonald & Machalicek,

2013). There is lack in the creation of employment programs for individual's with autism spectrum disorder and it is even believed, that these individuals with autism spectrum disorder have been neglected in programs related to work services, in comparison to other disabled groups (Howlin, Alock, & Burkin, 2005). Howlin, et al (2005) also found when individuals with autism spectrum disorder were placed work programs that only (68%) of them found job placement.

Daily Living Skills for Individuals with Autism Spectrum Disorder

Individuals with autism spectrum disorder have distinct deficits in there ability to perform daily living skills (Matson, Dempsey, & Fodstad, 2009). It is imperative that individuals with autism spectrum disorder achieve their highest level of possible independence, because one the highest indicators of success for students with disabilities in inclusion programs, is their ability to perform independently.

In (2012) Smith, Maenner, & Seltzer investigated the developmental trajectories of daily living skills for individuals with autism spectrum disorder. Using a ten-year longitudinal study, they found that overtime that the learning rate of daily living skills increased through adolescents. However, at approximately their late 20's these individuals with autism spectrum disorder began to plateau and even decrease in their learning rate of daily living skills. By the time these autism spectrum disorder individuals enter their 30's, their ability to perform daily living skills begins to decrease, in some case. A key factor that plays a role in an individual with autism spectrum disorder ability to learn daily living skills is the individuals IQ. An IQ above 70 significantly increases the learning speed of daily living skills (Freeman, Del'Homme, Guthrie & Zang 1999). Higher levels of autism spectrum disorder and a lower IQ, correlated to a slower learning

rate of daily living skills (Green & Carter 2014).

Independence Levels in Individuals Autism Spectrum Disorder

The educational and occupational outcomes for autism spectrum disorder individuals indicate a low rate of independent success among these individuals (Howlin, Goode, Hutton, & Rutter, 2004; Taylor & Seltzer, 2011). Howlin et al. (2004) found independent living, friendships and employment levels continue to be low, despite the recent increases resulting from related services. For individuals with intellectual and developmental disabilities being able to perform daily living skills independently is a key factor in successful outcomes (Esbensen, Bishop, Seltzer, & Taylor, 2010; Woolf, Woolf, & Oakland, 2010). Specifically, adults with autism spectrum disorder often have severe deficits in their ability to develop independence in daily living skills (DLS) (Liss et al., 2001;Perry, Flanagan, Dunn Geier, & Freeman, 2009).

A discrepancy in adaptive behavior and mental age is even apparent between individuals with autism spectrum disorder and individuals with other with developmental conditions can be seen as at the early stage of 36 months (Stone, Ousley, Hepburn, Hogan, & Brown, 1999). In fact, according to research, this lag continues to become more progressive as individuals with autism spectrum disorder age in comparison to same age peers (Kanne et al., 2011).

When individuals with autism spectrum disorder were directly compared to individuals with Down Syndrome, it was found that individuals with autism spectrum disorder were significantly impaired in life skills and factors related to adult independence (Esbensen et al., 2010).

Treatment for Adaptive Living Skills

The research of Matson, Hattier and Belva in (2011) reviewed treatments for adaptive living skills in individuals with autism spectrum disorder that implement the use of applied behavior analysis Mason et al.'s (2011) review of several studies discovered that applied behavioral analysis based methods area highly effective in teaching adaptive living skills to individuals with autism spectrum disorder. The use of picture-based systems has been effective in teaching individuals with autism spectrum disorder to learn multi-step tasks, which included, daily living tasks (Pierce & Schreibman, 1994).

Technology in the Classroom

Mobile technology has become commonplace among adults, utilized to help them in completing daily living tasks (Ayres, Mechling & Sansosti, 2013). The continually growing research in technology, to support individuals with disabilities, is a good indication, that technology based interventions are on the rise (Goldsmith & LeBlanc, 2004). In more recent research, mobile technology has become an area of focus (Myles, Ferguson, & Hagiwara, 2007). Technology, specifically mobile technology, may provide an opportunity for individuals with autism spectrum disorder to achieve a high level of independence (Ayres et al., 2013). Many studies have explored the numerous ways to use personal digital assistants (PDAs) (Ferguson, Myles, & Hagiwara, 2005; Gentry, Wallece, Kvarfordt, & Lynch, 2010; Mechling, Gast, & Seid, 2009; Myles et al., 2007).

The use of PDAs, has shown to improve occupational performance and retention of trained procedures for individuals with autism spectrum disorder (Gentry et al., 2010). The hope of this study is to explore that there may be an underlying motivator or

stimulation from using screen-based digital technology in learning.

An advantage of these technologies is that they are able to provide autism spectrum disorder individuals with photographic and video support (Johnston, Nelson, Evans, & Palazolo, 2003). An educational system based upon photographic support, has shown to be an effective tool for autism spectrum disorder individual (Lancioni & O'Reilly, 2001; Mechling, 2007).

