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The Effects of Assistive Technology versus Manual Communication Aids on the Vocabulary Development of Children with Autism

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Chapter One

Introduction

Background

Language acquisition and vocabulary development are very challenging processes for children with autism spectrum disorder (ASD). Most children with ASD are not responsive, and can focus on only one item at a time to the exclusion of others. These children demonstrate a lack of eye contact and engage in repetitive behavior, such as head banging and rocking a chair. Children with autism are unpredictable regarding sensitivity to pain, noise, light, and crowds.

To the trained eye, these children have difficulty interpreting the thoughts and feeling of other people. Therefore it is important that professionals, educators, and family member know different strategies to teach these children with special needs, such as, direct instruction (Ganza, Flores, 2009, p. 75-83).

This topic became an interest of mine when I was observing Special Day classrooms in public schools. Children with autism were facing several problems within their learning environment. Children did not have enough support to make their life easier; lack of funds made it difficult for school administrators to provide computer systems with supportive accessories. In addition the supply of books and other teaching materials was scarce. The public schools did not have enough trained staff to support children.
As a future teacher, I plan to search for the right tools and user friendly programs to teach children with autism productive language. There are multiple options available to teach language, such as computer software, hardware and accessories for children with special needs. There are also manual communication aids, which have step-by-step instructions to teach language/vocabulary by using graphics, symbols, and signs. Other materials, such as audio tapes and videos can enhance student learning in use of oral language. This study will compare two popular methods of teaching communication skills to children with autism spectrum disorder: manual communication aids and assistive technology.

**Statement of the Problem**

This study explores the effects of assistive technology versus manual communication aids on the vocabulary development of children with autism spectrum disorder. Assistive Technology is computer based assistance to support student learning in all subject areas, such as, using technology for augmentative and alternative communication (AAC) strategies to support the language acquisition in individuals with autism. Software tracks and analyzes student progress, offers help as needed, suggests and provides logical next steps for students to take (Jones, 2009, p. 5-12). Manual communication aid uses different signs, graphic symbols, and voice output to teach language to children with autism (Mirenda, 2003, p.203-216).
Significance of Study

This study will help the educational community consider the best way to assist students with autism spectrum disorder.

Summary:

This study will help effectively educate children with autism spectrum disorder. It provides information about the effects of assistive technology versus manual communication aid of vocabulary development. There are pros and cons in both methods. It is important to understand the meanings and definitions of key words, in order to learn this study in depth.

Definition of Terms

Autism Spectrum Disorder (ASD):

It is related to children who experience a typical language development. Their emerging linguistic skills relate to interactive competence, such as imitation. In this case these children demonstrate repetitive behavior (Morett et al., 2008, p. 1170-1177). Another behavior is joint attention (Luyster et al., 2008, p. 1426-1438). In this situation these children like to work with group of people, this group can be family members and can be group of community members or their teachers and friends. Children with autism spectrum disorder exhibit difficulties with transitioning from one activity to another, insistence on preservative behavior interest, unusual sensory interest, and repetitive behaviors.
**Assistive Technology (AT):**

AT is computer based assistance to support the language acquisition of individual with autism. Software tracks and analyzes student progress, offers help as needed, suggests and provides logical next steps for students to take (Jones, 2009, p. 5-12).

**Augmentative and Alternative Communication (AAC):**

Strategies that assist people with severe communication disabilities to participate more fully in their social roles, like learning, education, employment, and care management (Mirenda, 2001, p.141-151).

**Manual Communication Aids:**

These aids include use different signs, graphic symbols, and voice output to teach language to children with autism (Mirenda, 2003, p.203-216).

**Vocabulary:**

“Building vocabulary words is key to reading, to writing, to verbal expression, and in many ways, vocabulary is key to building analytical and critical thinking. A person's vocabulary skills can be measured in terms of building receptive vocabulary (ie understanding) words and their expressive vocabulary words. People can build their expressive vocabulary in two ways that can get measured: the written vocabulary words or their spoken vocabulary words. Building vocabulary skills improves reading comprehension and reading fluency. Without building a large vocabulary, students cannot read successfully” Building Vocabulary Skills (10/28/09).
Chapter Two

Review of Literature

Introduction

This study will explore the effects of assistive technology versus manual communication aid on the vocabulary development of children with Autism Spectrum Disorder. This chapter will review literature of assistive technology, and manual communication aids.

