

**ASSISTIVE TECHNOLOGY AND THE SELF-ESTEEM OF STUDENTS  
WITH LEARNING DISABILITIES**

*by*

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## ABSTRACT

This thesis explored the relationship between using assistive technology (AT), and the self-esteem of students with learning disabilities (LD). A case study was created for each of two participants and were compared in a cross case analysis. Each case study considered the participants' backgrounds as learners, and investigated their educational experiences prior to and during their participation in an assistive technology program. Although the standardized test scores of the two students did not confirm that there had been an appreciable improvement in academic performance, the in-depth interviews with the students, their parents, and teachers, indicated a perception of improvement. Further, these interviews and the use of a questionnaire that measured levels of self-esteem indicated that AT improved the individual students' self esteem, made them more willing participants in school activities, improved their status among their peers and made them optimistic about their future academic achievements. These results support the use of AT whether or not it improves standardized test scores.

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## CHAPTER 1: INTRODUCTION TO THE STUDY

The purpose of this study was to investigate the relationship between the use of assistive technology (AT) and the self-esteem of students with learning disabilities (LD).

Students with learning disabilities often possess low self-esteem (Smith, 1994; Heyman, 1990; Humphrey, 2002; Tracey, 2006; Lyons, 2007). The use of assistive technology helps students with learning disabilities improve the quality of their work (Roblyer & Schwier, 2003; Hopkins, 2004; Ashton, 2005; Edyburn, 2005; Meiring & Normal, 2005; Sitko, Laine, & Sitko, 2005; Dell, Newton, & Petroff, 2008). Improvements in school performance are associated with improved self-esteem (Covington, 1989; Lewis, 2005). Therefore, it is argued that the use of assistive technology has the potential to positively impact self-esteem. This study explores the relationship between the quality of schoolwork that result from the use of AT and the effect of AT use on the self-esteem of two students with LD.

This first chapter introduces the background and purpose of the study, my personal ground and interest, and an outline of the study's methodology. The chapter concludes with delimitations, and limitations. The research associated with learning disabilities, assistive technology and self-esteem, is vast and sometimes the terminology in these areas is ambiguous. For that reason I have included a glossary that sets out the definitions that I have used when using specific terms within this document.

### Personal Ground

My interest in this topic is both personal and professional. Specifically, 3 experiences lead me to this inquiry into self-esteem and students with learning disabilities:

1. My personal experience of having a sibling with a suspected but undiagnosed learning disability.

2. My work as an educational assistant and special education teacher in a Canadian school setting.

3. My work as a special education teacher in an international school setting.

I did not experience academic difficulties in school, but a person close to me did. He had academic difficulties, which seemed to surface around the grade 7 level. This person was not formally diagnosed as having a learning disability, but he struggled tremendously and by grade 10, had dropped out of school and was running with the wrong crowd. Eventually, he spent time incarcerated. This event had a very negative impact on his relationships, on his family, on me as an adolescent, and on his life course. In the late 1970s when he was struggling in school it was typical to have students with 'special needs' segregated into special schools. It was believed that mainstream schools and staff did not have necessary resources or expertise. Research on learning disabilities and the development of teaching strategies to help those with learning disabilities was just beginning. I believe that he might have had a learning disability and that if there had been opportunity for diagnosis, his life might have been different.

I worked for several years as an educational assistant and a special education teacher and I learned many techniques to facilitate the learning of students with exceptionalities. One of the most effective strategies was the use of technology. The educational experience of a student with learning difficulties could be changed dramatically with the use of assistive technology. I saw that students, prior to the introduction of the assistive technology, avoided schoolwork, experienced social isolation, had failing grades, and played sick to avoid coming to school. After the students had been formally diagnosed and began to use assistive technology, their demeanour and school experiences changed. They seemed to look forward to coming to school, and achievement levels went up. Other students saw them as having great opportunities because



they had access to the technological equipment. Generally speaking, the students with special needs were more accepted. The gains that these students made included academic success, maturation, improved responsibility, confidence, self-esteem, self-directedness in their learning, independence, and a sense of pride that they could learn academic competencies after all.

During the time frame of the research at hand, I was employed as a special education teacher in another country, working in a unique school setting. Families and individuals sought answers to help manage the special education needs of their children and I was able to explore the implementation of assistive technology.

#### Context of the Study and Conceptual Framework

Increasing numbers of students are diagnosed each year with learning disabilities (British Dyslexia Association, 2007). Smith & Diller (1996) described a learning disability as “significant differences in the way people manage everyday information in the world around them” (p. 5). Students with learning problems are often stressed in school. “A poor self-image is one of the most frequent consequences of having a learning disability...it is hard to feel good about yourself when you have problems organizing the information in the world around you” (Smith & Diller, 1996, p. 13). Dell, Newton, & Petroff (2008) argue that people with disabilities “have the right to independence, self-sufficiency, personal choice, participation, inclusion, and dignity” (p. 20). Educators must find ways to manage and reduce the impact of having a learning disability, especially knowing that the effects of that impact are cumulative (Smith & Diller, 1996). Teachers need to determine which methods of instruction are most effective in meeting the students’ individual learning needs and reducing the feelings of stress they experience.

Students with disabilities are increasingly being included in regular classrooms. The fully inclusive classrooms of today contain a range of students from the gifted to students with

complex disabilities who may be extremely needy in terms of additional teacher support to complete even basic tasks. Teachers always have struggled to find appropriate teaching strategies to address the unique educational needs of a range of students. The trend toward the fully inclusive classroom model makes this struggle even more essential.

In 2004, 43.1% of all students with special needs in Ontario had learning disabilities (Ontario Ministry of Education, 2006). A potential outcome of having a learning disability is that a student may possess low self-esteem (Smith, 1994; Smith & Diller, 1996; Heyman, 1990; Humphrey, 2002; Tracey, 2006; Lyons, 2007). Dealing with this outcome is a challenge for educators and parents alike, especially since this type of learning problem can extend into many areas of a person's life without that person even realizing it (Smith & Diller, 1996).

Historically, the implementation of curriculum for students with special educational needs "has entailed attempts to match content, process, and outcomes of the curriculum to the cognitive, developmental, social, and functional needs of the individual" (Rose, 2007, p. 295). Byers (1996) suggests that "the curriculum must above all else be seen to provide effective opportunities for learning for all pupils, including those who have been labelled as having special educational needs" (Rose, 2007, p. 297).

The theoretical framework of this study is rooted in three related research findings, that is, students with learning disabilities often possess low self-esteem (Smith, 1994; Heyman, 1990; Humphrey, 2002; Smith and Diller, 1996; Tracey, 2006; Lyons, 2007), the use of assistive technology helps students with learning disabilities improve the quality of their work (Roblyer & Schwier, 2003; Hopkins, 2004; Ashton, 2005; Edyburn, 2005; Meiring & Normal, 2005; Sitko, Laine, & Sitko, 2005; Dell, Newton, & Petroff, 2008) and improvements in school performance are associated with improved self-esteem (Covington, 1989; Lewis, 2005). The

hypothesis behind this thesis is an expectation that improvement in the quality of work associated with the use of AT might have a positive effect on the self-esteem of students with LD.

This study took place in a special education program that I developed as part of my work in an International School that integrated assistive technology. The goal of this assistive technology (AT) program was to scaffold and strengthen competencies in students with deficits. Students in the program used laptops with specialized software programs to assist them in accessing the curriculum at their particular grade level. They used the technology to support their in-class learning and for associated homework tasks that were assigned by classroom teachers. Students participating in the assistive technology program met with me in my role as a special education teacher on at least two occasions each school week for a year and a half. I provided remedial instruction to support learning and instruction in the use of specific computer programs and hardware. I also provided training in the use of assistive technology equipment and support for in-class work. My sessions with the students resulted in suggestions for further extending their use of AT throughout the subject areas.

At the time of this study, there were 14 students diagnosed with learning disabilities in the AT program. Most of these students had Dyslexia or Dysphasia related diagnoses. All 14 students received letters of information pertaining to this study. The two students with the longest exposure to the AT program that return the signed consent forms were selected for this work. The rationale for such selection was that longest exposure to AT was expected to maximize the potential for exhibiting improved self-esteem.

### Research Question

The primary question of this research was: What was the relationship between the use of assistive technology, performance in school and the self-esteem of students with learning disabilities?

The secondary questions were:

1. Did the use of AT result in improved school performance (as noted by standardized test scores)?
2. How did the levels of self-esteem change since the introduction of AT (as measured with interviews, the MALS scale, and standardized test scores)?

This study investigated the relationship between the use of assistive technology, changes in school performance, and the subsequent effects on the self-esteem of students with learning disabilities.

### Methodological Approach

This research employed a naturalistic design strategy and qualitative research methodology based on two case studies using within case and cross case analysis. Within each case, some quantitative data, in the form of students' standardized test scores and a standardized self-esteem instrument were also used. The case study approach, according to Creswell (2007) "involves the study of an issue explored through one or more cases within a bounded system" (p. 73). It allows the researcher to "clearly link identifiable cases to provide an in-depth understanding of the comparison of the cases" (Creswell, 2007, p. 74).

Data collection took multiple forms. Students were asked to participate in one on one in-depth interviews. The parents of the participants were interviewed (independently of their children) to gain additional perspective into their child's experience of the AT program.

Teachers outside of the study who interacted directly with the subjects of the study were interviewed. They shared their opinions of the participants and their educational experiences pre and post the introduction of assistive technology. The research considered test results- specifically changes in the participants' standardized test scores throughout the course of the AT program. Each participant completed the Myself as a Learner Scale (MALS), a digital questionnaire completed via computer used to collect information about students' perceptions of their self-esteem. Lastly, reference was made to an existing journal that considered events and critical observations made by me during the implementation of the AT program.

The data was examined using within-case and cross case analysis. In such analysis, "the researcher examines each case for themes" (Creswell, 2007, p. 246). Following this investigation, a cross-case analysis was conducted to examine "themes across cases so as to discern themes that are common to all cases" (Creswell, 2007, p. 245). Examination of these themes was intended to uncover new information and understanding such that we gain insight into the relationship between the self-esteem of the participants and their use of AT.

#### Significance of the Study

Many students with learning disabilities have low self-esteem (Smith, 1994; Smith & Diller, 1996; Heyman, 1990; Humphrey, 2002; Tracey, 2006; Lyons, 2007). The use of assistive technology has been shown to help students with learning disabilities to improve the quality of their work (Roblyer & Schwier, 2003; Hopkins, 2004; Ashton, 2005; Edyburn, 2005; Meiring & Normal, 2005; Sitko, Laine, & Sitko, 2005; Dell, Newton, & Petroff, 2008). Further, improvement in the quality of work has been linked to improvement in self-esteem (Covington, 1989; Lewis, 2005). It is anticipated that knowledge derived from this study will inform the relationship between learning disabilities, the use of assistive technology, school performance,

and self-esteem, and that it will hold value for and prompt further study in this field. It is hoped that the results from the study will make it easier for schools to include the provision of AT and thereby better meet the needs of students with learning disabilities.