In recent years, education has begun to utilize video technology to help teach academic, behavioral and job skills to individuals with autism spectrum disorder (Mechling, 2007). Video modeling is a technique that can be used to increase the learning potential of students with autism spectrum disorder in a number of ways, and is believed to be an effective educational teaching tool, particularly for students with autism spectrum disorder. Jowett, Moore, & Anderson (2012) found that a five year old was able to learn the numbers one through seven at a much better rate, and in a shorter amount of sessions with video modeling in comparison to typical teaching methods. However, video modeling has been less researched in other areas of academics, such as letter and number formation, and grammar (Jowett, Moore & Anderson 2012).

Controls in Educational Technology Studies

Although research in iPad educational, behavioral and social interventions has increased, there is often no use of control to compare how effective the intervention is compared to tradition methods. Additionally, most research does not appear to account for the impact of the screen itself, i.e., the novelty or electronic aspects, separate from the specific mode of teaching. This is sometimes minimized with the use of a baseline collection of data using traditional teaching methods (Burton, Darlene, Anderson, Prater,

& Dyches 2013; Jowett, Moore & Anderson 2012). Few studies have use controls, as close as possible to the iPad applications (Flores, Musgrove, Renner, Hinton, Strozier, Franklin & Hil 2012). Flores et. al. (2012) used a control of paper in comparison to iPad, that involved using a picture based communication system, with mixed effect size results

Another advantage of such technologies is devices such as an iPad, iPhone, and iPod touch, have become normalized in everyday use, not only in adults, but for the general population peers of child/adolescent individuals with autism spectrum disorder (Sennott & Bowker, 2009). These mobile devices are also portable, and convenient to use.

Paper versus Digital Screen Learning in the General Population

Past research indicates that individuals tend to have a preference to study text on paper in comparison to a digital screen (Buzzeto-More, Guy, & Elobaid, 2007; Dilevko & Gottlieb, 2002; Jamali, Nicholas, & Rowlands, 2009; Spencer, 2006; Woody, Daniel, & Baker, 2010). In the general population a preference towards learning on paper, positively influenced the an individual's reading comprehension test scores, while the preference of a digital screen, did not correlate to higher test scores (Ackerman & Lauterman, 2012). Ackerman & Lauterman (2012) found that in a pressured (i.e. constrained to seven minutes of study time) situation individuals tended to score much lower on screen based reading comprehension activities than paper based reading comprehension activities, however, in some cases, at paper and digital screen reading comprehension scores did not differ greatly. These results indicated, that metacognitive learning (MLR) might play a role in the discrepancies found between learning on a digital screen and paper. Brown (1987) "…(MLR) refers to higher-order thinking which

involves active control over the cognitive processes engaged in learning toward achieving one's goals…" (as cited by Ackerman & Lauterman, 2012, p. 1817)

The differences of learning on paper, in comparison to learning on a digital screen, have been explored primarily with in the general population and within reading comprehension appears to be limited (Magen, Walgermo & Bronnick, 2013). Some research indicates that digital screen learning has a higher cognitive load, than learning material on paper, in regards to reading comprehension (Watslund, Reinikka, Norlander, & Archer, 2005). Children appear to be more efficient in reading comprehension on paper, while on a digital screen they tend to learn the material at a slower rate (Kerr & Symons, 2006). Lower reading comprehension appears to be evident digital screen text, in comparison to paper text (Magen, Walgermo, Bronnick, 2013). This study hopes to find that the influences of learning on a digital screen will be different for individuals with autism spectrum disorder

Screen Based Media use in individuals with Autism Spectrum Disorders

Some longitudinal research has shown that individuals with autism spectrum disorder spend much of their discretionary activities using screen-based media, which included, television, time spent on the computer (Orsmond & Kuo, 2011). Individuals with autism spectrum disorder tend to have very restricted and repetitive interests, according to the DSM 5 this type of behavior is used as a key component in the diagnosis process for these individuals. The interest that individuals with autism spectrum disorder have in screen based media is so commonly accepted, that some studies have excluded this content while exploring the restricted interests that individuals commonly have (Klin et al. 2007). In this study time spent on the television and on the computer ranked far

above other discretionary activities. The first study to explore the comparison of autism spectrum disorder and screen based media with other populations found that as many as (64.2.%) of youths with autism spectrum disorder spend almost all of their free time on non-social media (Mazurek, Shattuck, Wagner, & Cooper, 2011). This study also found that only (13.2%) of these individuals spent time on social media. It was also found that individuals with autism spectrum disorder were more likely to use screen-based media more than other disabled groups.

There has been limited exploration to see if screen based media interest is related to other preoccupations that individuals with autism spectrum disorder have (Mazurek, Shattuck, Wagner, & Cooper, 2011). Studies have not seemed to explore the possible underlying motivations for individuals with autism spectrum disorder to be attracted to screen based media. The hope of this study is to explore these possible motivators, specifically looking at the impact of a digital screen, on devices such as screen based media, has on learning process for individuals with autism spectrum disorder.

Chapter 3

Methodology

Participants

The current study involved one elementary age student that has previously been diagnosed with autism spectrum disorder. The school used in this study, is located in the southern part of New Jersey. The student was enrolled in a specialized program for individuals with autism spectrum disorder.