Language Acquisition of Students with Autism Spectrum Disorder:

Autism spectrum disorder affects an individual in three main areas: social interaction, communication, and behavior. It is hard for children with autism to express their feelings, thoughts, and wishes to other people (Block, et al., 2006). Individuals with autism experience delay in or total lack of the development of spoken language and they fail to develop peer relationships due to lack of mutual nature of social interactions. It seems to be underdeveloped or missing an interest in being with, interacting with, and enjoying others. A child with autism spectrum disorder likes to hold a favorite object when he comes to physical education. The child tries to take the object away so he can participate in activities. Another unique behavior in many children with autism is hypersensitivity to sights, sounds, symbols, smells, and the feel of things.

(Chiang and Lin (2008) describe the expressive communication of Australian and Taiwanese children with autism who had limited spoken language in naturalistic settings. Researchers were using communicative
forms, functions, and partners to investigate. These children with autism spectrum disorders are being observed in different settings such as, at special schools, in self-contained special education classrooms, in general education classrooms, and at homes. Children’s severity of autism is being measured by Autism Rating Scale (CARS) scores. They find no considerable differences in the characteristics of expressive communication between children with speech and those without speech. Their study shows that children with autism spectrum disorder, who have normal verbal comprehension skills, demonstrate deficits in expressive communication and demonstrate a broad range of individual differences in both quantity and quality of expressive communication.

Noens and Onnes (2005) illustrate that language acquisition of individuals with autism spectrum disorders who do develop speech, can distinguish formal, semantic and pragmatic aspects, even though none of them is an independently developing subsystem. Other proper aspects include phonology and syntax. Regarding to phonology, there are mixed findings, generally suggesting delayed but not extremely unusual development in ASD. However vocal quality, intonation and stress patterns are particularly strange. Normal drive helps human beings to make sense of something, to see structure and meaning. Children with autism suffer with visual perception, auditory perception, and verbal semantics. Their communication and imagination usually shows repetitive behaviors, like head banging and rocking a chair.
It is important to find appropriate strategies to teach children with autism spectrum disorders in public schools. Hess, et al., (2008) conducted a survey to identify strategies used in education of children with autism spectrum disorders (ASD) in Georgia. A respondent of the web-based survey includes a representative sample of 185 teachers across the state, reporting on 226 children with ASD in grades preschool-12th. The top five strategies being used in Georgia are Gentle Teaching, sensory integration, cognitive behavioral modification, assistive technology, and social stories. Results draw attention to clear implications for pre-service and in-service educator training, and the need for continued research to document evidence-based strategy use in public school classrooms for student with ASD. There are limitations during the research. For example, there are parents, teachers, and students who do not have access to internet in order to take part in the survey. Researchers believe that it is important to understand children’s severity of autism spectrum disorder in order to assist their language acquisition and vocabulary development.
**Assistive Technology**

Assistive technology is computer-based assistance to support the language acquisition of individuals with autism. Software tracks and analyzes student progress, offers help as needed, suggests and provides logical next steps for students to take (Jones, 2009, p. 5-12). Digital media creates opportunities for teaching and learning through computer-aided instructions. Multimedia applications offer children more control in their learning environment. It also increases the motivation, engagement, and positive attitude among students with autism spectrum disorders.

More, (2008) believes that in the digital stories teachers can promote the skills by targeting various people or settings and can examine the specific needs of students. This strategy can be useful at home as well as in a classroom setting. More believes that it is important to help children with special needs begin to take ownership of learning as early as possible to avoid learned helplessness. The flow chart within the article, describes steps to create digital stories for teaching social skills. The result of her research indicates that, if children have the ability to start, stop, create, and edit the story, learning occurs in a naturalistic way.