#### Delimitations

This case study was bounded by the following limits:

1. The sample size of this study was limited to two participants formally diagnosed as having a learning disability, who had experience using assistive technology at one particular school.
2. Data was limited to that which could be derived from individual interviews with the participants, their parents, teachers who interacted with them prior to and throughout the course of the AT program, the academic marks of the students, the MALS digital questionnaire, and reference to an existing journal of the researcher.

#### Limitations

The following constraints applied:

1. Due to the limited sample size, the results of the study may not be generalizable beyond the specific cases.
2. The unique educational setting of an International School means that the results of this study may not transfer to other educational settings.
3. The prolonged engagement between program participants and the researcher may affect the responses given by the students in the data collection, as the researcher had authority over the students in the roles of teacher and researcher. This authority may have affected participant responses.

## CHAPTER 2: LITERATURE REVIEW

The theoretical framework of this study was initiated by the observations that: a) Many students with learning disabilities possess low self-esteem (Smith, 1994; Smith & Diller, 1996; Heyman, 1990; Humphrey, 2002; Tracey, 2006; Lyons, 2007); b) The use of assistive technology has been shown to be a ‘tool for enablement’ and can help students with learning disabilities improve the quality of their work (Roblyer & Schwier, 2003; Hopkins, 2004; Ashton, 2005; Edyburn, 2005; Meiring & Normal, 2005; Dell, Newton, & Petroff, 2008); c) Improvements in school performance are associated with improved self-esteem (Covington, 1989; Lewis, 2005), d) The use of assistive technology has the potential to impact self-esteem. Therefore, the literature that provides the background for this study is divided into three sections: a definition of learning disabilities, the connections between learning disabilities and self-esteem, and a background to learning disabilities and assistive technology. A glossary of terms and abbreviations will follow the sections to assist the reader in understanding the terminology.

### Learning Disabilities

A learning disability is defined as “a learning disorder evident in both academic and social situations that involves one or more of the processes necessary for the proper use of spoken language or the symbols of communication, and that is characterized by a condition that:

- a. Is not the primary result of impairment of vision or hearing, physical or developmental disability, primary emotional disturbance or cultural difference
- b. Results in a significant discrepancy between academic achievement and assessed intellectual ability with deficits in one or more of the following: receptive or expressive language, language processing, or mathematical computations

- c. May be associated with one or more conditions diagnosed as: a perceptual handicap, brain injury, minimal brain dysfunction, dyslexia, developmental aphasia” (Ontario Ministry of Education, 2000, p. 32).

It is estimated that 6 % of students have some form of learning difficulty that impacts their classroom performance (Statistics Canada, 1999). Learning difficulties can be described as learning challenges that students may face that complicate their learning processes beyond those of a typical student. Of those students experiencing difficulty, half have a diagnosed learning disability and are provided primarily with instruction in the regular classroom (Statistics Canada, 1999).

The phrase ‘learning disability’ is actually an ‘umbrella term’ widely used to describe a number of conditions including Dyslexia, Dyscalculia, Dysphasia, Dyspraxia, and NLD (Non-Verbal Learning Disability). Each disability shares characteristics with, and may co-exist with others (Learning Disabilities Association of Ontario (LDAO) , 2001). Comorbidity in which “two or more conditions that are diagnosed distinguishable from one another tend to occur together” (LDAO, 2001, p. 11) means that a student with Dyslexia can exhibit elements of Dyscalculia, or a student with Dysphasia can possess symptoms of Dyslexia. When comorbidity exists, there is a complex layering of learning difficulties to be identified, sorted out, and managed.

Comorbidity complicates issues associated with learning problems and program delivery. Helping educators understand the nature of learning disabilities can help with the delivery of a complex program and assist teachers to meet the needs of children who are affected. Students with learning disabilities may experience difficulty with performance in any of or a combination of the following areas: “oral language, listening comprehension, written expression, basic



reading skills, mathematical reasoning and calculations, social skills, study skills, and time management” (Hicks, 2007). There are many strategies that teachers can draw upon to facilitate access to the curriculum for students experiencing learning problems. In many jurisdictions, these strategies are coalesced into some form of Individual Education Plan (IEP). “An IEP is a working document which describes the specialized education program and/or services required by a particular student” (Ontario Ministry of Education, 2004). Also included in an IEP are teaching, instructional, and assessment strategies to be used by a teacher to meet the specific student’s needs (Ontario Ministry of Education, 2004).

IEPs are best developed by a school team. Special education teachers, classroom teachers, and school administration can establish roles and responsibilities, and determine the appropriate level and types of support required for students in particular cases. Resources might include direct instruction by a special education teacher, support from a paraprofessional, or one-on-one support by an educational assistant. The documentation and planning of a student’s Individual Education Plan can help to identify individual areas of student need, and appropriate classroom strategies can help to ensure student success. The ultimate goal of this process is to provide a clear plan to assist classroom teachers in facilitating the education of students with all types of disabilities (Ontario Ministry of Education, 2004).

The nature of Dyslexia and Dysphasia specifically are important to this study, as the participants selected for the study have been formally diagnosed with these learning disabilities: one of them with Dyslexia, and the other with Dysphasia. Dyslexia is probably the most well known of all learning disabilities. The British Dyslexia Association (BDA) defines Dyslexia as “a specific learning difficulty, which may be neurobiological in origin and persists across the lifespan. It is characterized by difficulties with phonological processing, rapid naming, working

memory, processing speed and the automatic development of skills that are unexpected in relation to an individual's other cognitive abilities" (British Dyslexia Association, 2007).

The specific difficulties of Dyslexic learners are described as "some or several of the following difficulties to differing degrees: decoding and spelling, letter recognition, poor short term or working memory, difficulty with sequencing and organization, problems achieving automaticity or fluency of skills, and directional confusions" (Department for Children, Schools, and Families (DfES), 2007). No two students diagnosed with Dyslexia experience the exact same struggles educationally. Each student is unique, having individual characteristics, experiences, and elements of their learning affected by their exceptionality. Non-neurological influences that impact on the learning of a student with Dyslexia include: individual learning styles (Deponio, Landon, & Reid, 2000) multiple intelligences, preferences for learning, and the teaching style of their teacher (Burden & Burdett, 2005).

Reid's (2007) research into the impact of addressing learning styles of Dyslexic students determined that "teachers need specific guidance on how to identify and support the needs of Dyslexic learners...it is important that the child's strengths, motivation and self-esteem, and learning styles are included in these considerations" (Peer & Reid, 2000, p. 53-57).

Understanding the individual needs of students with Dyslexia is imperative, but equally important is the use of appropriate pedagogical and organization strategies. Fundamentals like using a variety of teaching strategies or collaborative learning in lesson delivery, capitalizing on a student's favoured learning modality or intelligence, using assistive technology, and providing tools to promote independence in the classroom can go a long way in meeting the rudimentary needs of many students with Dyslexia (Neanon, 2005, p. 34-37). Some specific tools to promote

independence may include highlighters, graphic organizers, a daily schedule, or cue cards on which to place important information.

The other learning disability present in the students in this study is less well known. Dysphasia is a member of the 'Aphasia' family of language disorders. Aphasia can be defined as "an impairment of language, affecting the production or comprehension of speech and the ability to read or write" (National Aphasia Association, 2007). Wood (1960) described Dysphasia "as a disorder of spoken language either in its reception or expression" (p. 15). Hicks (2007) added to this earlier definition by explaining that Dysphasia "is an impairment in communication. It can involve an inability to speak with fluency or sometimes to understand others" (p.1). Individuals with Dysphasia may have "difficulty discriminating between sounds, understanding word meaning, comprehending written word, and discerning complex sentence structures. Problems can arise regarding recall of words, and using language correctly in context" (Tyquin Group, 1999, p. 4).

The nature of a student's Dysphasic disability lies in the area of expressive and receptive language skills and therefore professionals such as Speech Pathologists are used as resources and can help to provide suggestions and strategies for individual students. Chunking material and avoiding complex jargon can help with comprehension. Checking for understanding and providing verbal cues can assist students. Using assistive technology and providing visual support such as graphic organizers can aid in written expression, development of ideas, and thought organization.

In the traditional delivery of Special Education intervention programs, remediation has been the conventional method of reinforcing concepts for students with learning disabilities. Remediation is defined as "education designed to help people with learning difficulties to

improve their skills or knowledge” (Encarta Dictionary Online, 2007) and according to Edyburn (2005) remediation includes the process in which teachers

re-teach the information, use alternative instructional strategies, break the tasks down into smaller parts to analyze what the student knows and what components are problematic, reduce the number of items that must be completed, provide additional practice, engage in one on one tutoring, and so on. (p. 248)

In using these traditional teaching methods, students with special education needs have been subject to sometimes monotonous and boring remediation techniques of skill and drill; traditional paper and pencil tasks. However, with the continued advancement of educational technological tools and specialized equipment, the use of assistive technology has become an alternative and exciting compensatory solution to address the unique learning needs of students with learning difficulties (Edyburn, 2005).

### Learning Disabilities and Self-Esteem

Brooks (2001) describes self-esteem as “including the feelings and thoughts we have about our competencies and worth, our abilities to make a positive difference, our level of optimism, our willingness to confront rather than retreat from realistic challenges, our capacity to learn from both successes and failures, and our ability to treat ourselves as well as others with respect” (p. 2).

Self-esteem is a complicated aspect of being human that has many components. As infants and young children, we seek to have our physical needs met, which helps us to establish significant relationships with our family members. Development of these relationships assists children in the integration of their emotional and physical needs. Safety, security and competence are also factors affecting self-esteem. “The child who feels safe and secure

experiments with his or her environment through exploration and curiosity. The environment has to support this adventuring for the child to learn skills and feel competent” (Alsup, 2001, p. 2). In order for a child to have high self-esteem, these basic needs must be met.

A sense of belonging, giving and receiving respect, and having one’s needs for love met are also significant influences on a child’s self-esteem. “Children who have had their belonging and love needs met are turned on with life, they thrive and have empathy for others. They practice altruism and develop respect and compassion for themselves and others” (Alsup, 2001, p. 2).

Self-esteem is not innate; it is established over time; learned (Humphrey, 2002). It starts from birth. From early on, children look to their outside influences to help them determine who they are in light of the world around them. As a young child, self-esteem is mostly positive. It is based “largely on the feedback of others, especially from their parents about their goodness and worth” (Tracey, 2006, p. 1). As children grow and develop, they “integrate feedback from their experiences and their environment. Self-esteem becomes closer to their actual performance or reality” (Tracey, 2006, p. 1). Generally, by the age of 7, “children are able to compare their skills and abilities with others around them such as classmates (Humphrey, 2002). Once this is done, their perceived abilities and weaknesses compared to similar aged children becomes an important contributing factor to their self-esteem” (Tracey, 2006, p. 1).

