The Use of Technology to Teach Children with Autism Spectrum Disorder

A Meta-Synthesis

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Abstract

This meta-synthesis of empirical and non-empirical literature reviewed 43 journal articles that evaluated the availability and use of technology to educate and socialize learners with Autism Spectrum Disorder or Aspersers Disorder. Students with these disorders cannot be defined or categorized each individual is unique and elegant; challenging caregiver's and educator's creativity to teach and guide them toward a quality of life they would not find on their own. There are tools and research to support unique education on many levels of learning from academics to socialization. The literature indicates that while there is a wealth of technology available and new technology is constantly being developed cost can not only prohibit production it can lessen the quality. What gets into the classroom tool box is determined by the tenacity of the educator.

1. Introduction

1.1. Background

According to the American Psychiatric Association's (2000). *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV-TR), autism spectrum disorder falls under the category of pervasive developmental disorder. In this section, and specifically under diagnostic features, it states that this disorder represents itself through "markedly abnormal or impaired development in social interaction and communication and a markedly restricted repertoire of activity and interest" (p. 70). This diagnostic information mirrors definition found in the Individuals with Disabilities Education Improvement Act (IDEA) of 2004, which states that autism is a "developmental disability significantly affecting verbal and nonverbal communication and social interaction, generally evident before age 3, that it adversely affects a child's educational performance."

Regardless of the definition of this disorder name autism is a family affair. It not only appears to run in families being that, if a child had autism the siblings of that child could be 35 times more likely to also have autism (Brown, 2006; Szatmari, Zwaogembai, & Bryson, 2004). In fact it has been found that in twins if one twin has autism the other twin has an 82% to 92% chance to develop it as well.

Autism is a disorder with many different presentations and combinations of disabilities; rarely two children would present the same disabilities even in twins. Each case is unique because researchers are finding that there are case specific jumbles of both genetic and environmental triggers that make it almost impossible to decipher (Sander, 2011). However, geneticist are making advances in finding: "Abnormalities – specifically, duplications and deletions of DNA called copy number variations that were not passed down from parents but

arose spontaneously in the genomes of affected children" (Sanders, 2011, p. 1). These findings may one day lead to the solving of the autism mystery.

Families with children with autism spectrum disorder cannot wait for the geneticist, they need help now. Early detection and intervention can best serve these struggling families. It takes a long time to help these children and early intervention may help change the outcome and improve the functioning of a child struggling with ASD (Yeargin-Allsopp & Rice, 2004).

Families need help with their ASD child in many ways and obtaining that help through intervention services will help parents feel less helpless in the face of grief, fear or disappointment that often devastates families. Families are on the frontline as they battle the debilitating consequences of autism. Symptoms of anxiety are not only common in children with autism it is also high in parents of children with the disability. There are also, "high rates of depression, bipolar disorder and substance abuse found in these families" (Szatmari et al., 2004, p 50).

Although it is obvious that a family that is struggling with autism might experience depression and other side effects, researchers wonder if they are caused by stress or might they have, "A gene that might also cause autism" (Szatmari et al., 2004, p. 52). The true cause of autism remains unknown with only bits and pieces being slowly uncovered. Each person who lives with autism often struggles in private and but experiences it in public.

1.2. Author's beliefs and experiences

Autism is scary. A parent that has been given the autism spectrum disorder (ASD) diagnosis for their child could either be filled with immediate fear or relief of being heard and their struggles being understood. In either case grief is experienced by those parents, all parents whose child struggles with life learning challenges struggle with grief. It is not the

grief of the death of a person but the death of dreams. This kind of grief can sometimes be more painful and long lasting because closure is hard to find if it can ever be done. Whether the grief is put aside or expunged life continues and an exceptional child needs help.

I was a parent of an exceptional child and struggled with years of self recriminations and grief. I was thrown into an unfamiliar world of people, meetings, and privacy invasion where everyone believed that they knew better than I did on how to care for my child. Words and acronyms that I didn't understand but was expected to know made me feel lacking as a parent. It seemed like everyone had plans and solutions that didn't work very well.

My child was not autistic but extremely low in IQ and other co morbid conditions added on. It was difficult to get him to do many things but he would always get on the computer and stay lost in that world for hours until I forced him off. I remember thinking, "Why don't they come up with a way to help my child using the computer to teach him? His interest and focus would be more complete and involved." As a substitute teacher and later as a teacher, I saw the same attention and focus with students that I worked with and several autistic children that tore at my heart in the remembrances of the struggles with my son.

For all struggling students there are concerned parents and challenged teachers, both want to know what they are facing and a diagnosis is the place to start helping the child. The tool that is often used by the school psychologists to help them define and identify the various disabilities and disorders in the United States is the DSM-IV-TR. Although the DSM-IV-TR is not the final determination of any disorder it is a valuable tool to be used in conjunction with a team. For students with autism spectrum disorder a diagnosis is difficult because "ASD is not an official diagnostic category; rather, autistic disorder is one of several categories under the broader category of pervasive developmental disorders" (Brian, Boyd,

Odom, Humphreys, & Sam, 2010, p. 76). The term autistic spectrum disorder is a broad

category in which other lifelong developmental disabilities are included such as Asperger's

syndrome and other pervasive and other unspecified developmental disorders.

I didn't know anything about the DSM-IV-TR, IDEA (2004), or even ASD when I sat

next to a middle school student, in front of a computer, surprised that he had just hit me. I had

been working with this boy all day and I found him to be sweet, surprisingly interested in

learning, and a bit temperamental. On a regular basis this student would suddenly get upset

and angry. He had a five step program that he would go that helped her to regain control.

Even thought I knew that when he lashed out it was due to frustration with himself or

someone working with him, I was still surprised. There had been no warning sign and no

residual effects from him. It was like it didn't even happen. I was unhurt, confused and

intrigued as I worked with him.

This young man loved the computer and would spend enormous amounts of time in front

of the computer if allowed. He didn't seem to care what he was doing on the computer he just

wanted to be on it. Time on the computer was used as a reward for him as he kept himself

under control or kept control of himself.

I was in this classroom for two months and while in the role of a substitute I worked with

all of the seven autistic students involved in learning in that space. I noticed that other than the

use of the computer as a keyboard instructor or other various communication technologies,

there was very little use of what could be a powerful helping tool for learning tool, rather than

a toy.

I was a substitute teacher for seven years and throughout those years I evolved from a

substitute to a teacher and later to a special education teacher. I have never lost my original

interest in exceptional children with autism spectrum disorder and the question remains as to whether or not technology is available to help children with students with autism spectrum disorder learn earlier, quicker, and more efficiently than the tools used in the classroom today.

I have always interested in ways students were taught and desired to teach children in ways students wanted to learn. I noticed that it was in the special education classroom where the greatest conflict between interest, learning styles and teaching was found. It was curious to me to observe situations where learning and teaching clashed; if the two systems were not the same the result was often conflict or resistance. I observed that even children with autism spectrum disorder have interest that could be developed into learning rather or as well as a tool to motivate. It was then that the question started to formulate and later became an irritant; "Why can't students learn in ways that interest them and can I find them technology to meet those needs?

The primary question of students leaning through their interest never has changed much it only expanded to include all students not just special education. I don't understand why students that don't thrive under one form of curriculum or teaching style are not taught under another. It has been my experience that rather than finding a different curriculum students are often re-exposed to the same curriculum and teaching style, perhaps a lower grade level, as an intervention tool. The possibility that the curriculum is the problem is not addressed.

It was this observation that directed me to the idea of finding a way to individualized education for all my students and thus to my current position as a teacher advisor to home school parents. With parents I now have access to many forms of curriculum including online or technology presented curriculum that I can use to help them to teach their students

individually, through their students learning styles and interest. I have seen some elegant successes through this process.