A teacher collected the data; the data collected throughout the experiment is data normally collected during the student's vocabulary matching activity. This instruction time and methods took place at the same time, in the same way that was current with their normal learning procedures. The only difference throughout the study for the individual was the interventions medium in which the student learned and practiced/tested on the vocabulary matching activity. These differences implemented, were assigned by randomized alternating treatments, using Excel to mathematically randomize these treatments.

Materials

Collection of data took place over thirty classroom days, during the spring of 2014. The first 15 days consisted of baseline data, using the normal teaching method only (paper flash cards). Days 16 through 30 used the randomized alternating treatments of a screen based vocabulary-matching activity using Quizlet (iPad), or a paper based vocabulary-matching activity (flashcards). The data collected was the cumulative percentage score of the daily 3-4 trials of vocabulary matching practice.

The following were the measured dependent variables: the daily cumulative

vocabulary matching score and the number of vocabulary units mastered by the student.

Design

A single case study, using an alternating treatments design was used. The independent variables were both the use of a digital-screen based vocabulary matching activity using the Quizlet application (iPad) and a paper-based vocabulary matching activity on flash cards (paper). Quizlet is a free educational application for vocabulary learning, the only feature on the application that was utilized was the "scatter" feature. This "scatter" feature, as shown in figure 1, closely resembled the paper intervention of flashcards, to help control for variability between the two conditions. The following were measured dependent variables: cumulative daily percentage of the students 3-4 trials, and the number of vocabulary units passed by the student. The student only passed the vocabulary unit after meeting a predetermined criteria set by the classroom instructor. Independent task accuracy was measured by whether or not the student needed to be prompted by the teacher during that specific step.

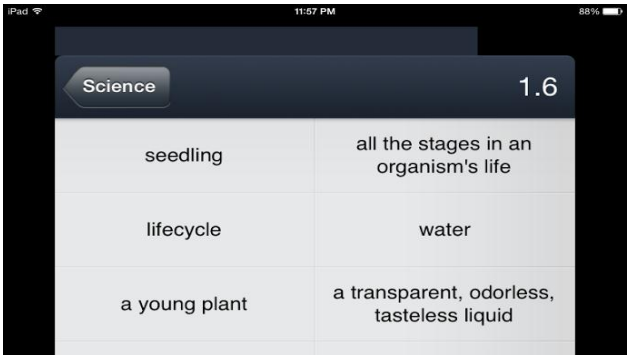

Figure 1. Quizlet app feature "scatter" activity

Procedure

The procedure of the current study utilized normal classroom instruction. The instruction and practice procedural checklist occurs on daily basis in this school's program. This activity was a vocabulary matching activity of two different subjects; science and social studies vocabulary words. This daily practice and instruction occurred during one classroom period daily. The only change made to the instruction was the random assignment of either the medium the student tried matching the vocabulary words with the Quizlet scatter activity (iPad) or flash card matching activity (paper).

Only on the first day, for one trial, did the teacher help the student practice the vocabulary matching activity, this was to avoid the student learning to recognize what words went together just by how they looked. The teacher reported that feedback was given more with the iPad than with the paper, especially at the beginning when the student was taught to use the Quizlet application. This means that early during the intervention phase that there was an adjustment period in which the student had to learn how to use the iPad correctly, however, the teacher reported after sometime the student become much more independent with the iPad. The student did 3-4 trials in a single day, and was prompted on whether or not they had matched the words correctly; if the student had not matched the words correctly they needed to re-match the words for practice. The data collect as from February 17, 2014 until April 1, 2014, during classroom instruction. All data collected was transferred to Excel to be analyzed. This data was encoded to ensure the participant's confidentiality. Permission from the programs director was required and acquired for the purpose of this study.

Chapter 4

Results

The current study explored the use of the classroom technology of an iPad, for a student with autism spectrum disorder in comparison to paper. The classroom activity used for this study was a vocabulary matching activity of words from the subjects of science and social studies to their words with their definitions. Baseline data was taken for 15 days, in which the student only used the original flash card activity (paper) to practice and master vocabulary units. Intervention data was taken for 15 days in which the student was randomly, and alternatively, assigned either the intervention of an iPad, using the app Quizlet, with its feature "scatter" or the intervention of flash cards, both of which were a vocabulary matching activity.

The hypotheses for the current study, first, were that the total daily percentage scores of the vocabulary matching activities would be higher on the digital screen (iPad) activity, in comparison to the flash card matching activity (paper) during the intervention phase. Second, the scores during the intervention phase (combination of both paper and iPad) will be higher than the baseline phase (paper only). Finally, the student will master vocabulary units at a higher rate during the intervention phase (alternating treatment of a paper or iPad vocabulary matching activity) in comparison to the baseline phase (paper flash card only).

Mean scores were ran in Excel and compared between the digital screen (iPad) and the paper based (flashcard) vocabulary matching activities, strictly using data from the intervention phase only. Within the intervention phase, iPad scores were (M= 91.88)

and paper scores were (M= 88.57). The mean scores between paper and iPad during the intervention phase the difference was small, as shown by figure 2.