More and Cheng (2005) explain how people are getting involved in building computers, virtual environment, and computer dialectics for children with ASD. These authors have special interest in teaching, learning, and creating software, hardware, and easy tools for children with autism. These tools help children in their social settings, like schools, homes, and work
environments. Researchers provide Avatars to their participants, which is an alternate to simplify and facilitate the inter-human communication in a practical world. The system has Avatars which represent four emotions: happy, sad, angry, and frightened. It includes animation, sound, and voice to capture the realistic nature of facial expression. A result of this study shows that Collaborative Virtual Environment (CVE) can be used as an assistive technology to help children with autism spectrum disorders to communicate. A study shows that speech-generating device (SGD) supports the communication of children with autism spectrum disorders. Research methodology is mixed, like case studies and qualitative analysis of individuals and groups. They also use the quantitative data for different functions and to see the effectiveness of device (Thunberg and Ahlsen (2007). This research also provides the positive results of the Activity Based Communication Analysis method. It reveals that SGD impacts children with autism. They use activities at mealtime, story reading, and sharing experience of the preschool day. The speech-generating device provides vocabulary which can bring them closer to their parents, teachers, and social workers by communicating properly.
Passerino and Santarosa (2008) conducted a study which addresses the importance and effectiveness of technology to enhance the communication skills in children with autism:

“We need to think of strategies that promote the development and social inclusion of autistic individuals who are systematically marginalized by society, even though these strategies must be carefully adopted so as to avoid a simple transition from digital to presentable, because we cannot forget that, digital learning environments consist of technological, human and methodological elements, including the entire socio-historical context making up a systemic whole, and not only an aggregation of elements that can be individually isolated”. (p. 402)

No one can deny the effects of technology when it comes to providing assistance to children with autism spectrum disorders. Researchers present a strategy of using a voice output communication aid (Olive, et al., 2006) describe the effectiveness of using EMT paired with VOCA to increase the communication skills of three children. In this study children receives intervention for five minutes each day in snack and play periods. This was a month long study. Researchers used a garage with plastic cars, Oreo cookies, Jigsaw puzzles, and figurines in different activities. It promoted quick response in children when they saw objects of their interest.

Also, there is some low tech assistance available. Talking Mats is a resource, which uses pictures to help children with autism to say what they
feel. Murphy & Carman state “Talking Mats is a low tech communication resource which helps understanding and supports expression. This study examines the effectiveness of the resource for people with intellectual disorder” (2008). The framework is based on three sets of picture symbols that are presented to the person with the communication difficulty. Topics being explored, options related to each topic, and a visual scale to allow participants to indicate their general feeling about each option. The result of this study showed increases the confidence in methodology and determined how Talking Mat can and cannot assist people with different special needs.

Another study investigates the relative engagement potential of four types of electronic screen medias (ESM): animated video, video of self, video of a familiar person engage with an immersive virtual reality (VR) game, and immersion of self in the VR game (Mineo, et al., (2009). This study questions whether engagement, once garnered and maintained, will impact learning in a positive way. The result shows that a vast majority of immersive VR applications are for entertainment or for physical conditioning purposes.

In some cases, people are using videos to create activity centers. Kimball, et al., (2004) explain how the centers for activities can be useful for children to learn. Results of this study show that boys’ respond more quickly than girls and it is self- directed. Children use clues to solve the problems or to answer the questions. They also describe that, it is a positive way of teaching social skills to children with autism.
Children with autism spectrum disorders can take advantage of modern technology. Parents, teachers, and professionals are able to use various software programs and different strategies to improve their children’s communication. Technology can assist children with autism to acquire their language in an artistic and positive way.

**Manual Communication Aids**

Language acquisition is a natural evolution in the use of language and occurs in six stages. This process begins at the pre-linguistic stage and continues into babbling stage, one word stage, two word stages, and the telegraphic speech stage. In the last stage, a child becomes a fluent speaker. Researchers explains that using different signs, graphic symbols, and voice output to teach language to children with autism is another option (Mirenda, 2003, p.203-216). Participants in this study are encouraged to make request for objects, photographs, and pictures. This study emphasizes on the practicality of manual signs by saying that they are more portable, more permanent, and more readily used at a distance from the listener than are graphic symbol displays without voice output.