It is a beautiful feeling of success when I have a student and parent sitting across my desk with both smiling; one a graduate and the other the proud parent. I remembered this young man sitting in the same seat a year and a half earlier as he and his mom sat across from me in my office. He sat with his head down avoiding eye contact with me as his mom talked to me about discipline problems, lack of educational success and failure to thrive in his public school environment.

I felt sad for the family but specifically for the young man who had expressed that he was dumb and why should he go to school anyway, I saw the hurt and pain in his mother's eyes as he said these words. She tried to tell him and then myself that he was not dumb and that she felt that he was smarter than anyone knew. I looked at his standard based assessments through to the ninth grade and found that what she said was probably true. Although he wasn't scoring in the advanced category he was classified proficient or just below proficient, however he hadn't passed his High School Qualifying Exit Exam. He wasn't in my office as a special education student he was just failing in school.

After mom was finished with her information I addressed the young man directly and after a few attempts at avoidance he started speaking about boredom, fear of asking questions, peer pressure, being bullied and lack of subject interest. I asked him about his interest, what he did for fun, what he read, what he did when he wanted to learn something. I found that he was an environmentalist, enjoyed hunting and fishing; he loved to ride snowmobiles and 4 wheelers, which He was the go to guy when his friends needed their four wheelers fixed. His dad was a mechanic and his mom did arts and crafts as a hobby.

He was a textile learner in a verbal and auditory teaching environment. He was a prime candidate for individualized education. With his family we created a program that he was interested in that combined technology, hands on learning, and environmental studies that used fieldwork as part of the curriculum also physical science through a program called *Exploration Education* that allows students to build electric cars, rockets, gliders, solar power cells and many other projects with the intent of using those built items to conduct experiments for learning. He took auto mechanics and carpentry as electives as that provided learning and interest in learning as well.

His success and many other successes with struggling students combined with my knowledge that there are thousands of curriculum to choose from only strengthens my position that there must be some form of curriculum that is or can be specifically designed to help students struggling with autism spectrum disorder. I suspect that help can be found for these students through technology; not only because technology seems to be interesting to them but because I believe that it can be designed to be specifically responsive to individuals and their needs. I believe that it can be a powerful teaching tool and not just a toy or reward. To this end I would search for answers to these questions:

1. Is there technology available that can meet the learning needs of the students struggling with lifelong developmental disabilities such as autistic disorder, Asperger syndrome, and other pervasive developmental disorders?

2. Is there technology available that can meet the social skill development needs of the students struggling with lifelong developmental disabilities such as autistic disorder, Asperger syndrome, and other pervasive developmental disorders?

I believe that using interest based education individualized for each student is a powerful form of teaching. It often requires the teacher to be the investigator rather than the deliverer. With the amazing advances in technology and my experiences with finding curriculum specifically for my student's learning needs, I know that there must be a way that I can help my exceptional students creatively and with innovation.

1.3. Purpose of this meta-synthesis

This meta-synthesis – which focused on using technology to teach children with ASD, Asperger syndrome, and other pervasive developmental disorders – had multiple purposes. One purpose was to locate and identify journal articles that presented digital curriculum opportunities and possibilities. I was specifically interested in how interactive technology can help autistic children learn social and academic skills. A second purpose was to discover journal articles that would explore new areas of the learning teaching paradigm using a form that is both interesting for the student use and for the teacher to provide. A third purpose of this meta-synthesis is to find hope. Hope for me, as a teacher, hope for my students, and hope for the families of my students. My ultimate purpose for conducting this meta-synthesis is to gather data and identify themes from the articles and connect these themes to my work with children as a teacher advisor and counselor for parents and teachers of exceptional children.

2. Methods

2.1. Selection criteria

The 43 journal articles included in this meta-synthesis met the following selection criteria.

1. Articles explored issues related to using technology to teach students with pervasive developmental disorders and specifically those with autism spectrum disorder and Asperger disorder.

2. The articles were all published in journals related to the field of education.

3. The articles were published between 1995 and 2011.

2.2. Search procedures

Database searches and ancestral searches were conducted to locate articles for this meta-synthesis.

2.2.1. Database searches

I conducted advanced searches within the Education Resources Information Center (ERIC, Ebsocohost) database using these specific search terms:

1. ("Autism").

2. ("Autism") AND ("Cause").

3. ("Autism") AND ("Technology").

4. ("Autism") AND ("Assistive Technology").

5. ("Autism") AND ("Epidemiology").

6. ("Asperger Syndrome") AND ("Assistive Technology").

7. ("Interactive Multimedia Computer Programs") and ("Autism").

The database searches yielded a total of 43 articles that met my selection criteria (Ash, 2009, Ayres, & Langone, 2008; Bellini & McConnell, 2011; Boone & Higgins, 2003; Brown, 2006 Brown, 2010; Boyd, Odom, Humphreys, & Sam, 2010; Golan, Ashwin, Granader, McClintock, Day, Leggett, & Baron-Cohen, 2009; Golan, Baron-Cohen, & Golan, 2008; Coleman-Martin, Heller, Cihak, & Irvine, 2005; Davis, 2011; Kimball & Smith, 2007;

Hopkins, Grower, Perez, Smith, Amthor, Wimsatt, & Biasini, 2011; Lacava, Golan, Baron-Cohen, & Myles, 2007; Maldonado, 2010; Moore, Cheng, McGrath, & Powell, 2005; Moore, Yufang, McGrath, & Thorpe, 2000; Mechling, Gast, & Krupa, 2007; Mirenda, Wilk, & Carson, 2000; Murrphy, 2007; Narkon, Wells, & Segal, 2011; Nikopoulos & Keenan, 2006; Peck & Scarpati, 2006; Parette, Hourcade, & Blum, 2011; Parette, Hourcade, Boeckmann, & Blume, 2008; Ramdoss, Lang, Mulloy, Franco, O'Reilly, Didden, Lancioni, 2010; Reichle, 2011; Reichle, & Drager, 2010; Ryan, & Charrugain, 2010; Sandyers, 2011; Schlosser & Blischak, 2001; Scruggs & Mastropieri, 2011; Shah, 2011; Skylar, 2007; Spencer, T. D. (2010); Stichter, J. P., Herzog, M. J., Visovsky, K., Schmidt, Randolf, Schultz, & Gage, 2010; Szatmari, Zwaigenbaum, & Bryson, 2004; Toth, 2009; West, 2008; Yeargin-Allsopp & Rice, 2003; Zirkel, 2011).

2.2.2. Ancestral searches

I performed an ancestral search which involves using previously published work to find additional works of relevant literature to a topic of interest (Welch, Brownell, & Sheridan, 1999). These ancestral searches resulted in two additional items that met the criteria of this work (Heimann, Nelson, Tjus & Gillberg, 1995; Coleman-Martin, Heller, Cihak, & Irvine, 2005)

2.3. Coding procedures

A coding form was developed to categorize the information that is presented in each of the 43 articles. The coding form was based on: (a) publication type; (b) research design; (c) participants; (d) data sources; and (e) findings of the studies.

2.3.1. Publication type

I classified each article by publication type (e.g., research study, guide, annotated bibliography, descriptive article, opinion piece/position paper, review of literature, or theoretical work). A *research study* is a paper where the author gathers and analyzes qualitative and/or quantitative data. A *guide* is a "how to" article that will describe a process in a step by step scenario. An *annotated bibliography* is a list in alphabetical order of books, articles, chapters or abstracts on a specific topic. A *descriptive article* describes specific phenomena without explaining gathering or analyzing methods. An *opinion piece/position paper* is a piece of written work where the author presents a personal opinion. A *review of literature* of a specific subject synthesizes previously published work into themes. A *theoretical work* explains or creates theories.