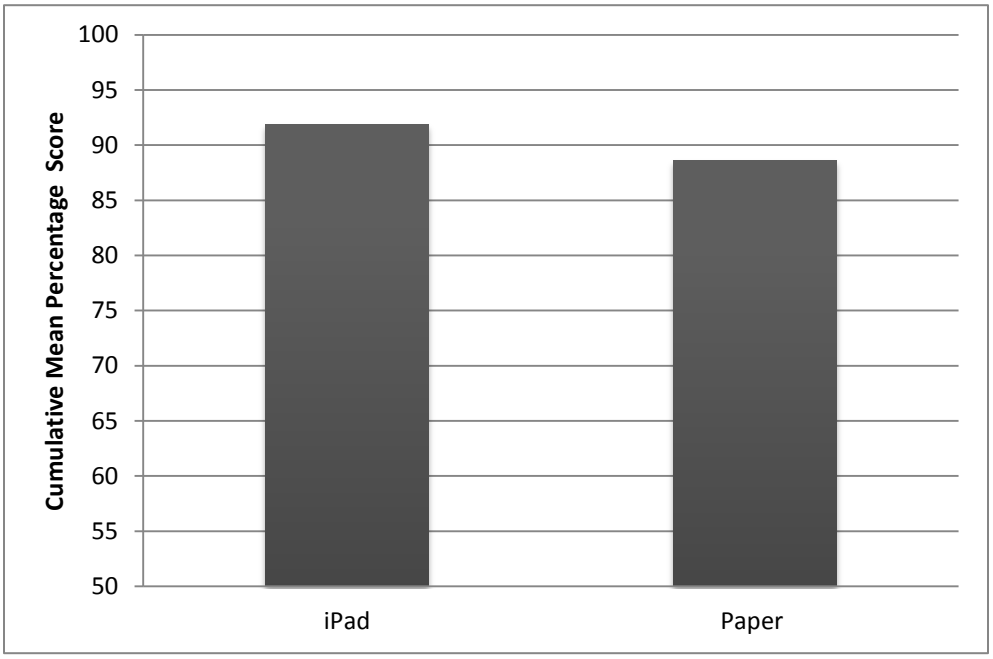

Figure 2. Cumulative mean scores of iPad and paper during the intervention phase.

Mean scores were ran in Excel and compared between the baseline phase (paper only) and the intervention phase (randomized alternating treatment of iPad or paper). The mean of the baseline phase was (M = 79), and the mean of the intervention phase was (M= $90.\overline{33}$), as shown in figure 3. There was some difference in scores between the baseline and intervention phase, with the intervention phase having higher scores, shown in figure 3.

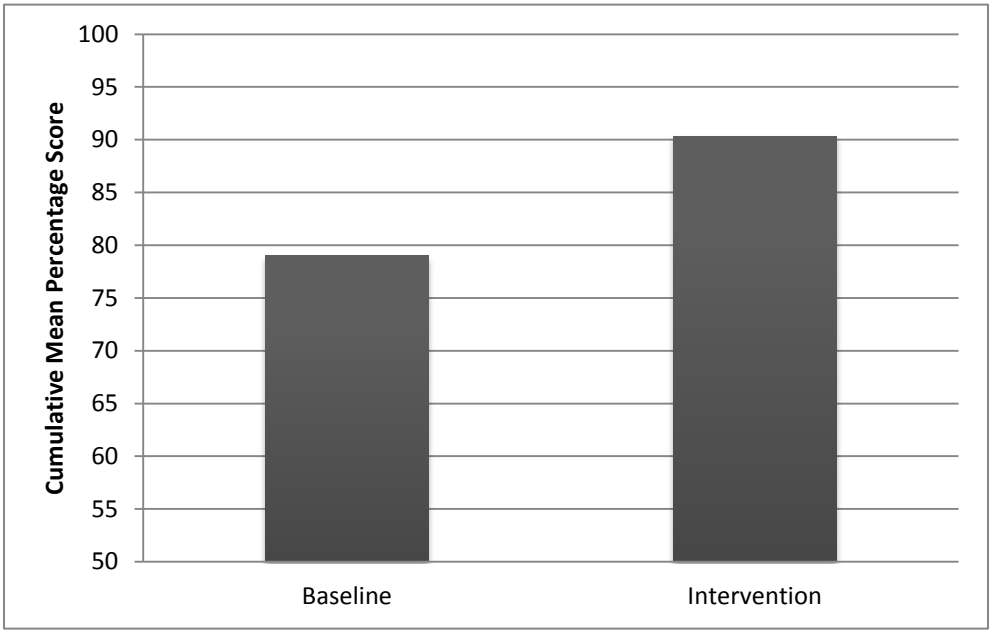

Figure 3. Cumulative mean scores of baseline and intervention phase

The frequency distribution of scores was investigated between the baseline and intervention, which ranged from scores of 40% to 100%, as shown in figure 4. A score of 40% occurred at a frequency of (1) time during the baseline phase and (0) times during the intervention phase. A score of 50% occurred at a frequency of (5) times during the baseline phase and (0) times during the intervention phase. A score of 60% occurred at a frequency of (2) times during the baseline phase (0) times during the intervention phase. A score of 70% occurred at a frequency of (1) time during the baseline phase (4) times during the intervention phase. A score of 80% occurred at a frequency of (9) times during the baseline phase (6) times during the intervention phase. A score of 90% occurred at a frequency of (3) times during the baseline phase (5) times during the intervention phase.