Self-esteem can present itself in both positive and negative ways. Children with high self-esteem may exhibit some of the following characteristics:

(They) approach new situations in a positive way, accept responsibility, keep situations in perspective, possess an internal locus of control, communicate feelings and emotions in a

variety of situations, and feel capable of influencing another's opinions or behaviours in a positive way. (Lavoie, 2003, p. 1)

Poor self-esteem can elicit varied responses for an individual, including physical, attitudinal, emotional, and behavioural. In the educational setting, poor self-esteem can manifest itself in students who:

Consistently use self-derogatory statements, show learned helplessness, practice perfectionism, are overly dependent, demonstrate an excessive need to be accepted, have difficulty making decisions, show a low frustration tolerance, become easily defensive, and have little faith in their own judgment. (Lavoie, 2003, p. 1)

When there is a disparity, positive or negative, between a child's view of themselves and where they fit into the scheme of the peer group, this can create poor self-esteem. Some children become cognizant of this disparity. Brooks describes this process as a "cycle that constantly operates in which our successes or failures impact our self-esteem, which then influences our beliefs and actions, which then influences our self-esteem" (Brooks, 2001, p. 2).

When a child begins to realize that they are not necessarily performing up to the same level of their peers and might have a learning problem, their self-esteem can suffer dramatically. According to Smith (1994), "one of the biggest battles we have teaching people with learning disabilities is dealing with negative self-images" (p. 1). "Once a child has low self-esteem, it can be very difficult to reverse their feeling of worthlessness and they enter a cycle that perpetuates and enhances their negative feelings" (Tracey, 2006, p. 2).

Some negative impacts for an individual having a learning disability and concomitant poor self-esteem may include

Feeling ashamed of the types of difficulties they struggle with, fear of failure, criticism, ridicule, or rejection, fear that others may think that they are stupid or incapable, ashamed that they are unable to read or that they have poor handwriting, may be left out of everyday discussions due to lack of understanding, may be depressed, or feel alone. (Wikipedia, 2007)

When comparing mainstream students to those with learning disabilities, it has been found that children with LD experience higher rates of poor self-esteem than their mainstream peers (Heyman, 1990; Humphrey, 2002; Lyons, 2007).

Children with learning disabilities may judge him or herself as ‘stupid’, ‘slow’ or ‘dumb’ based on academic comparisons with other children. These self-judgments are often global in nature in that a child who is having difficulty at school may perceive themselves negatively in all areas of their development. (Lyons, 2007, p. 1)

Humphrey’s (2002) study of students with Dyslexia indicated that Dyslexia had a negative impact on self-esteem. The study revealed a discrepancy between student perceptions of themselves and their ideal selves in relation to their academic performance. Humphrey (2002) suggests that, “using classroom based interventions with a focus on academic interventions could provide significant positive effects on the self-concept of students with Dyslexia”. He argued, “an emphasis needs to be put on looking at the whole child” (Humphrey, 2002, p. 35).

Humphrey (2002) suggests that in addition to experiencing their own poor feelings, about half of students with learning disabilities have been teased about their difficulties, and many have had bad experiences in mainstream education involving teachers who were ignorant of, or did not acknowledge the existence of their learning problem (Humphrey, 2002, p. 30).

The negative effects of a learning disability reach beyond the individual and have an impact on society. Students with learning disabilities that remain undiagnosed may not live up to their potential. Chronic low self-esteem can result in inappropriate life choices. Possible societal outcomes of having an undiagnosed learning disability include “an increased number of people on welfare, people who commit crimes or go to juvenile courts, who are held in juvenile detention centres, and who go to prison” (Wikipedia, 2007). According to recent statistics, approximately 80% of prison inmates in the United States are functionally illiterate (Moody, Holzer, & Roman, 2000, p. 69), and potentially suffer from a learning disability. Forty per cent of Canadian inmates have some type of learning disability (CBC, 2000).

Having a learning disability can have a negative impact on the self-esteem of the individual (Smith, 1994; Smith & Diller, 1996; Heyman, 1990; Humphrey, 2002; Tracey, 2006; Lyons, 2007), and potentially on society (Lacasse on CBC, 2000; Wikipedia, 2007). Educators and specialist teachers support the individual students experiencing learning difficulties in our educational systems by accessing and facilitating available tools to support children.

#### Learning Disabilities and Assistive Technology

One tool that may be used to assist students with learning disabilities is assistive technology (AT). Assistive technology can help to bridge the gaps between a student’s knowledge, and their ability to express that knowledge and thereby improve school performance. The use of AT has been shown to be a ‘tool of enablement’ associated with improved school performance (Roblyer & Schwier, 2003; Hopkins, 2004; Ashton, 2005; Edyburn, 2005; Meiring & Normal, 2005; Dell, Newton, & Petroff, 2008). The government of Canada has adopted the definition of AT service from the US Assistive Technology Act of 1998: “technology designed to be utilized in an assistive technology device or assistive technology service” (Industry Canada,



2010, p. 1). The Individuals with Disabilities Educational Improvement Act (IDEA) of 2004 defines assistive technology as “any item, piece of equipment or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of a child with a disability” (Dell, Newton, & Petroff, 2008, p. 4). In this work, AT refers to custom tailored computer hardware and software, packaged to meet the individual needs of students with special education needs in the educational environment.

In a general sense, the purpose of using such equipment is to provide individuals with a method or mode in which they are able to complete tasks, alternative to the remediation techniques of skill and drill; traditional paper and pencil tasks. In the educational environment, assistive technology is used to assist students with learning difficulties in accessing the curriculum to the greatest degree possible, and facilitate the expression of their knowledge. “Its applications and adaptations can help open doors to previously inaccessible learning opportunities for many children with special needs” (Ontario Ministry of Education: Education for All, 2005, p. 127). The continual advancement of tools and specialized equipment in education means that the use of assistive technology has become a compensatory alternative solution to address the unique learning needs of students with special education needs.

Assistive technology has existed for approximately 30 years. When it was first introduced into the schools, immediate extensions of individualized programs were realized for students with special education needs. As early as the 1980’s, students with disabilities were introduced to Braille writers, Intellikeys, and other prosthetic devices to assist them in their every day educational routines. Lewis (2005) presents the ideas of Behrmann and Lahm (1984) as they shared their early views on the use of technology in special education at a conference for the

Council for Exceptional Children: “Computer usage in special education is a natural extension of instruction because of the many similarities among the characteristics of computers, instructional methods used in special education, and the learning characteristics of handicapped children” (Lewis, 2005, p. 326). That is, the use of computers mimics repetitive drill and practice types of instruction as used in Special Education.

Several studies were conducted in the late 1980’s to attempt to measure the effectiveness of technological infusion. Results lead to the realization that technology helped to provide students with special education needs with “immediate feedback, enthusiasm for school work, engagement in tasks, improved academic performance, self-paced learning, and individualized instruction” (Lewis, 2005, p. 326).

Typical to the introduction of any new educational paradigm, there were also many barriers. In this field, a major barrier has been the fact that resources and accepted methods of applying them changed quickly and dramatically (Robyler & Schwier, 2003). The cost of computers and technical support were exorbitantly high for school boards to take on. The other huge hurdle was the major learning curve that had to be undertaken by educational professionals in order to learn how the computers worked, and determine how they could best be integrated into the schools in general, as well as how to serve the unique needs of individual students possessing exceptionalities.

In the 1990’s and early 2000’s, comprehensive studies such as the ‘Enhancing Writing Skills Project’ and ‘Project LITT’ were completed to examine how technology enhanced learning opportunities in the classroom (Lewis, 2005). Word processing and desktop publishing applications transformed learning since students could now use the computer beyond playing games. Keyboarding replaced the traditional study of typing skills. Speech synthesis tools, and

spell checkers revolutionized the process of writing. Multimedia and graphics programs exploded onto the educational scene. The pace at which technology was advancing was exponential in nature (Robyler & Schwier, 2003).

The No Child Left Behind Act of 2001 (NCLB) in the United States increased attention on meeting the needs of all students in the classroom. In Canada, the Ontario Ministry of Education document entitled *Standards for School Boards' Special Education Plan* (2000) addressed individual needs. In this document, procedures were outlined, roles and responsibilities defined, specific information was provided for Individual Education Plan (IEP) development, and processes were laid out for the Identification, Placement, and Review Committee (IPRC). A small paragraph on page 12 of the document provided a brief overview of the provision of individualized equipment for some students with special needs, requirements to meet the standard, and compliance of this standard by individual school boards. It was not until 2006 that school boards in Ontario were finally incorporating the use of assistive technology into their overall accessibility plans (WECDSB, 2006).

The implementation of assistive technology has evolved over the past 30 years, but is still considered to be in its infancy (Edyburn, 2005). The specific packages of assistive technology equipment they are utilizing is something that varies among individual students, from school to school, and to other boards.

In the educational environment, assistive technology is used to facilitate students with learning difficulties in accessing the curriculum to the greatest degree possible. Software used to support special education needs for students with learning disabilities in the classroom commonly falls into the following categories: “text to speech, word processors, word predictors, phonetic dictionaries, and graphic organizers” (Dell, Newton, & Petroff, 2008, pp. 53-56). Each

program has a specific function and is used to facilitate increased access to the curriculum dependent on the specific learning needs of each student in question.

When I speak of assistive technology, I am referring to specific computer hardware and software to meet the individual requirements of students with special education needs in the educational environment. When coupled with tailored instructional and learning strategies, the use of the technology allows students to show what they know in a way that meets their individual learning styles and multiple intelligences, at the same time as meeting the prescribed curriculum expectations.

The use of assistive technology offers what is often considered to be a modality preference for students with learning disabilities (Neanon, 2005). According to Deponio, Landon, and Reid (2000) as cited in West (1991) the suggestion is “that many Dyslexic learners are right-brain dominant and process information in a visual and holistic manner” (p. 58). When information from the curriculum is presented on the computer screen, it gives students visual feedback from which they can profit. The use of word processors in writing activities gives students access to spelling and grammatical checks of specific issues, which can typically be difficult for students with learning disabilities (Keates, 2002). Graphic organizer programs can facilitate students in organizing and planning assignments, opportunities, which in the past might have proved difficult to tackle.