2.3.2. Research design

I identified each article by research design (i.e., quantitative research, qualitative research, mixed methods research). Some articles were *quantitative research,* which means that numerical data was the medium used to answer research questions. Other articles were *qualitative research,* which collected and analyzed language-based information (i.e., non-numerical data) to answer research questions. Still other articles were *mixed methods research,* which used techniques from both the quantitative and the qualitative research methods to gather and analyze data for answers to research questions.

2.3.3. Participants, data sources, and findings

I identified the participants in each of the studies (e.g., K-12 students with Asperger syndrome, students with autism, students with speech and language disorders, students with other pervasive developmental disorders, and students who use computer-aided instruction). I also identified the data sources used and analyzed in each study (e.g., interviews,

observations, focus groups, surveys, standardized tests). I then summarized the findings of

each study (Table 2).

2.4. Data analysis

I used a modified version of the Stevick-Colizzi-Keen method previously employed by

Duke (2011) and Duke and Ward (2009) to analyze the 43 articles that I included in this meta-

synthesis. My first step was to identify the significant statements in each article. For the

purpose of this meta-synthesis I defined significant statements as statements that address

information related to: (a)advice and concerns for educators regarding technology use; (b)

benefits and challenges of computer based interventions (CBI); (c) challenges and solutions of

technology development for the classroom; (d) characteristics and qualities of learners with

autism spectrum disorders (ASD) or asperger's syndrome (AS); (e) hardware available to

meet ASD or AS learning needs; (f) software available to meet ASD or AS learning needs;

(g) ways that research found that specific conditions could be addressed by technology. I then

developed a list of non-repetitive and non-overlapping (verbatim) significant statements with

paraphrased formulated meanings. These (paraphrased) formulated meanings represent my

interpretation of each significant statement. I then grouped the formulated meanings from all

38 articles into emergent themes which represents the essence of the entire body of literature

(Table 3).

3. Results

3.1. Publication type

I found 43 articles that met my search criteria. I identified the publication type of each

article in Table 1. Thirteen of the articles (30.2%) were reviews of literature (Ayres &

Langone, 2008; Boyd, et al., 2010; Kimball & Smith, 2007; Ramdoss et al., 2010; Reichle,

2011; Reichle & Drager, 2010; Sanders, 2011; Schlosser & Doreen, 2001; Spencer, 2010; Szatmari et al., 2004;Toth, 2009; West, 2009; Zirkel, 2011). Eleven of the 43 articles (25.6%) included in the meta-synthesis were research studies (Coleman-Martin et al., 2005; Golan et al., 2009; Golan et al., 2008; Heimann et al., 1995; Hopkins et al., 2011; Lacava et al., 2007; Mechling et al., 2007; Mirenda et al., 2000; Nikopoulos & Keenan, 2007; Ryan & Charrugain, 2010; Stichter et al., 2010). Eleven of the articles (25.6%) were Descriptive (Boone & Higgins, 2007; Brown, 2006; Brown, 2010; Davis, 2011; Kirkman, 2008; Maldonado, 2010; Moore et al., 2005; Moore et al 2000; Murphy, 2007; Parette et al., 2011; Shah, 2011;). Five articles (11.6%) were opinion piece/position papers (Ash, 2009; Peck & Scarpati, 2006; Scrugg & Mastropieri, 2011; Skylar, 2007; Yeargin-Allsopp & Rice, 2003). Three of the articles (7%) were guides (Bellini & McConnell, 2010; Narkon et al., 2011; Parette et al, 2008).

Table 1

Author(s) & Year of Publication	Publication Type
Ash, 2009	Opinion Piece / Position Paper
Ayres & Langone, 2008	Review of Literature
Bellini & McConnell, 2010	Guide
Boone & Higgins, 2007	Descriptive Article
Boyd, Odom, Humphreys, & Sam, 2010	Review of Literature
Brown, 2006	Descriptive Article
Brown, 2010	Descriptive Article
Coleman-Martin, Heller, Cihak, & Irvine, 2005	Study
Davis, 2011	Descriptive Article
Golan et al., 2009	Study
Golan, Baron-Cohen, & Golan, 2008	Study
Heimann, Nelson, Tjus, & Gillberg, 1995	Study
Hopkins et al., 2011	Study
Kirkman, 2008	Descriptive Article
Kimball & Smith 2007	Review of Literature
Lacava, Golan, Baron-Cohen, & Smith, 2007	Study
Maldonado, 2010	Descriptive Article
Mechling, Gast, & Krupa, 2007	Study
Mirenda, Wilk, & Carson, 2000	Study
Moore, Yufang, McGrath, & Powell, 2005	Descriptive Article
Moore, McGrath, & Thorpe, 2000	Descriptive Article
Murphy, 2007	Descriptive Article
Narkon, Wells, & Segal, 2011	Guide
Nikopoulos & Keenan, 2007	Study
Parette, Hourcade, Boeckmann, & Blum, 2008	Guide
Parette, Hourcade, & Blum, 2011	Descriptive Article
Peck & Scarpati, 2006	Opinion Piece / Position Paper
Ramdoss, et al., 2010	Review of the Literature
Reichle, 2011	Review of Literature
Reichle & Drager, 2010	Review of Literature
Ryan & Charrugain, 2010	Study
Sanders, 2011	Review of Literature
Schlosser & Doreen, 2001	Review of Literature
Scruggs & Mastropieri, 2011	Opinion Piece / Position Paper
Shah, 2011	Descriptive Article
Skylar, 2007	Opinion Piece / Position Paper
Spencer, 2010	Review of Literature
Stichter et al., 2010	Study
Szatmari, Zwaigenbaum, & Bryson, 2004	Review of Literature
Toth, 2009	Review of Literature

West, 2009	Review of Literature
Yeargin-Allsopp & Rice, 2003	Opinion Piece / Position Paper
Zirkel, 2011	Review of Literature

3.2. Research design, participants, data sources, and findings of the studies

      As stated previously, I collected 11 research studies that met my search criteria

(Coleman-Martin et al., 2005; Golan et al., 2009; Golan et al., 2008; Heimann et al., 1995;

Hopkins et al., 2011; Lacava et al., 2007; Mechling et al., 2007; Mirenda et al., 2000;

Nikopoulos & Keenan, 2007; Ryan & Charrugain, 2010; Skylar, 2007; Stichter et al., 2010;

Szatmari et al., 2004). The research design, participants, data sources, and findings of each

study are noted in Table 2.

Table 2

Authors	Research Design	Participants	Data Sources	Findings
Coleman-Martin, Heller, Cihak, & Irvine, 2005	Quantitative	Three participants with multiple disabilities who met following criteria: (a) experiencing severe speech impairment; (b) recognizing letter-sound correspondence of the alphabet; (c) having a reading level at or above the first grade level but below the third grade level; (d) experiencing a two year difference between chronological age and expected reading level; (e) having never used the Nonverbal Reading Approach (NRA); and (f) being able to see.	Multiple staged testing design with drop down baseline followed by teacher survey using a Likert scale	The results of this study found that Nonverbal Reading Approach (NRA) is effective using computer-assisted technology freeing teacher time and giving students independence to practice decoding and word identification.
Golan et al., 2009	Quantitative	Three groups: (a) 20 participants with Autism Spectrum Conditions (15 males, 5 females) who received the intervention; (b) a control group of 19 participants with Autism	Pre- and post measures	The conclusion of this study is that the use *The Transporters* videos with children with HFA/AS improved significantly their ability to recognize emotion.