A score of 100% occurred at a frequency of (9) times during the baseline phase (15) times during the intervention phase.

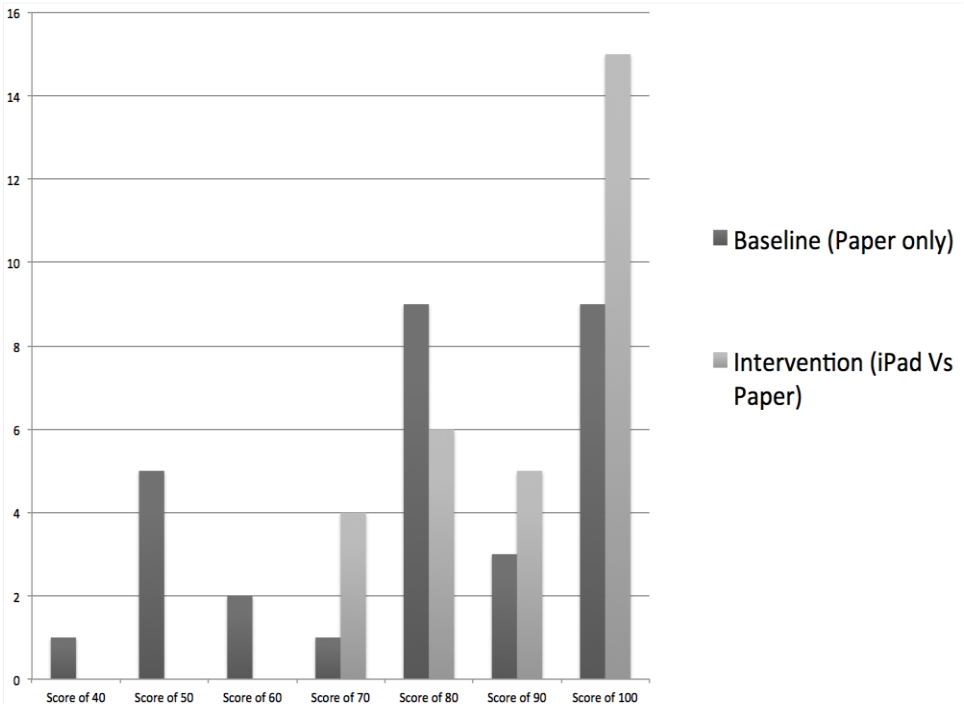

Figure 4. Frequency distribution of scores

Finally, the frequency the student met the predetermined criteria and mastered a vocabulary unit was assessed. During the baseline phase, the student mastered science vocabulary units at a frequency of (0) times and mastered social studies vocabulary units at a frequency of (1) time. During the intervention phase, the student mastered social studies vocabulary units at a frequency of (4) times and mastered social studies vocabulary units at a frequency of (4) times as shown in table 1. Even when omitting the scores that crossed over from the baseline phase to the intervention phase, the student mastered social studies vocabulary units at a frequency of (3) times and mastered social studies vocabulary units at a frequency of (3) times, shown in table 1. This means the

student mastered vocabulary units at a ratio of 1:6 when comparing the baseline phase to the intervention phase.

Table 1

Frequency of Vocabulary Mastery

Vocabulary Unit	Science	Social Studies
Baseline	0	1
Intervention	4	4
Intervention (With omitted scores)	3	3

Chapter 5

Discussion

Conclusions Regarding Digital Screen Versus Paper Vocabulary Matching

The purpose of this study was to explore the effect of a digital screen on the learning process for a student with autism spectrum disorder. Specifically, this study explored how a digital screen (iPad) affected the learning process of a vocabulary matching activity in comparison to a paper based (flashcard) vocabulary matching activity.

The hypotheses for the current study, first, is the total daily percentage scores of the vocabulary matching activities will be higher on the digital screen (iPad) vocabulary matching activity, in comparison to the flash card matching activity (paper) during the intervention phase (alternating treatment of paper and iPad vocabulary matching activity). After reviewing the data from the single subject student, the vocabulary percentage scores during the intervention phase did not differ much between treatments, which involved a randomized alternating treatment combination of a paper based (flashcard) vocabulary activity and digital screen based (iPad) vocabulary matching activity. These results indicate that within the intervention phase, the paper based or digital screen based learning tools were equal learning mediums and does not support the first hypothesis, that the total daily percentage scores of the vocabulary matching activities will be higher on the digital screen (iPad) vocabulary matching activity, in comparison to the flash card matching activity paper. Past research has indicated that iPad educational interventions, for students with autism spectrum disorder, are successful in many areas, such as in academics, life skills and vocational skills. However, because

this study worked to control more closely than many past research studies, by having a closely matching paper activity to a closely matched paper activity, it is seen in the case of this student, when iPad and paper activities were alternated, the scores only slightly differed. It is hard to say without further exploration, why this is the case. It might be that the student was able to generalize the vocational skills learned from the iPad to the paper activity, but with the current data taken, it is unknown. Past research, that focuses on the general population, for specifically reading comprehension, has found that a digital screen actually negatively influences reading comprehension, and learning. However, in the case of hypothesis one, we see that during the intervention phase, learning on a digital screen, did not negatively influence the learning process for this student.