Auditory reinforcement of information through text to speech software programs can assist in reinforcing concepts (Keates, 2002), pronunciation of words, and help to model expressive language skills. Assistive technology provides a method or mode in which students with learning problems are able to complete tasks. In the classroom, this can translate to students with learning disabilities having their own individualized computer equipment to complete day-

to-day activities. Students are trained to use specialized programs and hardware so that they are capable of working independently and managing their own daily educational tasks. Classroom teachers work in conjunction with specialist teachers and their students to ensure that students utilize their equipment in the most profitable ways. The results of such collaboration can allow students with learning disabilities, such as Dyslexia and Dysphasia for example, to show what they know, and access the curriculum more readily (Keates, 2002).

### *Assistive Technology Equipment*

The assistive technology equipment referred to in this paper consists of the following elements: *Hardware*: a desktop or laptop computer, scanner, printer, and *Software programs*: Kurzweil 3000, Lexia, Inspiration / Kidspiration, Co-Writer, and Write Outloud. The selection of these software solutions for the program in the school where this study took place meant that the level of support for these students was similar to Ontario's level 1 Intensive Support Amount (ISA 1) funding for specialized equipment.

Kurzweil 3000 "is a scaffolded reading, writing, and study skills solution for struggling learners, including ELL (English Language Learner) students and students with special needs. It enables educators to provide differentiated instruction without having to differentiate the curriculum" (Kurzweil Education Systems, 2006). It uses OCR (optical character recognition) to recognize various forms of electronic text and produces speech from that. It can be used to support reading comprehension, fluency, vocabulary building, spelling, study skills, and test taking. Students who have learning disabilities in the area of language generally benefit from using this software. Any student with special education needs who has difficulty reading can easily use this software to complete assigned work (Hopkins, 2004).

Lexia is a program that promotes "phonological awareness, sight word recognition, sound-symbol correspondence and word-attack skills, and strengthens a student's foundation for reading success. Emphasis on visual-spatial and logical reasoning skills strengthens a student's thinking, memory, and problem solving abilities" (Lexia Learning, 2006). This program comes in many levels to be selected depending on the specific needs of the student in question. Students identified with learning disabilities benefit from using this software. It can be used independently and the program can track the student's progress through its various activities. This program may also be used for mainstream students who are experiencing difficulty in language acquisition.

Inspiration and Kidspiration are visual learning tools that allow users to develop ideas and organize thinking graphically, using diagramming and outlining. Students who are high visual learners or need help in organizing their thoughts and notes would benefit from using this software. Kidspiration is generally used with younger students and Inspiration with older students.

Write Outloud is an auditory feedback word processing program that can be used in conjunction with Co-writer. The user can listen to each word, sentence, or paragraph as the software provides suggested word alternatives. This program would benefit students who have difficulty with spelling, word retrieval, and general written expression.

Co-writer is a word prediction program that works in conjunction with any word processor. It can reduce the number of keystrokes required to produce a word because it attempts to predict the next logical word in sequence. It also offers auditory feedback, which promotes independence. Students who are high auditory learners or have difficulty with word retrieval can benefit from using this program.

Assistive technology alone does not accomplish the didactic goals set out for students with special education needs. However, when coupled with tailored instructional and learning strategies, AT has the power to provide a bridge between the knowledge that students with special education needs already possess and the task that they must perform leading to improved school performance (Roblyer & Schwier, 2003; Hopkins, 2004; Ashton, 2005; Edyburn, 2005; Meiring & Normal, 2005; Dell, Newton, & Petroff, 2008). The use of the technology allows students to show what they know in a way that meets their individual learning styles and multiple intelligences (DePonio, Landon, & Reid, 2000), at the same time as meeting the prescribed curriculum expectations (Keates, 2002).

Some new paths have been revealed and are currently being researched in the field of assistive technology. Historically, AT was seen as having value in the sense of rehabilitation. At present the options are ever increasing. One of the latest areas under exploration is “examining the implications of how assistive technology enhances academic performance (Roblyer & Schwier, 2003; Hopkins, 2004; Ashton, 2005; Meiring & Normal, 2005; Dell, Newton, & Petroff, 2008)”. Ashton (2005) presents a study conducted by Sturm and Rankin-Erickson where researchers determined that by using the AT program ‘Inspiration’, students were able to produce essays scoring significantly higher than pre-test samples without using the program. As a result of the improved performance in writing, “student’s attitudes were dramatically more positive” (p. 233). Sitko, Laine & Sitko (2005) state “using word processing on computers is directly related to significant growth in writing ability and motivation for writing in children with severe learning disabilities” (p. 589). Lewis (2005) reports on a study she conducted in California where 189 teachers and 149 administrators were surveyed as to the benefits of using technology with students with severe learning disabilities. The groups identified improved academics and

self-concept as outcomes of using technology with these students. Although this improvement in academics has been identified with a correlation to self-concept, there has been no research to this effect to examine the impact of using AT on the self-esteem of students with learning disabilities.

Another path in current research in the area of assistive technology is its ability to act as a “cognitive prosthesis. Edyburn states that additional research is required to identify devices and tools that augment and extend cognitive functioning as a strategy for enhancing performance” (Edyburn, 2005, p. 247).

A third new area of focus is the inquiry into the principles of ‘remediation vs. compensation.’ Remediation can be defined as the traditional method of a teacher attempting to assist a student with special education needs by practicing skills through repetitive drill-like activities. Compensation on the other hand, when considered in conjunction with assistive technology used by a student with a learning problem, can help the student to atone for their deficits utilizing their personal strengths, and unique learning strategies offered through the use of the technology. The challenge that presents itself in the realm of Special Education is the determination of the delicate balance of the use of each method to assist the student in meeting their academic potential.

Sitko, Laine, & Sitko (2005) share some recent research regarding the use of assistive technology in their article titled *Writing Tools: Technology and Strategies for Struggling Writers*. There are several large scale projects going on which should help us to understand more about the impact of AT on students with learning disabilities. One such project called ‘Language Labs’ is taking place in Toronto, Canada. This research project was developed to promote reading and writing of students using assistive technology. The project has been



successful in the early stages resulting in noted improvement in written output of the students (Dell, Newton, & Petroff, 2008), and has expanded to more schools (p. 588).

Another large project involving assistive technology and developing writing skills is occurring in Macomb, Michigan. It is called *Begin with ME!* “The project combines simple effective technology tools, good support strategies, and motivating reasons to support good writing” (Sitko, Laine, & Sitko, 2005, p. 588). Initial results from the study indicate that students increased their writing proficiency (Dell, Newton, & Petroff, 2008) through the use of assistive technology, and were more motivated to write. The above-mentioned studies show the growing importance of AT in the educational environment.

Strangman and Dalton (2005) suggest “If the goal of levelling the playing field in the classroom is to offer students multiple instructional approaches and materials, technology is undoubtedly the key raw material” (p. 565). Use of assistive technology solutions for students with special education needs in the classroom has the potential to change lives. What is required is “taking a problem-solving attitude which can lead to creative solutions that eliminate obstacles caused by disabilities” (Dell, Newton, & Petroff, 2008, p. 19).

### Conclusion

All students have the right to feel good about themselves and their academic achievements. “The school environment plays an important role in self-concept formation” (Heyman, 1990, p. 472). For students with learning disabilities, “deficits in specific subject areas generalize to overall negative academic self-perception” (Heyman, 1990, p. 472).

Potentially there are enormous consequences for the individual student as well as for society if students with learning disabilities are ignored. Imagine the future possibilities for students with learning disabilities if all stakeholders involved had the following belief, “Being LD doesn’t

have to keep a person from chasing their dreams. It just means that he or she chases them differently” (Smith, 1994, p. 2).

In this literature review, I have examined the areas of learning disabilities, learning disabilities and self-esteem, and learning disabilities and assistive technology. These concepts are connected by research that indicates that learning disabilities lead to low performance, which has itself been shown to be a contributing factor for low self-esteem (Smith, 1994; Smith & Diller, 1996; Heyman, 1990; Humphrey, 2002; Tracey, 2006; Lyons, 2007). Students with learning disabilities experience increased performance when using assistive technology (Roblyer & Schwier, 2003; Hopkins, 2004; Ashton, 2005; Edyburn, 2005; Meiring & Normal, 2005; Dell, Newton, & Petroff, 2008). Improvements in school performance are associated with improved self-esteem (Covington 1989; Lewis, 2005). Use of AT might therefore be expected to boost self-esteem in children with learning disabilities.

#### Glossary

***Aphasia*** -“an impairment of language, affecting the production or comprehension of speech and the ability to read or write” (National Aphasia Association, 2007).

***Assistive Technology (AT)*** -“a system or support that allows a person with a disability to work around his / her area of challenge. It does not provide a ‘cure’ for the condition or disability, but helps the user to accomplish a task more independently” (Hopkins, 2004, p. 1).

***Comorbidity***- existing simultaneously; co-existing

***Concurrent Validity*** is measured “by examining how well a new scale correlates with well-established measures about which other sound data exists but which are not likely themselves to be completely suitable for the purposes to which the new scale will be put (MALS Manual, 2000).”

***Dyslexia*** -a specific learning difficulty neurobiological in origin and persists across the lifespan. It is characterized by difficulties with phonological processing, rapid naming, working memory, processing speed and the automatic development of skills that are unexpected in relation to an individual’s other cognitive abilities” (British Dyslexia Association, 2007).

**Dysphasia** - a disorder of spoken language either in its reception or expression (Wood, 1960, p. 15). or an impairment in communication. It can involve an inability to speak with fluency or sometimes to understand others. (Hicks, 2007)

**Face Validity** refers to whether or not the scale makes sense to those who would actually use it (MALS Manual, 2000).

**Form 1 Students**- refers to students the age equivalent of grade 6 in the Ontario school system.

**Learning Disability (LD)** is defined as “a learning disorder evident in both academic and social situations that involves one or more of the processes necessary for the proper use of spoken language or the symbols of communication, and that is characterized by a condition that:

- a. Is not the primary result of impairment of vision or hearing, physical or developmental disability, primary emotional disturbance or cultural difference
- b. Results in a significant discrepancy between academic achievement and assessed intellectual ability with deficits in one or more of the following: receptive or expressive language, language processing, or mathematical computations
- c. May be associated with one or more conditions diagnosed as: a perceptual handicap, brain injury, minimal brain dysfunction, dyslexia, developmental aphasia” (Ontario Ministry of Education, 2000, p. 32).

**Individual Education Plan (IEP)**- An IEP is defined as “a written plan describing the special education program and / or services required by a particular student based on a thorough assessment of the student’s strengths and needs” (Ontario Ministry of Education, 2004).

**Norm-Referenced Assessment** “is a method of assessment whereby pupils obtain standardized scores that allow their individual performance to be compared with that of their age-related peers. These scores are provided in norm tables, which take age into account. Information gained from norm-referenced assessment is particularly useful for comparing the performance of individuals with the national average; this allows standards to be monitored on a national and year group basis” (GL Assessment, 2008).