		Spectrum Conditions (15 males, 4 females); and (c) a control group of 18 participants with atypical development (12 males, 6 females)		
Golan, Baron-Cohen, & Golan, 2008	Quantitative	23 children diagnosed with Asperger Syndrome or High Functioning Autism (22 boys, 1 girl)	Pre- and post measures	The results of this study reveal that children with ASC have difficulty with the concept of empathy. The authors conclude that *'Reading the Mind in Films' task [Child Version]* can quantify the complex emotion recognition skill of a high functioning ASC or Asperger child. It may also be a useful in intervention research, monitor improvements or to augment diagnostic assessments.
Heimann, Nelson, Tjus, & Gillberg, 1995	Mixed Methods	A total of 30 children in three groups: Group A included 11children with Autism (9 boys, 2 girls); Group MH (Mixed Handicaps) included 10 children (4 boys, 6 girls); Group NP (Normal Preschool) included 10 preschool children without disabilities; mental ages of all children 5.8 to 6.9.	Multiple staged testing, observed twice with a follow – up assessment and interviews with the student's teachers and parents	The results showed that intervention with motivating multimedia could entice reading and communicating in children with various developmental disabilities.
Hopkins et al., 2011	Quantitative	49 children with Low Functioning Autism or High	Pre- and post measures	The conclusion of this study indicated that children with both LFA and HFA show

		Functioning Autism		improvements with emotion recognition and social interaction with the use of the computer-based social skills training program, *FaceSay*. HFA children also improved in the area of facial recognition.
Lacava, Golan, Baron-Cohen, & Smith, 2007	Qualitative	3 girls and 6 boys, ages 8-11, with Asperger Syndrome	Pre- and post measures	The conclusion of this study is that using the computer software, *Mind Reading: The Interactive Guide to Emotions*, improved children's skills of face and voice emotion recognition in both the basic and complex categories that were included in the software and also those that were not.
Mechling, Gast, & Krupa, 2007	Qualitative	3 students with multiple disabilities (2 boys, 1 girl) with IEP objectives for increasing sight word vocabulary	Pre- and post measures	The results of this study concluded that the use of white board technology is an effective tool that can be successfully used to teach sight word reading and observational learning of specific information to multiple students at one time.
Mirenda, Wilk, & Carson, 2000	Quantitative	170 students in this study met criteria (a)of having been diagnosed with Autism, (b) having goals that could be met with technology, (c) having annual follow-up reports on how technology was used by the student	Analysis of secondary data sources from previously published studies	The results of this study were that student success in the use of technology as an intervention related to writing, expressive communication and social interaction, was not related to the students' cognitive ability as much as it was to the age of intervention. Students that received technology at a young age experienced more success than those that received technology as adolescents.
Nikopoulos & Keenan, 2007	Qualitative	Three children with various degrees of Autism	Pre- and post measures	The results of this study showed that this video modeling procedure improved the social skills of all children, facilitated reciprocal play engagement and initiated imitative responses to behaviors not included in study.

| Ryan & Charrugain, 2010 | Quantitative | 3 girls and 30 boys with Autism between the ages of 6.9 and 14.3 years old | Pre- and post measures | The impact on children's ability to recognize different emotions using face expression training was significant including continued emotion recognition and improvements at follow-up. |
| Stichter et al., 2010 | Mixed Methods | 27 students with High Functioning Autism or Asperger Syndrome | Pre- and post measures | Parents reported improvements in areas of social skills and executive functioning while evidence showed significant improvements on facial expression recognition, theory of mind and problem solving. |

3.2.1. Research design

Five of the 11 research studies (45.5%) included in this meta-synthesis employed a quantitative research design (Golan et al., 2008; Golan et al., 2009; Hopkins et al., 2011; Mirenda et al., 2000; Ryan & Charrugain, 2010). Four of the eleven studies (36.4%) employed a qualitative research design (Coleman-Martin et al., 2005; Lacava et al., 2007; Mechling et al., 2007; Nikopoulos & Keenan, 2007). Two studies (18.2%) employed a mixed method research design (Heimann et al., 1995; Stichter et al., 2010).

3.2.2. Participants and data sources

The 11 studies included in this meta-synthesis analyzed data collected from students that fall under the pervasive developmental disorder category in the DSM-IV-TR and in which technology was a critical component of the study. Four of the 11 studies (36.4%) analyzed data gathered from K-12 students with Autistic Spectrum Disorder (ASD) (Golan et al., 2009; Mechling et al., 2007; Nikopoulos & Keenan, 2007 and Ryan & Charrugain, 2010). Three of the 11 studies (27.3%) specifically analyzed data from gathered from students with High Functioning Autism (HFA) or Asperger Syndrome (Golan et al., 2008; Lacava et al., 2007 and Stichter et al., 2010). Three additional studies (27.3%) analyzed data gathered from students with mixed disabilities that included children with Autism (Heimann et al., 1995; Coleman-Martin et al., 2005; Mirenda et al., 2000). One study (9.1%) analyzed data gathered from students with both Low Functioning Autism (LFA) and HFA (Hopkins et al., 2011).

Most of the studies contained in this meta-synthesis used the pretest and post-test measures to gather data from the study's participants. Eight of the studies (72.7%) used the pretest and posttest measures to gather data (Golan et al., 2008; Golan et al., 2009; Lacava et al., 2007; Mechling et al., 2007; Nikopoulos & Keenan, 2007 and Ryan & Charrugain, 2010 and

Stichter et al., 2010). Two studies (18.2%) used a multiple staged testing measure to gather data (Coleman-Martin et al., 2005 and Heimann et al. ,1995). One study (9.1%) analyzed secondary data sources to gather information (Mirenda et al., 2000).

3.2.3. *Findings of the studies*

The summary of findings of the 11 studies in this meta-synthesis is as follows:

1. Children struggling with different types of developmental disabilities including those with autism benefit from interventions using various forms of technology addressing areas of sight word recognition, decoding, specific information acquisition, reading, writing, expressive communication and social interaction.

2. Children struggling with Autism and Asperger Syndrome increase their ability to identify emotions based on facial and vocal cues using computer software and photographs as training tools.

3. Children struggling with Autism and Asperger Syndrome improve social skills in the areas of emotional recognition, social interaction, reciprocal play engagement, theory of mind and problem solving through the use of computer based training and video modeling.

3.3. *Emergent themes*

Seven themes developed from my analysis of the 43 articles included in this meta-synthesis. These emergent themes (or theme clusters) include: (a) advice and concerns for educators regarding technology use; (b) benefits and challenges of computer based interventions (CBI); (c) challenges and solutions of technology development for the classroom; (d) characteristics and qualities of learners with autism spectrum disorders (ASD) or Asperger syndrome (AS); (e) hardware available to meet ASD or AS learning needs; (f) software available to meet ASD or AS learning needs; (g) ways that research found that

specific conditions could be addressed by technology. These seven theme clusters and the

associated formulated meanings are delineated in Table 3.