After reviewing the data for the second hypothesis, that the scores during the intervention phase (combination of both paper and iPad) will be higher than the baseline phase (paper only) vocabulary matching activity, the intervention phase shows a $11.\overrightarrow{333}$ percentage point increase in the mean percentage scores, when compared to the baseline phase scores. The student's mean score moved up from a of 79% to $90.\overrightarrow{333}$% mean score range, which indicates a high increase in performance for the vocabulary matching activity. This data indicates that the student's scores were not only higher on the iPad, but that the paper scores were raised in conjunction to the iPad scores. Without taking research a step further, it's hard to distinguish whether or not the iPad raised the paper scores, or if the iPad and paper had some sort of interaction effect, that increased the student's percentage scores. Past research in digital screen based educational interventions has found these interventions, such as an iPad, for individual's autistic spectrum disorder, to be successful in many areas, including areas such as academics.

However, these studies do not often control for the effect the screen may have on learning for individuals with autism spectrum disorder. Since the current study, controlled closely for cofounding variables, such as audio, and video feedback, we see in this case, that the screen itself may play a role in increasing the learning rate for this student with autism spectrum disorder. This result is contrary to prior research that has found that in the general population, reading comprehension and digital screen test actually hinder performance. Without bringing this same experiment over to the general education population, it is hard to know if there is on fact a difference in learning on a digital screen between the neuro-typical population in comparison to the autism spectrum disorder population.

Finally, after reviewing the data for the third hypothesis, that this student would master the vocabulary matching skills at a faster rate in the intervention than the baseline phase was proven to be true. The student mastered one vocabulary unit in the baseline phase at a rate of one, while in the intervention phase he mastered six. Meaning that this student mastered this vocabulary matching activity at 1:6 ratio, when comparing baseline phase mastery rates, to intervention mastery rates. This indicates, that the use of an iPad for practicing and testing this vocabulary unit, for this student, was successful educational intervention. Pervious research has indicated, in other academic activities that an iPad can be a successful academic intervention tool for students with autism spectrum disorder. However, as previously discussed, much of this research uses applications that add cofounding variables such as audio, and video feedback. In the case of this single case study, it is difficult to understand why, and if it was solely due the use of the iPad, or a based on combination learning effect of the iPad and paper. Further research would need

to be taken, along with use of a control population to begin to really see if there is a digital screen learning effect for students with autism spectrum disorder.

Limitations

This study had several limitations. A major limitation, was its sample size, this study can only tell us the effect an iPad had on learning with one student with autism spectrum disorder autism spectrum disorder and cannot be generalized to other students with autism spectrum disorder.

Another limitation was the use of teachers as the data collection and the procedural consistency between the iPad and paper treatment. The researcher was not able to observe the teachers during this vocabulary activity, and had to rely off of teacher's own observations of procedures.

Finally, the study could have controlled better for cofounding variables between the iPad and the paper vocabulary matching activities.

Future Research

Future research possibilities include the collection of data with a larger sample size of students with autism spectrum disorder. This includes students with autism spectrum disorder from different range ages as well. Other studies could improve upon this research by collecting data for a longer period of time, and the possible inclusion of an iPad only phase, to help begin to understand if the iPad improved this students learning on its own, or did the paper and iPad have some type of interaction effect on the student's learning. Future research could explore other populations, such as students with ADHD or typically developing students.

Future research could better handle cofounding variables found in this studies end. These include feedback given from the Quizlet app visually, and possible differences in the teaching procedures between iPad and paper.

References

Ackerman, R., & Lauterman, T. (2012). Taking reading comprehension exams on screen or on paper? A metacognitive analysis of learning texts under time pressure. *Computers in Human Behavior*, *28*(5), 1816-1828.

Alloway, T. P., Rajendran, G., & Archibald, L. M. (2009). Working memory in children with developmental disorders. *Journal of Learning Disabilities*, *42*(4), 372-382.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, D.C.: American Psychiatric Publishing.

Ayres, K. M., Mechling, L., & Sansosti, F. (2013). The use of mobile technologies to assist with life skills/independence of students with moderate/severe intellectual disability and/or autism spectrum disorders. Considerations for the future of school psychology. *Psychology in the Schools*, *50*(3), 259-271.

Baron-Cohen, S. (1995). Mindblindness: An essay on autism and theory of mind. Learning, development, and conceptual change. Baron-Cohen, Simon Cambridge, MA, US: The MIT Press. (1995). xxii 171 pp.

Baron-Cohen, S. (2002). The extreme male brain theory of autism. *Trends in Cognitive Sciences, Volume 6* (6), 248-254.

Baron-Cohen, S. (2006). The hyper-systemizing, assortative mating theory of autism. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, *30*(5), 865-872.

Baron-Cohen, S. (2009). Autism: The Empathizing–Systemizing (E-S) Theory. *Annals of the New York Academy of Sciences*, *1156*, 68-80.

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a "theory of mind" ? *Cognition* , *21*(1), 37-46.