**Normative Curve** is defined as “A graph of a normal bell curve showing statistics used in standardized testing assessment. The scales include standard deviations, cumulative percentages, percentile equivalents, Z-scores, T-scores, standard nines, and percentages in standard nines” (Wikipedia, 2007).

**Reliability** “concerns the consistency of an assessment with which it measures whatever it is supposed to be measuring. A reliable assessment is dependable and will yield similar results each time it is used. Perfect reliability is represented by a reliability coefficient of 1.0, but in practice this is never achieved although figures upwards of about 0.85 are commonly obtained” (GL Assessment, 2008).

*Self-Esteem* “includes the feelings and thoughts we have about our competencies and worth, our abilities to make a positive difference, our level of optimism, our willingness to confront rather than retreat from realistic challenges, our capacity to learn from both successes and failures, and our ability to treat ourselves as well as others with respect” (Brooks, 2001, p. 2).

*Standardized Score* is a “score attained by an individual student on a selected test, related to that individual’s chronological age group and then converted to normative scores. The scores indicate evidence of an individual’s present level of development of the area being investigated. Standardized scores are mostly used with respect to educational and psychological testing. In the educational setting, standardized scores are used to identify students who may have particular educational requirements” (CAT 3 Administration Manual, 2001).

*Validity* can be described as “measuring what an assessment claims to measure. Evidence may be presented in various ways satisfactory correlations with other assessments of the same abilities or skills; or with teachers’ estimates of their pupils’ abilities; or with the pupils’ subsequent achievements such as their results in public examinations” (GL Assessment, 2008).

### CHAPTER 3: METHODOLOGY AND METHODS

This chapter presents the methodology and research design chosen for this study. Information is given regarding the participants, the strategies and techniques for data collection, the steps for data analysis and criteria for interpretation.

#### Research Design

Creswell (2007) described research design as “the entire process of research from conceptualizing a problem to writing research questions, on to data collection, analysis, interpretation, and report writing” (p. 5). Yin, as stated in Creswell 2007, added that the research design process is “the logical sequence that connects the empirical data to a study’s initial research questions, and ultimately to its conclusions” (p. 20).

This research study used a naturalistic design strategy to gain insight into the realities and constructs that the participants experienced. “Qualitative designs are naturalistic to the extent that the research takes place in the real world and the researcher does not attempt to manipulate the phenomenon of interest” (Patton, 2002, p. 39). Characteristics of naturalistic inquiry as they apply to this study are based on those cited by Cohen, Manion and Morrison, 2007:

1. Humans actively construct their own meanings of situations
2. Behaviour and data are socially situated, context related, context dependent, and context rich. To understand a situation, researchers need to understand the context because situations affect behaviour and perspectives, and vice versa.
3. Realities are multiple, constructed, and holistic
4. The attribution of meaning is continuous and evolving over time and
5. Research must include thick description of the contextualized behaviour (p. 167).

In this study the thick description of the contextualized behaviour came from a variety of sources including the students, their teachers and their parents. The behaviour was studied within the context of the school setting where I had familiarity with the situation and was in a position to continually observe and reflect upon the multiple realities associated with these students as they were introduced to and became engaged in using assistive technologies. I was able to help the participants “actively construct” their own meanings of the situation and identify meanings that evolved over a period of several years.

Naturalistic research methods are “intended to address the major questions, what are the characteristics of the social phenomenon, what are the causes of the social phenomenon, and lastly, what are the consequences of the social phenomenon” (Lofland, 1971, cited in Cohen, Manion, & Morrison, 2007, p. 169). The major question of this work was to explore the relationship between the use of assistive technology, performance in school and the self-esteem of students with learning disabilities. Secondly, questions were investigated regarding whether or not the use of AT resulted in improved school performance, and if the levels of self-esteem change with the introduction of AT. The naturalistic research of this work used case study methodology to investigate questions, causes and consequences in an examination of the possible relationship between assistive technology and the self-esteem of students with learning disabilities.

Creswell (2007) defined case study research as “a qualitative approach in which the investigator explores a bounded system over time, through detailed, in-depth data collection involving multiple sources of information, and reports a case description and case-based themes” (p. 73). The multiple sources used for the construction of these cases included interviews with the students, parents and teachers, standardized test scores, results from the MALS questionnaire,

and entries in an existing journal of the researcher. Patton (2002) described well-constructed case studies as “holistic and context sensitive” (p. 447). The purpose of utilizing this method of inquiry is to “gather comprehensive, systematic, and in-depth information about each case of interest” (Patton, 2002, p. 447), “and generate findings that are useful” (Patton, 2003, p. 2). As Creswell suggested, “this approach is a good one when the inquirer has clearly identifiable cases with boundaries and seeks to provide an in-depth understanding of the cases” (Creswell, 2007, p. 74). In this research, a qualitative research approach is utilized to determine how the use of assistive technology relates to student performance and self-esteem. The naturalistic research methods associated with case study analysis is used to examine the way AT support, school performance, and student self esteem are connected in one instance.

In this study, two case studies were created. Each case included a thorough description of the participants, their individual academic histories, and accounts of their experiences participating in the Assistive Technology program. This information was identified through data collected from students’ parents and their teachers, standardized test scores and an existing journal of the researcher. Triangulation of all these data sources was used. Then an inter-case analysis was done to investigate whether or not the use of assistive technology positively impacted on the self-esteem of the students with learning disabilities.

#### Case Study Participants

All of the students in the AT program were non-native English speakers, educated in an English speaking International school program. The participants selected for this study were two students in the AT program who were formally diagnosed by a licensed Psychologist as having a learning disability (Dyslexia and/or Dysphasia). There is a possibility that there were some biasing effects due to the fact that the tests are not designed for non-English speakers. The

students had been participating in the AT program since its inception one and a half years before the study began, and they had received individualized instruction to learn the purpose and functions of the technology in their daily school experience, including its use in the classroom and in the completion of homework tasks as assigned by their teachers. The selection of these two students exemplified purposeful and homogeneous sampling by “offering insight into the central phenomenon being considered” (Creswell, 2007), which enabled the researcher to “focus on, reduce, simplify, and facilitate interviewing” (Miles and Huberman, 1994, p. 28).

Participants for this study were part of a larger group of students identified as having learning disabilities. The group was participating in a program that provided them with AT to augment their learning and were chosen for this study because they had “potential or ability to offer new insights into the emerging theory” (Cohen, Manion, & Morrison, 2007, p. 177). This purposeful sampling was undertaken “to offer insight into the central phenomenon being considered” (Creswell, 2007). The students of this study were selected based on the fact that they had participated in the AT program for the longest amount of time, and they had the most potential for offering insight into the effects of using assistive technology on the self-esteem of students with learning disabilities.

#### Data Collection

According to Creswell (2007), “Case study data collection involves a wide array of procedures as the researcher builds an in-depth picture of the case” (p. 132). The data for the two case studies were collected by means of in-depth interviews with participants, their parents and teachers, references to academic marks, the Myself as a Learner Scale (MALS) questionnaire, and an existing journal kept by the researcher for reference as a teacher. Each of these sources is considered separately below.



### *In-depth interviews*

Fontana and Frey (2005) described the interview as

Not merely the neutral exchange of asking questions and getting answers. Two or more people are involved in this process, and their exchanges lead to the creation of a collaborative effort called *the interview*. The key here is the active nature of the process that leads to a contextually bound and mutually created story-the interview (p. 696).

Lincoln and Guba (1985) proposed that “there are several purposes for interviewing which include to present constructions of events, feelings, persons, organizations, activities, motivations, concerns, claims” (pp. 268-79). The purpose of conducting these interviews was to collect data on the educational experiences of the participants being interviewed.

The planning procedures used for the interviews were based on the steps suggested by Cohen et al. (2007): “thematizing, designing, conducting the interview, transcribing, analyzing, verifying, and reporting” (p. 356-373). In this section, the data collection process is described. The last three steps, that is, the “analyzing, verifying and reporting” steps are discussed in the data analysis and interpretation section to follow.

### *Thematizing the interviews*

In this study, a description of the cases was provided to enable the researcher to identify specific themes, collect information into large clusters of ideas, and provide details that supported those themes. The themes being examined are the perceptions of the student and his or her support structure of the use of AT in the classroom with particular attention being paid to affect of AT on the student’s grades and on his or her self-esteem.

### *Designing the interviews*

“Asking questions and getting answers is a much harder task than it may seem at first” (Fontana & Frey, 2005, p. 697). Therefore, I was careful to develop the interview guide questions to facilitate the support of, and potential expansion upon, the responses of the interviewees. Appendix C presents individual interview guiding questions for the student participants. I used a semi-structured format so that question delivery and student response could be spontaneous yet directed throughout the interview as per Fontana & Frey (2005).

Similarly, interviews were conducted with the parents and teachers of the participating students using guiding questions to provide an additional viewpoint regarding the experience of the participants in the assistive technology program, and the child’s educational experience and self-esteem. (See Appendices D & E respectively) The participant and parent interviews were conducted individually following the conclusion of the AT program. The teacher interviews were conducted in formal teaching teams to facilitate a more efficient number of interview transcripts following the end of the AT program. Each transcript was numbered according to its order with respect to completion date. These interviews provided a holistic and transparent view into the parent’s and teacher’s perspective of the student’s experience pre and post use of Assistive Technology, the impact of AT on their academic performance and the subsequent effects of AT on the student’s self-esteem.

### *Conducting the interviews*

According to Cohen, Manion, & Morrison (2007), “it is critical to remember that an interview is a social, interpersonal encounter, not merely a data collection exercise” (p. 361). Each interview with the participants, teachers and parents took approximately 60 minutes to complete and was conducted individually. All interviews were taped for audio transcription

purposes only, and were subject to the initial consent of the participants and their parents. The interviews took place in the special education office, at a time pre-arranged with parents, teachers, and students. All of the interviews were conducted within a one-week time span to facilitate triangulation of the data, and the development of the case studies.

I used active listening to engage all interview participants. Active listening is defined as “listening for meaning, in which the listener checks with the speaker to see that a statement has been correctly heard and understood” (University of Colorado, 1998, pp. 1-2). It was anticipated that by using the technique of active listening, participants would feel at ease with their responses during the interviews, and share more openly their experiences of the assistive technology program.

#### *Transcribing the interviews*

Each interview was conducted individually, and taped for later transcription. Audio was then transcribed manually to text. Each transcript was numbered according to its order with respect to completion date. The data was organized according to the interview questions and the relevant speaker in the interview. The interview questions were numbered to assist in facilitating later retrieval of information.

Once the initial transcription was complete, the data were examined to assist in coding. Key words were tagged with a label to clearly identify the main repeating foci. This process was conducted for each interview undertaken. From this, the codes were placed into a chart whereby the researcher cross-referenced each interview to help identify reoccurring patterns via the interview questions. The information collected from this process was then used to extract information to construct the within and cross-case analysis.