Table 3

Theme Clusters	Formulated Meanings
Advice and Concerns for Educators Regarding Technology Use	• Educators should understand that a student who has learned control over their behavior could be significantly more motivated to perform a task over which they have greater control. • Educators should know that computer based intervention is not different from in person-intervention, the success of the intervention depends in large part on the extent to which the system, whether person or computer, is able to implement effective techniques. • Educators should know that computer based software having features that the children are already family with such as animation, color, large screen presentation may enhance emergent literacy in these and other children. • Educators should know Data indicates that instructional design elements that are suitable and desired for one disability would not be appropriate for someone with a different disability. For example graphics should not be overwhelming or distracting for most students with learning disabilities; but students with emotional disabilities should have those elements emphasized in interface and screen design. • Educators need to be careful of being so impressed by test to speech capabilities of screen-reader software that they just accept the fact that the speech is difficult to understand and that the formatted characters that are embedded in the text are often spoken aloud. • Educators of children with autism need to utilize a wide range of intervention strategies that can take advantage of visual modalities. • Educators should know that If communication deficits are untreated difficulties connected with communication are likely to persist across and individuals lifespan. • Educators should know it is common that when a technology emerges, research tends to focus on demonstrating how that the particular technology has an effect on learner performance; instead there needs to be a comparison of how that new technology compares with the instructional technology it improves. • Educators should know that it is important to not become enamored with technology as the ultimate conclusion for improved instruction of students of cognitive disabilities and autism; or to use it in place of best practices. • Educators should know that mere access to content in inadequate as and assistive technology unless that same access is mediated with instructional design supports appropriate for the specific disability of the user. • Educators should know that one concern of researchers is that computer based interventions may reduce interactions between teachers, therapist, and even caregivers and the individual with Autism Spectrum Disorder, increase social isolation and reduce opportunity to practice social interactions. • Educators should know that one of the problems with technology is the

time that is required for the teacher to learn how to use and develop skills necessary to implement in the classroom.

- Educators should know that simply providing ASD youth with ongoing experiences within natural settings including typically developing peers does not predicate learning social skills.
- Educators have access to a variety of educational software that is designed to support emergent literacy skills.
- Educators should know that technology should not compensate for shortages in budgets or any motivation that is less than addressing the best interest of students.
- Educators should know that the development of supported curriculum materials is a bit different to the more traditional role of assistive technology of which the focus is on supporting specifically individual students.
- Educators should know that the gap between assistive technology designed for persons with disabilities and typical learners is not as wide as had been thought. Many technology based strategies that proved to be successful for individuals with disabilities have subsequently been found effective and useful for the typical learner or typical technology user.
- Educators should know that the most beneficial approach to teaching autistic people Theory of Mind (ToM) concepts is to use a combination of approaches.
- Educators should know that there is not a difference between access to information and access to learning nor does access to the medium of print necessarily translate to access to comprehending print.
- Educators should know that there is not definitive recipe for augmentative and alternative communication success but its universal ingredients can be found at home; the understanding that all children need to express themselves; willingness to embrace technology regardless of technological background or inclinations; the recognition of AAC devices as part of a holistic communication approach; integrating multiple forms of self-expression and firm but realistic expectations.
- Educators should know that using pictorial cues for children with autism can effectively and efficiently transfer stimulus control from the instructor.
- Educators should know that while it is important to explore computer based and video-supported strategies that supplement the actual instruction in the real environment and reports indicates that simulations cannot completely replace the real thing.
- Educators should know that while there are many new products available for struggling students, it is a challenge to keep the decision makers informed about what's available and what the benefits of assistive technologies are.
- Educators should know that with video game play constituting 97% of the preteen and teenage population's leisure time there is no doubt regarding the interest technology attracts to the youth.
- Educators should know that children with severe communication struggles

have an increased risk of developing challenging behavior issues resulting in fewer opportunities for school and community involvement.

- Educators should know that due to the wide number of disorders within the classification of cognitive disabilities, identifying the barriers these individuals encounter while interacting with digital content is complex.
- Educators should know that professionals who work with Autistic children need to utilize a verity of intervention strategies that can take advantage of visual modalities.
- Educators should know that researchers have suggested the need to recognize and support the long-term needs of adolescents and adults with autism to include the development of social competence.
- Educators should know that social behaviors that cause the student to withdrawn not only isolates the student or restricts the delivery of intervention, thus exacerbating social competence delays.
- Educators should know that students who receive technology at a young age appear to experience more success than those who receive it as adolescents.
- Educators should know that students who receive technology at a young age appear to experience more success than those who receive it as adolescents.
- Educators should know that students with disabilities often struggle with emergent literacy prerequisite skill such as phonological awareness, alphabetic principles, comprehension, and concepts about print and vocabulary development.
- Educators should know that students with learning disabilities time constraints are discouraged and students with emotional disabilities, activities should be fast-paced, requiring the student to respond quickly. However, for students with mental retardation, time control for responses should be regulated by the teacher.
- Educators should know that the use of computer based applications with instructional features has increased tremendously in the contemporary classroom.
- Educators should know that there are two major difficulties in teaching social skills the first being that there is an infinite number of social skills and the second they cannot be taught in packages because such skill as being polite, friendly or co-operative are too broad and needs to be broke into smaller skills.
- Educators should be aware that there is a concern with adults using CVE is their perception of the experience as being a game and those inappropriate actions hindering their ability to learn from their experiences.
- Educators should know that although it is a common fear of parents that using a "high tech" alternative to traditional communicative behavior may impede communicative development research has shown that speech generating devices are not likely to impede speech acquisition.
- Educators should know that due to the wide number of disorders within the classification of cognitive disabilities, identifying the barriers these

	individuals encounter while interacting with digital content is complex.
Benefits and Challenges of Computer Based Interventions (CBI)	• A benefit of Computer Based Interventions (CBI) is that it promises powerful uses in enhancing the skill sets of young learners with developmental delays and disabilities. • A benefit was found in one study that compared computer based intervention to person implemented instruction found that CBI students had fewer behavior problems during the instruction than person implemented instruction but not difference in learning rate. • A benefit is that once there are successful interventions of communication issues there is that there are co morbid improvements in behavior and other connected issues. • Benefits are found in the use of computers and are evidence by the successes that people with autism find when working with computers and they are it involves no social factors, it is consistent and predictable and it allows for control the work at their own pace. • A benefit of augmentative communication systems have been proven can dramatically alter social and communication opportunities for individuals struggling with developmental disabilities. • A benefit found through research is that 3 of 4 students with ASD exhibited higher motivation to learn and fewer disruptive behaviors while using computer-based instruction compared to more traditional personal instruction. • A benefit to Software programs is that it can perform many tasks that is time-consuming or cumbersome in classrooms with high student-teacher ratios such as: immediate reinforcement, fading prompts and collecting data. • A benefit of Computer Virtual Environments (CVE) is the extra time that the Autistic person can use during CVE interactions and the slower rate of interaction allows time to think of alternative ways of dealing with particular situations. • A benefit of the control that CVE gives the autistic person is that it may give them more confidence in social situations. • A benefit of the ease in which media can be manipulated can transform digital media and allow for multiple methods of presenting the information for students with cognitive disabilities providing alternatives to reading. • A benefit of the processing capabilities of the desktop allows designs for highly visual and highly interactive learning experiences, allowing for a significant number of learning trials to be experienced and learned from. • A benefit shown through various works demonstrate that pictorial and video models assist learners in the acquisition of target skills and in generalizing those target skills to community settings. • A benefit to students who are using technology is that they don't have to cope with personal interactions or interpreting facial expressions and because they are less anxious they are ready to learn. • A benefit with the rapidity of technologies advances and interest among