Baron-Cohen, S., Richler, J., Bisarya, D., Gurunathan, N., & Wheelwright, S. (2003).The systemizing quotient: an investigation of adults with Asperger syndrome or high–functioning autism, and normal sex differences. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, *358*(1430), 361-374.
.

Buzzetto-More, N., Guy, R., & Elobaid, M. (2007). Reading in a digital age: E-books are students ready for this learning object?. *Interdisciplinary Journal of E-Learning and Learning Objects*, *3*(1), 239-250.

Christ, S. E., Kester, L. E., Bodner, K. E., & Miles, J. H. (2011). Evidence for selective inhibitory impairment in individuals with autism spectrum disorder. *Neuropsychology, 25*(6), 690-701.

Cole, L., Baron-Cohen, S., & Hill, J. (2007). Do children with autism have a theory of mind? A non-verbal test of autism vs. specific language impairment. *Journal of Autism and Developmental Disorders*, *37*(4), 716-723.

Dilevko, J., & Gottlieb, L. (2002). Print sources in an electronic age: A vital part of the research process for undergraduate students. *The Journal of AcademicLibrarianship, 28*(6), 381-392.

Esbensen, A. J., Bishop, S., Seltzer, M. M., Greenberg, J. S., & Taylor, J. L. (2010). Comparisons between individuals with autism spectrum disorders and individuals with Down syndrome in adulthood. *Journal Information*, *115*(4).

Ferguson, H., Myles, B., & Hagiwara, T. (2005). Using a personal digital assistant to enhance the independence of an adolescent with Asperger Syndrome. *Education and Training in Developmental Disabilities, 40*(1), 60-67.

Freeman, B. J., Del'Homme, M., Guthrie, D., & Zhang, F. (1999). Vineland Adaptive Behavior Scale scores as a function of age and initial IQ in 210 autistic children. *Journal of autism and developmental disorders*, *29*(5), 379-384.

Gentry, T., Wallace, J., Kvarfordt, C., & Lynch, K. B. (2010). Personal digital assistants as cognitive aids for high school students with autism: Results of a community-based trial. *Journal of Vocational Rehabilitation, 32*, 101-107.

Goldsmith, T. R., & LeBlanc, L. A. (2004). Use of Technology in Interventions for Children with Autism. *Journal of Early and Intensive Behavior Intervention, 1*(2), 166-178.

Green, S.A., & Carter, A.S. (2014). Predictors and course of daily living skills development in toddlers with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 44(2), 256-263.

Grove, R., Baillie, A., Baron-Cohen, S., & Hoekstra, R. A. (2013). Empathizing, systemizing, and autistic traits: Latent structure in individuals with autism, their parents, and general population controls. *Journal of Abnormal Psychology, 122*(2), 600-609.

Hill, E. L. (2004). Executive dysfunction in autism. *Trends in cognitive sciences*, *8*(1), 26-32.

Hill, E. L., & Bird, C. M. (2006). Executive processes in Asperger syndrome: Patterns of performance in a multiple case series. *Neuropsychology, 44*(14), 2822-2835.

Howlin, P., Alcock, J., & Burkin, C. (2005). An 8 year follow-up of a specialist supported employment service for high-ability adults with autism or Asperger syndrome. *Autism*, *9*(5), 533-549.

Howlin, P., Goode, S., Hutton, J., & Rutter, M. (2004). Adult outcome for children with autism. *Journal of Child Psychology and Psychiatry*, *45*(2), 212-229.

Jamali, H. R., Nicholas, D., & Rowlands, I. (2009, January). Scholarly e-books: the views of 16,000 academics: Results from the JISC National E-Book Observatory. *Aslib Proceedings* (Vol. 61, No. 1, pp. 33-47). Emerald Group Publishing Limited.

Johnston, S., Nelson, C., Evans, J., & Palazolo, K. (2003). The use of visual supports in teaching young children with autism spectrum disorder to initiate interactions. *Augmentative and Alternative Communication*, *19*(2), 86-103.

Jones, C. R., Happe, F., Pickles, A., Marsden, A. J., Tregay, J., Baird, G., ... Charman, T. (2011). 'Everyday memory' impairments in autism spectrum disorders. *Journal of Autism and Developmental Disorders*., *41*(4), 455-464.

Jowett, E. L., Moore, D. W., & Anderson, A. A. (2012). Using an iPad-based video modeling package to teach numeracy skills to a child with an autism spectrum disorder. *Developmental Neuro-rehabilitation*, *15*(4), 304-312.

Kanne, S., Gerber, A., Quirmbach, L., Sparrow, S., Cicchetti, D., & Saulnier, C. (2011). The role of adaptive behavior in autism spectrum disorders: implications for functional outcome. *Journal of Autism Developmental Disorders*, *41*(8), 1007-

Kerr, M. A., & Symons, S. E. (2006). Computerized presentation of text: Effects on children's reading of informational material. *Reading and Writing*, *19*(1), 1-19.

Klin, A., Danovitch, J. H., Merz, A. B., & Volkmar, F. R. (2007). Circumscribed interests in higher functioning individuals with autism spectrum disorders: An exploratory study. Research and *Practice for Persons with Severe Disabilities*, *32*(2), 89–100.