### *Analyzing the interviews*

Analysis of the data commenced using the coding patterns identified in the transcription process of the interviews. The researcher looked at each case individually to get an overall sense of the case. From this point, the cases were cross-referenced in order to determine if there were any points of recognition, similarity, or existing pattern. When it appeared that there was a similar point made, a note was made, and the analysis continued. Once both cases were analyzed, the additional data collected was brought into the picture, considering how the other sources might have an impact or influence on the cases as a whole. This was done for the standardized test scores collected, the results from the MALS questionnaire, and the existing journal of the researcher.

### *Verifying the data collected*

All data sources were triangulated to determine if there were commonalities among them. This was done in hopes of increasing the validity and credibility. The cases were built by first coding the individual interviews and interviews with the parents of the program participants. Next, the standardized test scores were considered. Comments from the interviews with the teachers were cross-referenced. Lastly, the MALS questionnaire results were incorporated. It was from this triangulation that the cases were formed and themes were derived.

### *Standardized Test Scores*

This data source included the standardized scores that the potential participants obtained through regular academic testing conducted by the school. They included (a) Cognitive Ability Test (CAT 3), (b) Progress in English (PiE), (c) Progress in Maths (PiM), and (d) Single Word Spelling Test (SWST). These tests are standardized. They provided the researcher with a benchmark for all students the same age as the case study participants. Participant's results were

compared against the normative curve. This comparison provided the researcher with an indication of the case study participants' progress (if any) relative to children their age. Information regarding the individual tests follows.

The CAT 3 test measures the three principal forms of reasoning – verbal, non-verbal and numerical – as well as an element of spatial ability (GL Assessment, 2008). This test was used to gain an overall understanding of the case study participants' functioning in the main cognitive areas.

The Progress in English test is a series of writing and reading assessments for 5 to 14 year olds that measure reading and writing in an accessible way, enabling teachers to produce individual or group profiles of their pupils' strengths and needs. (GL Assessment, 2008).

The Progress in English test was chosen specifically for use because of its ability to depict the separate areas of study in the English language that could be helpful in identifying areas of progress and / or need of the students.

The Progress in Maths test was chosen specifically for use because of its ability to depict the separate areas of study of Maths that could be helpful in identifying areas of progress and / or need of the students.

Lastly, the Single Word Spelling Test is a series of nine standardized tests designed to assess the spelling attainment of 6-14 year olds (GL Assessment, 2008). The SWST was chosen to assist the researcher in determining if the students made progress in the area of spelling. This was of particular concern relating to the student formally diagnosed as being Dyslexic.

#### *Myself as a Learner Scale (MALS Questionnaire)*

The MALS was conducted immediately following the conclusion of the AT program. According to the manual, the Myself as a Learner Scale (MALS), developed by R. Burden, was

“constructed to meet a perceived lack of available techniques for assessing general academic self-perceptions. The scale consists of 20 self-referring statements to which individuals are invited to respond in a positive, negative, or neutral manner” (MALS Manual, 2000).

The MALS identified the “key elements of a positive self-perception as a learner and problem solver as being: (a) confidence in one’s ability to do well in a variety of academic learning situations, (b) enjoyment in problem solving, (c) a reflective learning style, (d) lack of anxiety, and (e) access to and use of a wide vocabulary” (MALS Manual, 2000, p. 7).

The MALS was selected for use in this study because the test was available digitally and results were available immediately. Digital tests such as the MALS offered a result package that made possible cross comparisons of specific samples allowing the researcher to readily compare the results of each study participant.

Each participant completed the MALS independently. They signed into the digital test portal using a pre-assigned user name and password. Questions were displayed on the computer screen so that students could indicate their most appropriate response to the questions presented when prompted. When the questionnaire was complete, it was submitted and scored digitally at the GL Assessment Centre. The results were returned to the school’s digital testing portal in many forms: a standardized score for each participant, the potential participant’s individual responses for each question, and a group-reporting format combining all participant responses and scores. The standardized scores were then compared to the normative curve to gain a sense of the individual student’s perceptions of their perceived academic ability. Individual’s question responses were used to compare data from each case. The group-reporting format was used in the data analysis to perform cross-case analysis.

The overall results from the MALS questionnaire were contrasted against the individually reported levels of self-esteem of the participants from their past academic experiences via the in-depth interviews to assist in determining whether or not there was an impact on their self-esteem following the use of assistive technology.

#### *Existing Journal of the Researcher*

The data collection of this study was rounded out by the consideration of an existing journal of the researcher. This journal contained notes regarding the individual participants, observations during the program implementation, and specific issues related to each child's participation in the program. It was written from a teacher's perspective and was used to clarify questions regarding the students' participation in the AT program.

#### *Data Analysis and Interpretation*

According to Cohen, Manion, & Morrison (2007), data analysis involves organizing, accounting for, and exploring the data" (p. 183). The steps involved in the process of data analysis include

Establishing units of analysis of the data to find how they are similar / different, creating a domain analysis, establishing relationships and linkages between the domains, making speculative inferences, summarizing, seeking negative and discrepant cases, theory generation, and finally writing the report. (Cohen, Manion, & Morrison, 2007, p. 184)

#### *Organization of the Data*

In this study, I set out to follow the process described by Cohen et al. The data collected in this study was organized as two separate cases via within-case analysis, and then cross-referenced in the cross-case analysis. Using the educational situations of the participants, I summarized and interpreted their experiences, discovered patterns and generated themes, raised

issues, explained causality of the data, discovered commonalities; differences and similarities, and considered the application of the same issues in different contexts as suggested by Cohen, Manion, & Morrison, 2007, pp. 470-1.

Data analysis followed the method prescribed by Miles & Huberman (1994):

Coding, noting patterns and themes, seeking plausibility, clustering information into categories, making metaphors, selecting variables to elaborate, differentiate, and unpack ideas, identify and note relation between variables, build logical chains of evidence, and making conceptual and theoretical coherence. (Cohen, Manion, & Morrison, 2007, pp. 470-1).

#### *Within and Cross-Case Analysis*

##### *Accounting for the data*

Information from the interviews with students, their parents and teachers was combined with the other data sources to develop coding categories. Bogdan & Bilken (2003) described this process as “searching through the data for regularities and patterns as well as for topics that the data covers, and then writing down words and phrases to represent the topics and patterns. Consequently, “coding categories will result” (p. 16). Qualitative Data Analysis software was not used to assist the researcher in analyzing the data as the sample size of this study is small, and the data collected was manageable enough to be coded manually. Each data source was coded for each student, identifying significant and noteworthy foci in the process. Key words were identified and made note of. Coded data was placed into a chart per case to assist the researcher in gaining a clear picture of the information presented, and provide an opportunity for noting patterns simultaneously. The data were presented firstly through an exploration of the educational environment of the students prior to the use of assistive technology using teacher’s



comments. Standardized scores of the students were examined both pre and post AT use to investigate whether or not there was any identifiable impact on school performance resulting from the use of assistive technology. Lastly, the responses of the MALS questionnaire were cross referenced with the data collected in the in-depth interviews to determine whether or not there was a change in levels of self-esteem of the participants. Where possible, information from the existing journal of the researcher was added to assist in building the case studies.

### *Exploring the data*

Once the data collection was complete in this study, each individual case was examined using a within case analysis. In this type of analysis, “the researcher examines each case for themes” (Creswell, 2007, p. 246). The presentation of the within case analysis included:

1. An introduction to the participant. This included a description of circumstances in which each student came to be involved with the researcher.
2. An outline of each student’s experience in the AT program
3. The impact of AT on class performance was examined using standardized test scores. They were grouped according to curriculum focus to assist the reader in understanding the comparison of outcomes.
4. Information relevant to any improvement in performance and the potential effect on self-esteem was considered. This involved examination of data collected from interviews with students, parents, and teachers. Where appropriate, questions were taken verbatim from the field data. The purpose of using this approach was to “increase the comparability of the responses from the interviews” (Patton, 2002, pg. 349). The MALS questionnaire results were considered when looking at the connection between AT and self-esteem.

5. Theme identification and analysis occurred by examining all of the results of the data sources collectively.

This method of within-case analysis attempted to reduce the data by seeking points of note, clustering it, and finally noting relationships between the items to generate a description of each case. To assure anonymity, each student was referred to by pseudonym and the school name was not identified.

Following this application of investigation, a cross-case analysis was conducted. “This analysis step usually follows within case analysis, examining themes across cases to discern themes that are common to all cases” (Creswell, 2007, p. 245). Results from the standardized test scores, individual participant and parent interviews, and teacher observations of the students prior to and following their use of assistive technology were analyzed as a post AT program tool to determine if there was an impact from the use of the AT on the school performance of the students. These results were then compared to the remaining data of the study to assist in determining whether or not there was an impact on or change in the self-esteem of the participants. The MALS questionnaire responses were considered in reference to how / if the self-esteem of the students was affected by the use of the AT. Ultimately, all data was triangulated in the within case analysis and the themes that were identified for the cross-case analysis were used to develop themes and establish credibility in the cross case analysis.

#### Ethical Considerations

This study involved two participants in an educational setting. The information letter (Appendix A) outlined the purpose of the study and was directed to the participants, their parents and teachers. The nature of participation in this study was described indicating time

involvement, access to information, confidentiality issues, and general facts about the publication of the results of the study. Parental permission was sought to release student marks.

Participants were informed that participation was strictly voluntary, and they may refuse to participate or withdraw from the study at any time. This included the right of refusal to answer specific questions or involvement in any part of the procedure. Explicit information was provided regarding the recording of interviews, and the use of those interviews for transcription purposes only. Participants were also informed that they also had the right to give or refuse consent to recording. Confidentiality was maintained at all times. No information pertaining to the identity or information about the study participants was used in any publication or presentation of the study results. Pseudonyms were generated for each of the participants of the study. There were no foreseeable risks, harm to participants, or inconveniences associated with this study. Consideration was given regarding possible ethical implications of using one's own students as research subjects by the researcher.

As this study was conducted outside of Canada, ethical approval and permission was obtained from the International School as per the Personal Data Collection Act of 2000 (Freedom Info.org, 2008) of the Netherlands, the Dutch equivalent of the Ontario Freedom of Information and Protection of Privacy Act of 1990 (Ontario Ministry of the Attorney General, 2008).

The data collected is and will be securely stored at Lakehead University for seven years locked in the Faculty of Education at Lakehead University. Any files associated with the data collection stored on memory stick were deleted subsequent to the completion of the study. All actions involving the implementation of this thesis conformed to the rules, regulations, and procedural guidelines of the Faculty of Graduate Studies, Lakehead University, Thunder Bay, Ontario, Canada.