Ganz, (2004) addresses the potential of Augmentative and Alternative Communication (AAC) systems in children with autism spectrum disorders (ASD). The author states, that current study examined the role of picture exchange communication system (PECS) in improving the number of words spoken, increasing the complexity and length of phrases, and decreasing the non-word vocalization of three children with ASD and developmental delays.
with related characteristics. Participants were chosen from different ethnic
groups and different gender. One child was an Asian female, another was
African American, and the third was Caucasian male. The result indicates the
progress in mastery of the PECS system and demonstrated an increase in
average words spoken per trial.

Sigafoos, (2004) describes the effectiveness of teaching the children
with autism spectrum disorders, who have limited or no speech to ask for
AAC when it is not accessible. VOCA is a great tool for this purpose and this
study identifies it as an instructional priority. During the study researchers
taught device operation and symbol discrimination to three children. They
worked with a female student, who has limited social skills, spoken language,
and also suffers the repetitive behavior like head banging. The second student
has severe mental retardation. He showed aggression, destroyed property
destruction, and at times pointed to the objects that he wanted. Third
participant of this study was a male student and used few manual signs
(WANT, MORE). He could feed, dress, and toilet himself, but needed help in
other self-care tasks (tying his shoes, bathing, brushing his teeth). With
intervention of VOCA, the students learned to get up from table, search the
room until they located the VOCA, brought it back to the table, and use it to
make their required request. This process relates to Augmentative and
Alternative Communication skill AAC. The result of this study is very
encouraging. All of the participants were able to improve their social
interaction, noticeably progresses in asking their items of need, and were able to learn some commands which were given by adults.

One other approach to help children with autism spectrum disorders in their language acquisition is the use of visual aids. It includes pictures, icons, images, cartoons, and photographs. Tissot & Evans (2003) provide interesting information about visual teaching strategies. They clarify that visual strategies do not exclude vocal exchange and they should be viewed as a temporary support mechanism for communication and reduced when appropriate to the individual. The goal of visual strategies is to enhance the meaning of communication for the child. There is no perfect and best approach for any one individual child. The conclusion of this study was that traditional teaching methods rely on spoken instructions. Visual learners can benefit from movement-based systems, but it is important to match the system according to the needs of child. There are some issues to consider while choosing these visual systems. Such as, is the family of this child willing to learn with him? Will the visual system grow with the child’s need? These factors can affect the language acquisition process of child with ASD. This study showed that visual educational approach can provide great support to children who have limited or no speech. It can also develop their social skills by interaction to their teachers and peers.

Existing knowledge about manual communication aids is abundant and can be helpful for people, who can not afford expensive electronic devices for their children with autism spectrum disorders. People can take advantage of
this information to teach and learn in public school classrooms or in private settings effectively.

**Summary**

This study provides the information about the effects of assistive technology versus manual communication aids on the vocabulary development and language acquisition of children with autism spectrum disorders. Researchers from various parts of the world share their experiences and presented results of their studies through literature. The following chapter will describe the methodology of this study.
Chapter Three

Methodology

Introduction

This study explores the effects of assistive technology versus manual communication aids on the vocabulary development of children with autism spectrum disorders. The researcher will select a school district in a suburban area of Southern California, to study two groups of four children with autism to test the validity of this research to see which method works better to acquire the language in our public school classrooms. Four participants will be female and four of them will be male, between the ages of seven and eight years. These participants are from the following ethnic groups, Hispanic, African American, Asian, and white Americans. This study will assess these children with autism by using Technology and manual communication aids. This ten week study will include a pre-study assessment, two separate interventions, a pst-study assessment and analysis of data. Two of participants do not have access to computers on specific days and one is partially blind, and unable to see small letters and graphics. The researcher will create special visuals for them.

Design

This study used a mixed model. Christensen & Johnson (2008) define mixed research as: “Research in which the researcher used a combination of quantitative and qualitative approaches in single study” (p. 51). This study used a combination of quantitative and qualitative data to be collected,
analyzed, validated, and interpreted by using systematic techniques. Children with autism spectrum disorders were assessed and scored. A bar graph was presented for progression. At the same time, the student’s histories were discussed for language learning process in early years.