	researchers is that technologies can be found that will improve the efficiency with which learners are able to navigate communication • A challenge for CVE supporters is the concern that it may exacerbate social difficulties causing them to rely on CVE or become obsessed with it and engage less in real social situations. • A challenge with Communication interventions is that they require low student to teacher ratio and many hours per week therefore they present logistical obstacles and resources which may be scarce. • A challenge with computers is that it is possible that children with ASD may perseverate on computer use and as a result strengthen-based stereotypes, challenging behavior maintained by computer access and obsessive compulsive type behaviors. • A challenge to computers usage is concerns that some learners may become distracted by some features of high text equipment. • A challenge with computer usage is that there is a danger that individuals might come to believe that computers are actually thinking and feeling and it will be up to the teacher to make the links with human minds explicit.
Challenges and Solutions of Technology Development for the Classroom	• A Challenge with technology is that Learners with ASD and even those with Attention Deficit Hyperactive Disorder (ADHD) don't benefit from the presence of well-established organizations such and the American Counsel of the Blind or the National Association of the Deaf that lobby for supportive legislation and also provide for Assistive Technology (AT) services to consumers. • A solution to the cost of technology is to combining different groups of people who would benefit from assistive technology such as environmental controls, sight enhancements, home and community safety related devices and navigation/ mobility tools is logical and easily accomplished; unfortunately it is more difficult to find combinations of groups for educational technology. • A challenge of technology is that even if technology based instructional devices is effective they are not widely available because they are not commercially profitable, especially for smaller populations with highly specific needs. • A challenge of technology is that researchers have found that few software publishers were aware of or interested in designing their software to work with even the simplest assistive technology devices. Educators are then left with having to balance exciting opportunities for computer-based technology against a propensity of the commercial software industry to provide marginally useful products, especially for use by persons with disabilities. • A challenge to technology is that scholars identified a significant gap in many ASD interventions in that they are too specific and lacking generalization ability or are overly global which makes outcome change difficult to ascertain. • A challenge to technology is that schools are faced with the challenge of having to balance their technology-purchasing decisions to what services

	the most students.
	• A challenge to technology is that the cost is a huge factor when looking for specialized software and could be economically challenging.
	• A challenge of technology is that the work creating effective pictorial and video models that assist learners is prohibitively expensive in the development of scenes of sufficient quality to provide the learners with realistic video portrayals of complex functional and social skills.
	• A solution to technology cost is that there is an increasing number of individuals that through different lifespan stages become candidates of aided communication systems.
Characteristics and Qualities of Learners with Autism Spectrum Disorder (ASD) or Asperger Syndrome (AS)	• Learners with ASD are the fastest growing developmental disability in the United States.
	• Learners with ASD have impairments in communication that is often the earliest observed symptom and a defining feature of autism spectrum disorder.
	• Learners with ASD are visual learners and thinkers.
	• Learners with ASD often have things done for them which may inhibit opportunities for them to develop the skills they need to become independence.
	• Learners with ASD experience executive functioning deficits and may be better understood in the context of the inability to conduct everyday problem solving.
	• Learners with ASD do not integrate visual, auditory and linguistic information to arrive at an answer, but rather they focus on one channel, the linguistic.
	• Learners with ASD often fail to monitor the effect of their conversations or behaviors on other people.
	• Learners with ASD like to look at videos over and over again which is an effective way of conveying information.
	• Learners with ASD with sensory issues will have difficulties with bells, crowds, noise and hallway crowds of the brick and mortar school environment can be traumatic so online education allows such students control over their environments; online education also allows students who are hyper-focused in certain areas follow that interest where they would otherwise not be able to go.
	• Learners with ASD seem to have natural affinity for computers and the controlled environment the computer provides.
	• Learners with ASD had been shown to lack imitative skills.
	• Learners with ASD struggles with a triad of issues, they find it hard to relate to or empathize with other people; there are communication issues, and there is tendency towards rigidity of thought resulting in inflexibility in thinking, language and behavior.
	• Learners with ASD have poor performance on emotion recognition and one possible explanation would be that it has been demonstrated that the eye region reveals more information than the mouth region in the

presentation of complex emotions. In fact some consider that the most important social skill for the development of empathy is emotion recognition.

- Learners with ASD process faces differently and therefore show reduced attention to faces and facial expressions; this may be due to the mentalist and emotional information conveyed by the eyes.
- Learners with ASD appear to process faces by relying on local facial features rather than on holistic faces which means that their recognition performance is not impacted by upside down faces. Research shows that Learners with ASD spend twice as much time looking at the mouth region of faces than on the eye region.
- Learners with ASD can be taught to attend to faces and to know what different expressions means does not mean that they can react in an emotionally appropriate way.
- Learners with ASD struggle with social skill challenges struggle with listening skills, the recognition and understanding of emotional facial expressions, and appropriate employment of gesture, posture and proximity.
- Learners with ASD have deficits in three cognition processes; theory of mind (ToM), emotion recognition and executive functioning.
- Learners with ASD struggle with social relationships and they often experience social exclusion.
- Learners with ASD struggle with a developmental disability that impairs their social, communication and imagination abilities.
- Learners with ASD need specific targeted interventions because they exhibit problematic social behavior and can become socially withdrawn.
- Learners with ASD can exhibit significant language deficits that include delayed or absent speech, perseveration, and echolalia.
- Learners with ASD have strong abilities in systemizing which are the drive to analyze or build systems allowing on to predict the behavior of the system and be in control of it.
- There are theories that the strengths individuals with ASC display are a result of their enhanced attention to detail which is is a requirement to be able to systemize.
- Learners with ASD who struggle with Theory of Mind (ToM) issues have difficulties recognizing complex emotions such as surprise or embarrassment.
- Learners with ASD and having (ToM) result in people having difficulty with acknowledging that other's have thoughts and beliefs that are as distinct as their own resulting in the inability to tell fact from fiction
- Learners with ASD struggle with (ToM) deficits which result in people having difficulty with acknowledging that other's have thoughts and beliefs that are as distinct as their own resulting in the inability to tell fact from fiction.
- Learners with ASD could find out that online education can be the right

	fit, taking away the sensory overload and social stigma that can happen in other forms of education and allowing them to pursue subjects they're passionate about, above and beyond what they'd get in the classroom.
Hardware Available to Meet Autism Spectrum Disorder (ASD) or Asperger Syndrome (AS) Learning Needs	• Hardware that can meet the need of a student with ASD and struggling with speech is the DynaVox which is a synthesized voice-output device with a dynamic display of vocabulary that changes in a logical sequence with one's selection, mirroring the natural language formation process that produces speech. • Hardware, DynaVox comes in several types; The Dyna Vox 2 which is smaller thatn the regular DynaVox and has a color screen, A portable version of the DynaVox is the DynaMate 3100 and the DynaVox MT4 which is the most complex version. • Hardware can be simple such as the DigiVox which is a digitized speech-output device with paper overlays filled with vocabulary choices of words and symbols where the symbols can be changed but involves photocopying Picture Communication Symbols, then coloring, cutting and pasting each one to the overlay. *Boardmaker* page creation software simplifies things. • Hardware for communication systems come in different augmentative communication systems that offer viable options for communicators with cognitive and physical disabilities that result speech that is difficult to understand. • Hardware can be as low tech as the use of Lego Therapy whose aim is to enhance socio-emotions skills in ACS children who are motivated by lego because it involves constructional systems and are encouraged ot build Lego models in groups of 3 introducing opportunities for social interaction in an autism-friendly way. • Hardware that is also backed by research can support software use such as SMART Board Technology or other interactive electric whiteboard as a tool to teach multiple students at one time. • Hardware such as the desk top computer changed the direction of student interventions. • Hardware that is new to the assistive technology field is the iPad. However it is a technology that is only as good as the therapist teaching students and it appears to be a motivating tool and parents are requesting iPads as part of their children's individualized education programs.
Software Available to Meet Autism Spectrum Disorder (ASD) or Asperger Syndrome (AS) Learning Needs	• Software that has animation is a powerful tool that has been used with learning, especially those with disabilities. • Software in the form of Computer Virtual Environments (CVE) enables communication that is simple and non-threatening than face to face encounters. • The software *FaceSay* is a computer program that uses interactive and realistic avatar assistants to allow children to practice social interactions in natural environments. • The software *Mind Reading* is another example of and intervention; this one includes educational software designed to be an interactive and

systematic guide to emotions. It was designed to help people with ASC learn to recognize simple and complex emotions.