## Trustworthiness

The concepts of reliability and validity can be problematic in case study research (Bassey, 1999). By way of solution, Lincoln and Guba (1985) described the criteria for trustworthiness in case study research using terms related to '*naturalistic inquiry*' that included credibility, transferability, dependability, and confirmability (Bassey, 1999). Considering these elements in the research process illuminates the ethic of respect for truth in case study research (Bassey, 1999).

### *Credibility*

As stated by Patton, "The credibility of qualitative inquiry depends on three related elements: rigorous methods for doing fieldwork, the credibility of the researcher, and the philosophical belief in the value of qualitative inquiry" (2002, p. 552-3). Lincoln and Guba (1985) recommended using multiple strategies to serve in improving the findings, and supporting the interpretations of this type of naturalistic inquiry method as being considered credible. Methods implemented in this study to enhance credibility included prolonged engagement, triangulation, and peer debriefing (Geelan, 2004).

Prolonged engagement referred to the researcher "spending enough time with the respondents to become familiar with the variety of ways in which the respondents construe an experience" (Lee, 2002, p. 215). This prolonged engagement allowed for the "development of trust between the researcher and participants, reducing the distortions introduced by the presence of the researcher, and allowing the researcher to engage more fully in the culture of the research context" (Geelan, 2004, p. 2). I spent 1.5 years establishing and implementing the assistive technology program. Students actively participated and received ongoing support. This created a relationship that was conducive to meeting prolonged engagement criteria.

“Triangulation strengthens a study by combining methods” (Patton, 2002, p. 247). In this study, triangulation occurred as a result of the combining of data collected in the one on one interview with the participants, interviews with their parents and teachers, the standardized test results of the students, the responses of the MALS questionnaires, and the existing journal kept by the researcher. I attempted to strengthen the confidence in the findings of the study by "bringing together data from different sources, searching for significant features of the cases, and making analytical statements illuminating these features" (Bassegy, 1999, p. 76). By “checking the consistency of findings generated by different data collection methods” (Patton, 2002, p. 556), it was anticipated that credibility could be established, and as Denzin (1990) in Patton (2002) stated, “by combining multiple observers, theories, methods, and data sources, ...overcome the intrinsic bias that comes from single-methods, single-observer, and single-theory studies” (p.555).

Peer debriefing was also used to assist in establishment of the credibility of this study. Peer debriefing is described by Lincoln and Guba (1985) as "a process of exposing oneself to an interested peer in a manner paralleling an analytic session and for the purpose of exploring aspects of the inquiry that might otherwise remain only implicit within the inquirer's mind" (p. 308). "The peer debriefer is usually a member of the researcher's professional community, and provides an important 'grounding' of the work in terms of that community" (Geelan, 2004, p. 2). In this study, the peer debriefer was a special education coordinator who participated in the establishment of the assistive technology program. This colleague’s professional experience in special education, knowledge of the assistive technology program, and relationships with the potential participants made her an ideal candidate for the function of peer debriefing in this research study.

### *Dependability and Confirmability*

Lincoln and Guba (1985) suggested that the dependability of qualitative research can be “enhanced by conducting an inquiry audit” (p. 317). To establish dependability, an auditor examined the process by which the various stages of the study were conducted. To establish confirmability, “the researcher should keep a detailed record which would allow an auditor to check stage by stage on the research in order to certify that the conclusions are justified” (Bassey, 1999, p. 77). In order to verify the conclusions of this research, the researcher kept a journal so each stage of the research process could be identified, followed, and acknowledged by the auditor. The auditor of this study was a special education coordinator, a colleague of the researcher who was directly involved in the implementation of the assistive technology program since its commencement. Implementation of a checking process throughout the stages of research lent itself to the trustworthiness and confirmability of the results of this inquiry.

### *Reliability and Validity*

The reliability and validity of the MALS questionnaire was established with confidence in a variety of settings. GL Assessment (2008) explains that

perfect reliability is represented by a reliability coefficient of 1.0, but in practice this is never achieved although figures upwards of about 0.85 are commonly obtained (GL Assessment, 2008).

Validity is described as “measuring what an assessment claims to measure. Evidence may be presented in various ways. Satisfactory correlations with other assessments of the same abilities or skills; or with teachers’ estimates of their pupils’ abilities; or with the pupils’ subsequent achievements such as their results in public examinations (GL Assessment, 2008).” Validity was established for the MALS in two ways: using face validity and concurrent validity.

Face validity refers to:

Whether or not the scale makes sense to those who would actually use it. This ‘face validity’ was established by asking students if they understood the items statements and whether or not those statements were meaningful with regard to how they saw themselves as learners in school. Concurrent validity is measured by examining how well a new scale correlates with well-established measures about which other sound data exists but which are not likely themselves to be completely suitable for the purposes to which the new scale will be put. This measure of validity was completed when the standardization sample of the MALS also completed the Connell Children’s Perception of Control Scale. This scale has been found to be statistically very sound, and covers some of the same issues to which the MALS is devoted (MALS Manual, 2000, 9-10).

## CHAPTER 4: WITHIN CASE AND CROSS CASE ANALYSIS

In this chapter a description of the setting and situational context of the AT program will be provided. The case studies are presented in their entirety, including an outline of the students' participation in the AT program, the impact of AT on class performance and the standardized test scores, and assistive technology and self-esteem. In each case, the themes are presented and analyzed. Following this presentation of data, cross case analysis provides teacher perceptions of the students' participation in the AT program prior to and after their use of AT. Themes are then discussed relating to AT and class performance and AT and self-esteem.

### Setting and Situational Context

The students in this study attended an International School with 230 students from over 34 different countries. The curriculum was based on the British National Curriculum, both the IGCSE (International General Certificate of Secondary Education) and IB (International Baccalaureate) programs were offered. The two participants were selected for this study from the Form 1 class, which would equate to a grade 6 level in the Ontario school system.

Before this study began, I had developed an assistive technology (AT) program at the target school in an effort to address some of the learning needs of its students. This program was used with 14 students who were formally diagnosed through psycho-educational assessments as having learning disabilities. In the AT program, the students used laptops with specialized software programs: Kurzweil, Co-Writer, Write Outloud, Inspiration, and Lexia to assist them in accessing the curriculum at their particular grade level. The purpose was to enable students to show what they knew by using software that assisted them in bridging learning gaps that they were experiencing. It had been in place for two years before the study began. By that time, the students and I had established a connection, and a level of trust. In September 2006, after



agreeing on terms and conditions of program participation, Student A and I began our working relationship. Student B joined the program in May 2007.

As the teacher running the AT program, I provided all students with direct training on how to use the hardware and specialized software on their laptops over a series of specific lessons. This was done while providing the students with structured lessons to support their individual learning needs. Eventually, the students were taught to integrate the use of the technology with the completion of expected tasks, as assigned by the classroom teacher and I. The final goal was to have the students be able to be fully independent in the use of the AT and the completion of their expected tasks.

The 2 case studies will be presented individually, first as within case studies, and then compared in a cross-case analysis.

#### *Case Study One- Student A*

At the onset of the study, Student A was a 10-year-old boy of French nationality. He and his family had relocated to facilitate his father's career. He was a first year ESL (English as a Second Language) student just beginning to learn English.

Student A's past educational experience in the French national education system had been problematic. His parents realized that he had not been able to follow the curricular expectations of the French system and he had been held back a year. Psychological testing confirmed that he had a learning disability, Dyslexia. He had not had an affirming previous educational experience.

My work with Student A in the AT program started when he came to the school in 2006. He had been in the program for 2 years at the time of this study. This student had arrived as a new 'French speaking' ESL (English as a Second Language student) with the further

complication of having a learning disability. Our introduction was made in hopes that I could provide some support to him in his learning.

*Outline of student A's experience in the AT program.*

Student A recalled why he began using the assistive technology. "I think it was because I wasn't that good in remembering things, in some reading, and ya..." Student A's mother also remembered:

He was suffering from Dyslexia, and he had difficulties especially in spelling but I think the reading was also very difficult. He couldn't read correctly. He had no problem to understand what he reads, but he has problems to read, so he was quite slow.

Student A had adapted quickly to the technology. His mother said, "At the beginning he used the computer very easily. He was very happy to use this technology because it's very attractive and he compared it to a game."

Student A shared, "At school, I was the first one. I had the scanner and the printer behind me." He continued, "When I had a test, I could scan it and do it on the computer. Or, when I would actually have a spelling test, or to read things." He listed a few examples of how he used it: "reading, learning new words, getting to know more about computers...also how to remember lists of words, longer ones...trying to make less mistakes in my writing."

He was pleased to be able to use the technology:

It was better using the technology than doing by myself. I think it was better when I had the computer to work with because if I didn't know a word I could just ask it to read it for me. And it would do it, just like how you would spell; there would be spelling checks.

Overall, student A shared, “Before I had the computer, I had not such good results than without the computer because with the computer, it was like I had a second brain or something... It was pretty nice to work with.”

A class teacher commented

I can think of a particular student (Student A) who came from a really low experience in a standardized program with no attention to special educational needs who constantly struggled and had developed a history of difficulties, low self-esteem and evasive tactics personality wise, character wise, and the student and the parents were frustrated in general. With the introduction of Assistive Technology, within a short time, the student was able to access far more of the curriculum, and over the period of a year and a half, became a different child. He was able to show and demonstrate his intelligence, and abilities, and his interests. He was also able to participate with the other children in the class. I thought that having a child in the class with a laptop might be a negative thing because he is perceived as having a special disability, and in fact, it had the opposite effect. The child was able to use the computer that the other children were interested in and he became a leader of information gathering and discussions. (Transcript 7, Teacher 4)

Student A’s mother thought that AT helped her son in completing his schoolwork in several areas: 1. “The software could read the story for him and make it a lot easier. 2. The computer helped him to “build a story and to write sentences, which was a good help to organize his own ideas.” 3. “He did a lot of progress in spelling. 4. I think it has helped him with comprehension at school. and, 5. He wrote faster what was written on the blackboard.” Student A’s mother described how she thought her son “worked more using the technology,” because “it

seemed to be easier, so he could work more.” She added that he had a good attitude about using it; “he was responsible for the material because we told him it was an expensive computer.” She used words like ‘mature’ and ‘careful’ to describe her son’s use of the equipment. Student A’s mother explained how he was likely to “be famous in his class because he had the laptop; the other students were very interested and they could also participate on work in a team with him, so he felt very proud.” She continued to describe how he now had good self-confidence as compared to his work before the technology.