This study used triangulation. “It is the term given, when the researches seek convergence and corroborate of results from different methods studying the same phenomenon. It could substantially increase the credibility of a research finding” (Johnson, 2008).

Setting

District. This research took place in Southern California at Beautiful Elementary School in a large suburban school district, “Great District of Flowers”. The population of this area is about one hundred forty five thousand. Average family income is forty nine thousand one hundred ninety four dollars. The age range of this population is thirty to sixty two two years old.

School. The Beautiful School serves children from Kindergarten -5th grade and in every grade level, there is an average of one hundred thirty students. Forty nine percent of its students were female and fifty one percent were male. Eighty nine percent of students were English language Learners (ELL).

Classroom. The researcher had chosen a Special Day Classroom. This classroom had students who range in age from five to eight years old. There was one teacher, one assistant teacher, and one aid in this class. As soon as, the researcher walked into the room; she noticed a warm, friendly, and cooperative environment. It was quite a big room about fifteen feet wide and
twenty feet long. On the door “WELCOME” was written in the big letters. One wall had alphabet charts, time table for the whole week, calendar, and some special notes for different students. The second wall had three windows. The room also had trash baskets, a sink, wood cabinets, a microwave, and some sign language posters. The other wall was decorated with different animal pictures, different shapes with bright colors, a five senses chart, and with some stuffed toys. One wall was decorated with children’s art work from other classes. It had nice pictures of pumpkins and rainbows. The ceiling was full of mini lights and flowers. One side of the room had computers, a book rack for students, and in the middle of the room there were two big doughnuts to put children for playing with balls. The Round Doughnuts are made of soft rubber and plastic to protect children from physical injuries. The teacher of this classroom has taught for seven years. Her classroom consists of students from different ethnic backgrounds and with multiple primary languages, such as, Spanish, Chinese, and Urdu. She has a total of twelve students to teach every day and some students come to her twice a week for math and language arts.

**Participants.** This study included eight students from Special Day Classroom in this research, who were facing the challenges of Autism Spectrum Disorders. Four of participants were female and four of them were male, between the ages of seven to eight years. These participants were from different ethnic groups, Hispanic, African American, Asian, and Caucasian.
Technology Vs. Manual Communication Aids

Materials.

The researcher used one computer-based assessment and one manual communication aid during this study.

**Learning Language with Symbols. (Mayer, J. 2009).** This software can teach the meaning of one thousand words using, PCS Animations and photographs. During the language learning process, students match symbols to animation, photos or text and a unique voice recording feature allows children with autism to vocalize their thoughts.

Another assessment and intervention tool was used a manual communication aid named, Bumble-Bee (2008).

**Bumble-Bee.** This manual communication aid has oversized flash cards to assess and teach basic sight words to children with autism spectrum disorders.

Procedure and Timeline

**Week one.** Researcher selected students for the study according to the severity of autism spectrum disorders. Group “A” was selected to take part in manual communication aids activities. Group “B” was selected to take part in learning with technology.

**Week two.** Researcher gave both groups A and B a pre-test to assess their existing level of language by using Bumble-Bee and Learning Language with Symbols. Both groups were given the same time to complete the test.

**Weeks three through five.** Researcher taught basic sight words through either Bumble-Bee and Learning Language with Symbols to Groups A and B. The two groups received equal instruction time in the learning process. The researcher
assessed their learning by administering a test. It provided information about which program is superior to the other.

**List of words for Pre-Test:**

Giraffe, Fingers, Tub, Monkey, Clown, Bicycle, Penguin, Tractor, Candy, Pizza, Table, Girl, Dress, Toes, Merry Go Round, Puzzle, Hippo, Vacuum, Button, Ice Cream, Boy, Tree.

**List of words for Post-Test:**

Motorcycle, Egg, Shark, Sweater, Watermelon, Woman, Lollipop, Potty, Pajamas, Umbrella, Carrots, Mouse, Tummy, Turtle, Sand, Glasses, Man, Tiger, alligator, Juice, Frog, Roller skates, Hair.

**Final Week Six.** The researcher gave post-test to both Groups A & B to determine success of each intervention program. The researcher compared scores of both groups and improvement in language and created a bar graph for progression.