- Software called *Reading the Mind Films* uses 22 short ecologically valid scenes, taken from feature films that include facial features and body language, action prosody, verbal content to help individuals with ASC recognized details of facial features.
- Software such as video modeling is that it does not require any initial instructions or specific training.
- Software called *Transporters* is a high quality 3D children's animation series created using vehicles with faces on it hoping that it attracts the attention and engage the ACS children in a rule based environment to teach them appropriate language and cognitive abilities.
- The software that produces computer virtual environments can be used in a learning environment is to practice and rehearse real world events.
- *Powerpoint* is software that is easily available tool for the educational professional because of its inclusion in the Microsoft ubiquitous.
- The graphic editing qualities of *Powerpoint* offer the ability to specialize the computer application and use visual animation to effectively attract a specific learner's attention and meet their unique needs.
- Software such as Screen Readers allow text to be read aloud for auditory learners or struggling readers; Video can explain concepts across all grade levels and content areas with no cost to teachers.
- The introduction of the software creating virtual learning for students with disabilities has spawned distinctive courses and teaching methods focusing on students learning needs.
- The software such as Wii is currently emerging in K-12 classrooms as a means for teaching the arts, physical education, English as a second language , science, geography, and other topics in innovative ways; children averse to rigorous play activity become engaged in physical activity; children with disabilities benefit in areas of language, math, reading and social skills.
- Wii has products other than simply games such as, *Olympic Games, Brain Academy, My Word Coach, ELLs, Endless Oceans, Wild Earth, African Safari or Music* that can and is used in the classroom for education purposes as well as teaching socialization skills.
- Video game systems are beginning to make its way into curriculum with video companies creating more advanced learning systems for non-entertainment purposes.
- Software that supports video- self modeling (VSM) can be an effective and is an underused instructional strategy for students on the autism spectrum.
- Software that is supported by studies are in support of the uses of computer-based interactive games with the aid of avatar assistants for enhancing specific social skills.
- Software that support virtual environments is a promising approach to computer based learning for people with autism.

	• Universal Design for Learning (UDL) is technology that is used to create curriculum and environments by design, lack the traditional barriers to learn. • Although it is not true software, one of the advantages of using internet is the ability to integrate different types of digital media which allows an integration of media in ways a static textbook cannot offer, since media may use animation, hypertext, and clickable programs.
Ways That Research found that Specific Conditions Could be Addressed by Technology	• Research show that CBI can be effective with individuals who struggle with organization issues can find aid through software programs that can be used to create clear routines, expectations and reduce distraction by providing controls for the influence of autism-specific characteristics such as stimulus over selectivity. • Research has shown that CBI programs that enhance the social skills of children that have other developmental disabilities, such as Attention-Deficit/ Hyperactivity Disorder, could also further our understanding and could provide additional opportunities to expand on understanding of theory of mind and impairments in social skills. • Research has shown that Assistive Technology (AT) shows great promise by empowering learners with language disabilities to be more functional in communicating with others, having access to leisure activities and learning academic and social-communicative skills. • Research has shown that students with disabilities can learn through CAI, in small groups and acquire information through observational learning. • Research has found that word processing software with synthetic speech capabilities is a potential means for improving the spelling and frequency of spontaneous utterances of individuals with ASD. • Research demonstrated that an interactive microcomputer learning environment might facilitate language learning for individuals with autism as well as for those individuals with other handicaps such as cerebral palsy and mental retardation. • Research reported improvements in such academics as reading, writing, math, social studies and science following the use of computer based interventions with students with low to high incidence disabilities. • Research showed that video modeling procedure enhances the social initiation skills of all children. • Research showed that students who had opportunities to practice attending to eye gaze, discriminating facial expressions, emotions and recognizing faces in a structured environment with interactive avatar assistants improved their social skills. • Research has shown that students who had previously been thought to be unreachable have been able to access curricula including the general by using technology. • Research shows that students with ASD are willing to engage instruction and spend extended time with reading material when they access it via a computer; as a result they have shown significant increases in words learned during computer instruction as compared to teacher only

	instruction. • Research shows that the use on online apps can help students learn their addresses, phone numbers, and other basic information it can also provide games to improve balance and coordination, aid communication, and even prepare for a trip to the dentist. • Research showed that video modeling facilitated reciprocal play engagement and imitative responding of sequence behaviors. It also showed that video modeling is a research based intervention for children with ASD to teach simple but socially relevant behaviors. • Research supports the use of digital text as an AT and when text becomes digital many new opportunities for reader support becomes available. • Research found that while real life practice remains the most important part of social skills training, computer-based simulation might be a non-threatening starting point for individuals with ASD. • Research is still ongoing regarding the use of iPads. With the growing number of apps on computer and iPads, students are now using those apps to improve such functions as social skills and communication.

4. Discussion

4.1. Advice and concerns for educators regarding technology use

The review of the literature of this meta-synthesis acknowledges the teacher as the core user of technology. It advises the teacher to be wise consumers of technology; avoid the glamour traps of new improved technology and evaluate all aspects of both the new and old. The teacher should also consider product cost, teacher learn time, options for multiple student instruction or use, the intended students diagnosis and IEP goals and the possibility for social involvement.

There are some specific concerns mentioned in the research that directly impact my current involvement with exceptional students and their families. There are strong indicators that technological interventions should start at a young age to encourage a viable learning experience verses technology being viewed as simply another game device. Therefore timing and cost are crucial. Finding the right product within a specific budget, getting the right training and putting that into the hands of the caregiver/teacher could be a monumental task especially when the caregiver/teacher does not have the educational discernment that could be needed to properly use a product. Finesse must be used to create learning opportunities for both the family and the student so that both become a learning team.

4.2. Benefits and challenges of computer based interventions

Research shows that there are benefits as well as challenges of computer based interventions. However the benefits seem to make the challenges valuable obstacles to overcome. Student's motivation to use the computer scored high in the research as an intervention to improve behavior issues, communication disparities, and the avoidance of disruptive behavior issues. It also highlighted that removing the socialization requirements

during some academic learning processes removes the anxiety of interpreting personal

interaction and facial expressions actually enhances learning.

A challenge is that students can become so involved with computer based interventions

that they lose the desire for any social interactions and become obsessed with such programs

as computer virtual environments. Another similar challenge is that a student may perseverate

on computer use or an individual comes to believe that computers are actually thinking and

feeling.

As a home school teacher advisor of exceptional students this is one of my greatest

concerns because there are those families that struggle with the idea that if a little is good

more is better and that may not be the case. My son could become some completely enamored

with a computer program that his conversation would become cluttered with references to it. I

know how easy it is to suddenly be faced with a student who loses focus on where reality is

and the question becomes is learning happening?

4.3. Challenges and solutions of technology development for the classroom

Research shows that the greatest challenge of the development of technology for the

classroom is the cost of producing and researching a product. Even if technology based

instruction is developed it is not widely available because it is simply not commercially

profitable especially for low incidence disabilities. Often schools are presented the challenge

of having to balance their decisions of technology investment on how many students it will

service. Educators are left with having computer based technology from an industry that

would provide marginally useful products for persons with disabilities.

Many individuals with low incidence disabilities do not benefit from well established

organizations such as the American Counsel of the blind or the National Association of the

Deaf to lobby for supportive legislation and funding for assistive technology. A solution to

this dilemma is being researched from the perspective of combining different groups of people who would also benefit from different forms of assistive technology such as environmental controls, sight enhancement, home and community safety related devices and navigation/mobility tools. It is harder to find learning combinations although some are slowly developing though groups such as re-teaching stroke, brain injuries or lack of oxygen victims.