Lancioni, G., & O'Reilly, M. (2001). Self-management of instruction cues for occupation: Review of studies with people with severe and profound developmental disabilities. *Research in Developmental Disabilities*, *22*(1), 41-65.

Liss, M., Harel, B., Fein, D., Allen, D., Dunn, M., Feinstein, C., ... Rapin, I. (2001). Predictors and correlates of adaptive functioning in children with developmental disorders. *Journal of Autism and Developmental Disorders*, *31*(2), 219-230.

Mangen, A., Walgermo, B. R., & Brønnick, K. (2013). Reading linear texts on paper versus computer screen: Effects on reading comprehension. *International Journal of Educational Research*, *58*, 61-68.

Matson, J. L., Dempsey, T., & Fodstad, J. C. (2009). The effect of autism spectrum disorders on adaptive independent living skills in adults with severe intellectual disability. *Research in Developmental Disabilities, 30*(6), 1203-1211.

Mazurek, M. O., Shattuck, P. T., Wagner, M., & Cooper, B. P. (2012). Prevalence and Correlates of Screen-Based Media Use Among Youths with Autism Spectrum Disorders. *Journal of Autism & Developmental Disorders*, 42, 1757-1767.

Matson, J. L., Hattier, M. A., & Belva, B. (2011). Treating adaptive living skills of persons with autism using applied behavior analysis: A review . *Research in Autism Spectrum Disorders, 6*(1), 271-276.

McDonald, T., & Machalicek, W. (2013). Systematic review of intervention research with adolescents with autism spectrum disorders. *Research in Autism Spectrum Disorders, 7*(11), 1439-1460..

Mechling, L. (2007). Assistive technology as a self-management tool for prompting students with intellectual disabilities to initiate and complete daily tasks. *Education and Training in Developmental Disabilities, 42*(3), 252-269.

Mechling, L., Gast, D., & Seid, N. (2009). Using a personal digital assistant to increase independent task completion by students with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *39*(10), 1420-1434.

Myles, B., Ferguson, H., & Hagiwara, T. (2007). Using a personal digital assistant to improve the recording of homework assignments by an adolescent with Asperger syndrome. *Focus on Autism and Other Developmental Disabilities* , *22*(2), 96-99.

Orsmond, G. I., & Kuo, H. (2011). The daily lives of adolescents with an autism spectrum disorder. *The National Autistic Society*, *15*(5), 579-599.

Pellicano, E. (2007). Links between theory of mind and executive function in young children with autism: Clues to developmental primacy. *Developmental Psychology*, *43*(4), 974-990.

Pellicano, E. (2010). Individual differences in executive function and central coherence predict developmental changes in theory of mind in autism. *Developmental Psychology, 46*(2),

Perry, A., Flanagan, H., Dunn Geier, J., & Freeman, N. (2009). Brief report: the Vineland Adaptive Behavior Scales in young children with autism spectrum disorders at different cognitive levels. *Jounal of Autism Developmental Disorders*, *39*(7), 1066-1078.

Pierce, K. L., & Schreibman, L. (1994). Teaching daily living skills to children with autism in unsupervised settings through pictorial self-management. *Journal of Applied Behavior Analysis*, *27*(3), 471-481.

Pillay, Y., & Suniti-Bhat, C. (2012). Facilitation support for students with Asperger's syndrome. *Journal of College Student Psychotherapy*, *26*(2), 140-154.

Rosenthal, M., Wallace, G. L., Lawson, R., Wills, M. C., Dixon, E., Yerys, B. E., & Kenworthy, L. (2013, January). Impairments in real-world executive function increase from childhood to adolescence in autism spectrum disorders. *Neuropsychology*, *27*(1), 13-18.

Rutter, M. (2007). Incidence of autism spectrum disorders: Changes over time and their meaning. *Acta Paediatrica*, *94*(1), 2-15.

Smith, L. E., Maenner, M. J., & Seltzer, M. M. (2012). Developmental trajectories in adolescents and adults with autism: the case of daily living skills. *Journal of the American Academy of Child & Adolescent Psychiatry*, *51*(6), 622-631.

Stone, W., Ousley, O., Hepburn, S., Hogan, K., & Brown, C. (1999). Patterns of adaptive behavior in very young children with autism. *American Journal on Mental Retardation*, *104*(2), 187-199.

Taylor, J. L., & Seltzer, M. M. (2011). Employment and post-secondary educational activities for young adults with autism spectrum disorders during the transition to adulthood. *Journal of autism and developmental disorders*, 41(5), 566-574.

Wästlund, E., Reinikka, H., Norlander, T., & Archer, T. (2005). Effects of VDT and paper presentation on consumption and production of information: Psychological and physiological factors. *Computers in human behavior*, *21*(2), 377-394

Woody, W. D., Daniel, D. B., & Baker, C. A. (2010). E-books or textbooks: Students prefer textbooks. *Computers & Education*, *55*(3), 945-948.

Woolf, S., Woolf, C. M., & Oakland, T. (2010). Adaptive behavior among adults with intellectual disabilities and its relationship to community independence. *Journal Information*, 48(3).