**Analysis of Data:**

**Bar Graph.** The researcher recorded scores for pre-test and created a bar graph to show the existing level of language. In the final week of the study, after administering the post-test, the researcher recorded and created another bar graph to show present levels of language for the students with autism spectrum disorders.

**Line Graph.** The researcher created a line graph for each participant to indicate the results of teaching with manual communication aids and with technology.
Descriptive Statistics: The researcher prepared a report using descriptive statistics to compare the scores of all participants in both methods of learning; assistive technology and manual communication aids to develop vocabulary.

**Limitations:**

The study might require more time and resources. The researcher will need more computer systems in order to provide equal access. Students need more time to practice their skills. Expertise is needed when designing and implementing both qualitative and quantitative phases. This study can yield contradictory findings, because participants may start switching their interests towards other group. Another possibility is that they withdraw themselves from the study.

**Summary:**

This chapter described the methodology of this study. It provided information about design, setting, school district, school, classroom, participants, materials, procedure, and time line. This chapter also addresses analyzing data and study limitations.
Chapter Four

Data Analysis

Statement of the Problem

This study explored the effects of assistive technology versus manual communication aids in the vocabulary development of children within the autism spectrum.

Materials.

The researcher used a computer-based program and oversized flash cards as intervention/assessment tools during this study.

Learning Language with Symbols. (Mayer, J. 2009). This software teaches the meaning of one thousand words using, PCS Animations and photographs. During the language learning process, students matched symbols to animation, photos or text and a unique voice recording feature which allowed children with autism spectrum disorders to vocalize their thoughts.

Bumble-Bee. This intervention involves oversized flash cards to assess and teach basic sight words to children with autism spectrum disorders.

Week one. (1/21/10) Researcher selected students for the study according to the severity of their autism spectrum disorders. Group “A” was selected to take part in manual communication aids activities. Group “B” was selected to take part in learning with technology.
Week two. The researcher administered a pre-study assessment to both Groups A and B to assess their existing level of language by using Bumble-Bee and Learning Language with Symbols. Both groups were given equal time to complete the test.

Weeks three through five. The researcher taught basic sight words through Bumble-Bee to Group A and Learning Language with Symbols to Group B. The groups received equal instruction time during the study.

Week six. The researcher assessed their learning with a post-study assessment. The results provided the data needed to determine which instructional strategy were more effective teaching 23 sight words to students with autism spectrum disorders.

See page# 32 for table of scores and page# 33 for Pre-test Bar Graph.

Both Groups A and B consisted of participants with autism spectrum disorders and had language and communicative deficits of vocabulary/language.

This study consisted of three phases. Phase 1 measured existing level of language/vocabulary by administering a pre-study assessment. Participants received scores and the researcher created a bar graph for both Groups A and B. In Phase 2 children with autism spectrum disorders learned specific sight words through a manual aid program Bumble-Bee (2008). or through a computer software Learning Language with Symbols. (Mayer, J. 2009), for a period of six weeks.

In Phase 3 the researcher administered a post-study assessment to calculate the results of both interventions to determine which instructional strategy worked better.
Lessons

A software program was used to create the vocabulary lessons in *Learning Language with Symbols*. (Mayer, J. 2009). This software incorporates an animation and images of the vocabulary items. The visual images were associated with the spoken words and phrases.

The manual aid program *Bumble-Bee* (2008) was used to teach sight words with flash cards and symbols to the children with autism spectrum disorders according to their grade level. Intervention continued until a student was able to accurately identify all 23 vocabulary items.

The students were taught in 15 minute sessions, once a week, for six weeks.

**Participants.** This study will include eight students from Special Day Classroom in this research, who are facing the challenges of Autism Spectrum Disorders. Four of participants will be female and four of them will be male, between the ages of seven to eight years. These participants are from different ethnic groups, Hispanic, African American, Asian, and Caucasian.

**Lesson difficulty**

The researcher’s intervention methods determined that it was important to insure that lessons were equally difficult in both methods, computer-based and manual aid.