The lack of affordable technology handicaps not only the student but the teacher as well. The motivation is very high for computer based interventions which lends itself to technology that almost works and that almost hinders learners but also provides some experience opportunities. I, like other teachers learn to make do with what we have and be creative how we use it.

4.4. Characteristics and qualities of learners with autism spectrum disorders (ASD) or Asperger syndrome (AS)

Each learner with ASD or AS is unique with individual set of challenges; rarely are there two alike even in the cases of identical twins. Some common traits are that they are primarily visual learners and thinkers usually with the inability to conduct everyday problem solving. They are challenged to gather visual, auditory and linguistic information and integrate it to discover an answer. They often do not monitor facial cues of others and find it difficult to relate to or empathize or respond appropriately to others. Learners with ASD or AS also usually struggle with rigidity of thought, believing that everybody thinks like they do is a common example of this; they struggle with emotion recognition, and even if they can name the emotion they struggle with acting appropriately; and executive functioning.

Research shows that learners with ASD often have sensory issues which make school community involvement a challenge. Therefore the environment of the computer is a safe and

predictable world that they can create and control. The world of computer preferences makes online education desirable because it removes the social aspect of education and allows them the opportunity to explore subjects that are of interest to them. One of the primary reasons that computer works so well for these individuals is that they often have strong talents in systemizing because of their propensity to attend to details.

Individuals with ASD or AS struggles challenge me to find a educational match; a way to use the attraction for computers with software that will effect learning goals. There are some programs that can help students learn academics, experience social situations, and even recognize emotions through face recognition. The complexity is that no two individuals with ASD or AS are the same and their individualized educational plan must be unique.

4.5. Hardware available to meet autism spectrum disorders (ASD) or Asperger syndrome (AS) learning needs

Research has shown that one of the ways that hardware can meet the needs of struggling learners is through communication devices. Research has found that even those students who can verbalize can benefit from some sort of communication assistance. It has been found that once communication issues are resolved and communication is established many co morbid behavior issues are also resolved. To meet this need there are several types of hardware that is available such as a DynaVox which is a synthesized voice-output device. There are many versions each designed specifically to meet the variety of user's needs and levels of proficiency.

A common tool found in classrooms a hardware backed by research in the form of Whiteboard Technology which is a computer enhanced and connected screen that replaces the regular white boards in the classroom with a tool that can provide a plethora of learning

opportunities and learning enhancements for student at all levels of learning needs. This tool can allow the teacher the opportunity to provide interventions to several students at a time which previously required one on one attention.

The combining thread too many technology based interventions is the desktop computer without which the classroom teacher would be hampered; this tool changed the direction of student interventions. It is this piece of hardware that I have easily available for the families that are under my responsibly in the home school environment. I also use tools like iPads that have many apps that can accommodate student learning; the Nook and Kindle which provides access to reading materials that can be enlarged, backlit or even verbalized for learners struggling with reading, fluency or vision issues. The personal computer changed the world for struggling learners and the teachers of those learners.

For my son the computer is the window from which he safely sees the world, has social experiences, is entertained, and the venue that he uses to pursue his interest. As an adult the teaching that made this digitized world available to him may not have made him a great thinker or taught him all the things his teachers would have liked him to learn but it has given him a quality of life that would otherwise have been absent and resulted in a much sadder situation for him.

4.6. Software available to meet autism spectrum disorders (ASD) or Asperger syndrome (AS) learning needs

Research for this meta-synthesis has revealed studies that explored different software tools to help the struggling learner. There are Computer Virtual Environments such as *FaceSay* that allows students to use avatars to practice in non threatening social situations; there are programs such as *Mind Reading* which is an interactive program to help learners

recognize emotions; *Reading the Mind Films* that include not only help for the learner to

recognize facial features and identify emotions, understand body language, action and verbal

content to help learners recognize emotional nuances; *Transporters* is also a 3D program that

uses vehicles with faces and animation to attract learners attention to teach them appropriate

language and cognitive abilities.

There are less elaborate software that are being used in the classroom such as *Microsoft*

PowerPoint that can be designed to meet the needs of specific learners; software such as

screen readers that allow text to be read aloud; whiteboard technology enhances learning

opportunities for visual, audio and tactile learners equally and new to the classroom is the *Wii*

using such programs as Endless Oceans, Wild Earth, African Safari, Brain Academy, and

Olympic Games.

In my current position as a Teacher Advisor in a home school program I have access to

many types of curriculum that might be otherwise unknown to teachers. Through the research

of this meta-synthesis I have learned that textbooks that are simply digitized does not make

them easier to understand I know from personal experience that when a curriculum is

specifically designed to be digitized that it can become an assistive learning tool.

4.7. Ways that research found that specific conditions could be addressed by technology

Research has shown that the use of technology can address some of the issues that plague

learners with ASD and AS. Computer Based Interventions have been designed, researched

and found to enhance the social skills of struggling learners. There is research that shows that

assistive technology helps by empowering learners with language disabilities to be more

functional. The word processing software with synthetic speech capabilities has shown to

improve not only communication issues but also behavioral issues. Video modeling was

shown to provide a platform for facial recognition and emotional comprehension for learners

who struggle with ASD & AS. There is computer based interventions that help not only in the

venue of social skills but also in the realm of academics. Research based computer

interventions can help the inaudible to be heard, the unsociable to adapt and the unteachable

to learn.

I am always on a quest to find help for my families that struggle helping learners with

difficulties. The information found in this meta-synthesis will impact my profession through

the knowledge gained through the data gathering process and results. I will be able to advise

my families confidently of the technology available and how each one may work for their

learners. The extreme interest in computers of most ASD & AS learners will motivate these

students and help them pursue their interest and create a higher quality of life for themselves.

Research has shown that many of the programs developed for ASD or AS can be also

used with people who need to re-learn due to traumatic injuries or even older learners that did

not have the opportunities when they were younger. My son is older now but with the results

of the information gathered for this meta-synthesis and my appreciation of his intense interest

in the computer I can see that there is hope and possibilities for growth.

5. Conclusion

We teachers know that students will go in and out of our lives and we hope that we have

some small positive impact on those futures. Helping students who learn differently provides

a great and wonderful chance for us to find a way to let the light of learning shine into a space

where it had not been before. I find that different learners give me the opportunity to provide

amazing chances and that even if the effect seems small I will take small; sometimes many

smalls can make great light. I know that unique learning has the possibility to change the quality of life for the individual.

The research in this meta-synthesis has brought forward technology that I didn't know was available and presented the possibilities of more to come. We already have available to us the magnificent invention that is the computer in all its forms from old school desk top varieties to the current rave, The Tablet. Regardless of the tool used it is an intervention that incites motivation and fuses learning with fun in such a way that the learner can be surprised at what they have learned.

Software for these tools is constantly changing and improving and changing again. These changes are challenges for the educator and family alike. Access to these programs can be difficult through requiring the teacher to not only find appropriate software but also to learn how to use it; technology pushes families who need to learn how to use the software and to encourage their learners; school districts are constantly looking for ways to fund the purchase of appropriate and sometimes expensive technology. However the greatest obstacle lies in the path of the industry which continues to research, invent and invest in children who are struggling and learning so differently.

This meta-synthesis has brought out from the bowels of academia and the trenches of research information that I would not have known was available. Working with individuals with Autism Spectrum Disorder and Asperger Syndrome is hard, labor intensive, emotionally costly and must continue. Continue the research, the education, and the investment because even though we can't see the end of the road does not mean that it isn't there.

You cannot dress the flowers, just provide the fertilizer and wait for the miracles.
- Joy Boitnott

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