**Analysis**

The researcher broke down the intervention results by carrying out an analysis of variance on the proportion of receptive identifications with *Bumble-Bee* (2008), and *Learning Language with Symbols*. (Mayer, J. 2009) pre-study assessment versus
post-study assessment. Post-study performance was better than pre-study performance.

Since the post-study/pre-study difference reflects the amount learned in a given lesson, we can conclude as expected, the children of Group B eventually learned more with the computer-based software program *Learning Language with Symbols.* (Mayer, J. 2009).

This positive result occurred even though the design of the experiment was biased against finding a strong advantage of technology vs. manual aid. The researcher felt it was biased, because children love colorful pictures and animations while playing computer games. This group had to take part in their favorite activities during the research.

**Summary:**

This chapter provided information about participants, materials, procedure, and time line. It provided analysis of data and limitations. It provided the visual representation by bar graphs and line graph to show the results of intervention. Now, it is important to think about future recommendations for the educational community and present the conclusion to this study.
Chapter Five

Recommendations

This study set out to determine the effects of assistive technology versus manual communication aids in the vocabulary development of children with the autism spectrum disorder.

Results for both Groups A and B.

See page #34 for post-study bar graph and page# 35 for final scores presented in a line graph.

Results for those subjects with autism

1. The use of Learning Language with Symbols, computer software is more fascinating than Bumble-Bee, manual communication aids, thereby favoring use of the technology.

2. The memories of students with autism are quite good, so it is easy to remember where the keys of keyboard are located and how the mouse can do the clicking for them.

3. Pressing the keys is faster than looking at the pictures and converting them into to meaningful words or phrases, resulting in less impatience and learning a greater number of vocabulary/sight words.

4. The subjects, on average focused the same during the technology lessons and manual communication aids lessons.

Results for those subjects with language-based disabilities
1. All the subjects were able to attend for 100% of the time, while working on the computer.

2. Due to lack of experience using the keyboard, some of the students seemed frustrated when they were unable to locate the keys easily or not able to move the mouse properly.

**Results for both disability groups**

1. Some subjects were beginning to use both hands (index fingers) on the keyboard; greater exposure might have produced better results with keyboard and mouse.

2. Using the mouse and keyboard requires less fine motor skills; therefore, students do not tire easily. This also favors technology use.

**Limitations to this study**

This study used a small number of subjects.

The disabilities varied in this sample of subjects.

All subjects were not confined to a single age group. Four students were in kindergarten, two students were in the first grade, and two were in third grade.

Subjects had varying degrees of experience using computer’s keyboard and mouse.

The subjects had only six weeks of intervention period.

**Recommendations for future study**

Based on the results of this study, new opportunities exist for further research.

For this study to achieve more reliable results, the following procedures are recommended:
Use one age group of students, either kindergarten or first grade.
Consider students with comparable computer skills.
Use a large sampling of subjects.
As an additional control, subjects should learn same sight words and
vocabulary words to better determine which modality produces better results.
Other studies might be undertaken on related subjects.
The study could examine use of the colored keyboards, since very young
children are the participants of this study.
Accomplish two separate studies one on autism and one on language-based
disabilities.

**Conclusion of the whole study**

This study explored the effects of assistive technology versus manual
communication aids in the vocabulary development of children within the
autism spectrum.

Overall, it seems *Learning language with Symbols* would be more
beneficial for first and second grade students. It helps them remain focused, it
is less tiring and they can enjoy the medium of communication.

Even though, kindergarten students were more proficient in *Bumble-
Bee* oversized flash cards to learn sight words, it will be important for them to
be exposed to computer based activities. if they are able to practice using the
mouse and keyboard in the younger grades, than by the time they are in junior
of high school, they will be skilled at using keyboards, a common and integral
component of computers.
Learning language with Symbols and other form of technological communication better allow students with autism spectrum and language based disabilities to communicate. The sooner such students are taught to keyboard, the sooner they will be able to communicate efficiently and effectively.
## Table of Pre-Test Scores

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## Table of Post-Test Scores

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Pre-Test Scores Bar-Graph for Group A & B
Post-Test Scores Bar-Graph for Group A & B
References


Building Vocabulary Skills - Games & Activities.

http://www.time4learning.com/readingpyramid/vocabulary.htm