One teacher added,

I can think of one student (Student A) with his reading. It would usually be a real struggle for him. It would take him forever to get through a piece of written text. And now, he can scan it and listen to it and he can show us what his true ability is and he is able to understand a lot of. (Transcript 5, Teacher 1)

She continued

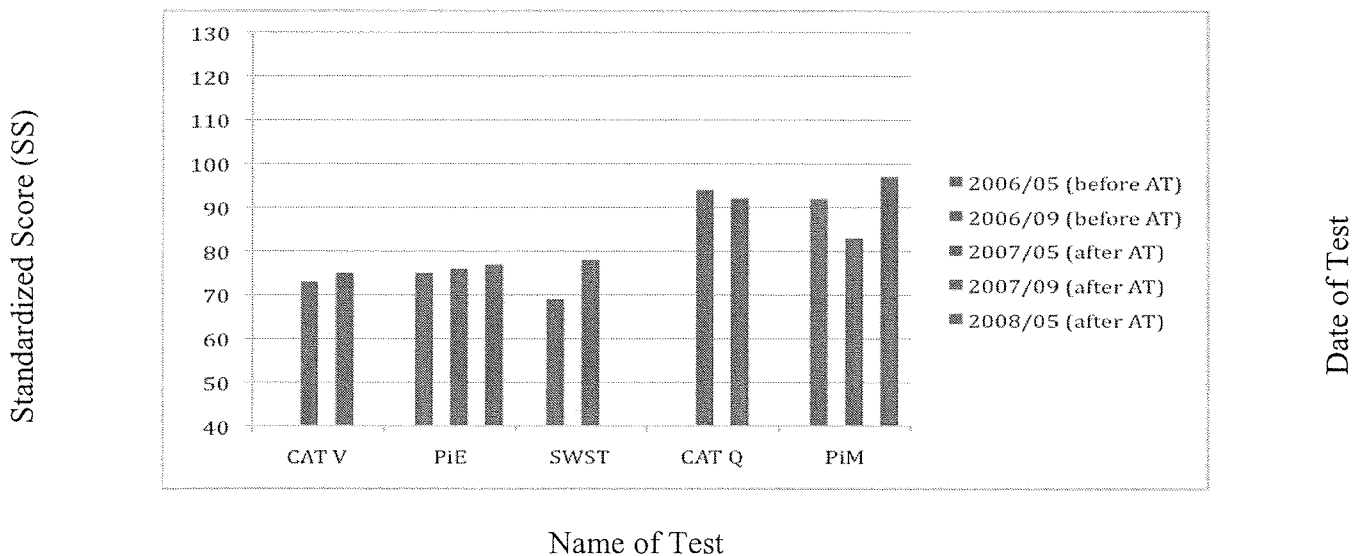
He couldn’t succeed previously because it took him so long to decode all this text that the whole comprehension was out the window. Now he is not held back by it at all and he can actually perform at a high level. (Transcript 5, Teacher 1)

His mother outlined how her son “needed time to adapt to using the new technology.” She shared that sometimes he felt it was easier to take out the pencil and paper; “but when he was starting with the computer, for example, writing a text or a story, he realized it was easier to change one word for another one...and after a while he realized he would get better results from the computer.” She thought he was able to finish tasks using the computer as compared to previously “stopping work before the task was finished.”

*Impact of AT on class performance using standardized test scores.*

The academic standing for this student was assessed by examining the scores the student achieved on the standardized test prior to the AT intervention and at the time of the study. When the first test was taken May 2006, the child had just come to the school. He had just begun the AT use and continued on a regular testing regimen conducted within the school for all students.

The following standardized test scores were collected from the student records of Student A spanning 2 school years including the time frame from May 2006-July 2008. Testing was conducted in regular intervals. In all tests, the standardized score of between 90 and 110 is considered average, as can be seen from the data in Figure 1.



*Figure 1.* Academic performance of student A

The CAT V (Cognitive Abilities Test Verbal), PiE (Progress in English), and SWST (Single Word Spelling Test) were placed adjacently in Figure 1 to depict potential improvement in the area of language related subjects. Student A's performance in these tests was of particular

interest given the formal diagnosis of Dyslexia, which translates to the following possible difficulties:

Dyslexic learners are likely to have some or several of the following difficulties to differing degrees: decoding and spelling, letter recognition, poor short term or working memory, difficulty with sequencing and organization, problems achieving automaticity or fluency of skills, and directional confusions. (Department of Children, Schools and Families (DfES), 2007)

In the SWST, Student A's initial score in May 2006 was 69. Subsequent testing in May 2007 was 78. This improvement in spelling scores may point to a role played by technology in the academic results attained by this student. The ongoing exposure to the spell check function of the computer helped to reinforce proper spelling of words. The practice and repetition potentially assisted Student A in learning to spell better.

Over time Student A showed slight increases in: the CAT V, 73 to 75, and the PiE 75,76, 77. The expected levels for students in this age range fall in the scoring area relative to the normative curve, that being from 90 to 110. Although Student A did not achieve results in the 'normal range', he did show some improvement, especially in the area of spelling. In Mathematical results, Student A showed a slight decrease on the CAT Q when tested in September 2006 (94), and when retested in September 2007 (92). In the other Maths scores May 2006, (scoring 92), May 2007 (83), and then in May 2008 (97) there was a dip in scores followed by slight increase as indicated by the latter result (2008).

#### *AT and self-esteem.*

This section of the data presentation considers the relationship between assistive technology use and self-esteem referring to information collected from the one-on-one

interviews with Student A, and his mother relating to his classroom experience using assistive technology and how it impacted him.

Student A thought that using assistive technology helped him in completing his homework but there were also drawbacks: “Sometimes yes, and sometimes no. Sometimes I couldn’t really do some math work. When the teacher gave me the work, it would be a little more complicated because I would have to scan.”

He indicated that it was most helpful for reading, and described how in library time he was able to scan books and still have them in his computer afterwards. His mother reported that it hadn’t helped him because “ He didn’t really use it for homework”.

Student A described school as being “boring at first, because it was in English, and I didn’t really understand the language. And when I got the computer, I started to learn with new technology. I’ve actually been able to just get on with my level.” Student A continued and described one of the programs specifically.

Like with Lexia, it’s a pretty good program. I’ve been able to go from levels to levels by doing all the exercises, by understanding it. If I made mistakes, it would ask me to redo it. Or, if I didn’t understand, I could just ask again.

He felt that the assistive technology had an impact on his motivation to do his work. Student A’s mother supported the statement:

When he prepared something with just the paper and pencil, he is always a bit disappointed because it didn’t look very nice. But, when he printed it on the computer, it looked great...and the teacher was always happy with it. Definitely it is better.

When discussing Student A’s aspirations, he was asked if using the technology had improved his hopes for the future. He replied,

I think ya. I want to be a person that is travelling around the world in my future. Like I would go to another country to sell this kind of product. Sort of like a businessman or something like this. And usually with businessmen, they know how to speak English. And with this, I might get my dream closer.

Similarly, Student A's mother said,

Before he thought he did not perform very well at school so he thought he would do a job like a chef or I mean with a short time at school. And now, he has changed his mind. He thinks things are more possible because he is good with the computer. He is good in English and he learns many things about life and about himself. He changed his mind and he is expecting more in his life.

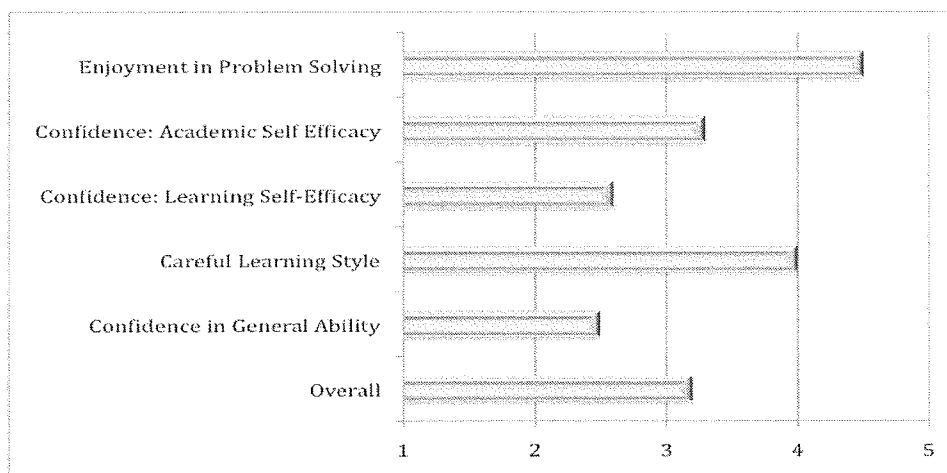
Regarding confidence, when I described it as the way you feel about yourself as a learner Student A responded, "I think it (the use of the AT) made me feel better...because it actually gave me a bit more hope to not like redo a class." He added "cause with the computer, we know we can take most of our time by thinking because when we have our test in front of us we have to write. I found it stressed us more than with the computer." Student A's mother thought he "grew up in self-confidence. He is very capable and he can do many things."

When asked how using the assistive technology impacted his feelings about himself, Student A replied, "a bit more happy to know I am like learning new words in a different language in a different country. And the people can help me, and my computer can also help me." His mother concurred, "He is feeling very well now, and having a laptop, it was a bit like his Dad. His father works a lot with a laptop, not only a laptop but a computer. And he felt the same, that he was able to use it as his Dad." Student A's mother concluded the interview by adding "I think it is good for him because he knows that with a computer he can get a new life."



The following paragraphs will outline for the reader how learning disabilities and self-esteem interrelate via the presentation of the MALS questionnaire results of Student A. Student A's responses during the interview indicated that he felt that the AT had been beneficial for his self-esteem. No comparative data was collected prior to the use of the technology but the MALS, the Myself as a Learner Scale indicates that the child had a positive sense of self-esteem at the time of the study in June of 2008. The Myself as a Learner Scale (MALS scale) consists of 20 self-referring statements to which individuals are invited to respond in a positive, negative, or neutral manner" (MALS Manual, 2000). The scale ratings of the MALS Questionnaire range between 1-5; the 1 meaning definitely not true, the 2-not very true, 3-not sure, 4-a bit true, and 5-definitely true. It is broken down into 6 sections. The results in each section are provided in Figure 2.

Overall, the six sections of the MALS questionnaire depict information regarding the individual's enjoyment in problem solving, confidence about school work, confidence about their learning ability, the level of their taking care with their work, and confidence about their general ability. The scores reported below indicate the individual's self-perception regarding their academic self-concept. (MALS Manual, 2000)



*Figure 2.* Student A's MALS questionnaire results

Student A's total MALS score was 64 where the national average score range was 60-82 with a total possible score of 100. This score in the average band suggests that Student A felt 'average' in terms of his self-esteem after participating in the assistive technology program.

Via the questionnaire results, Student A stated that he liked to have problems to solve and that problem solving was fun. He shared that he needed lots of help with his work but that he didn't find schoolwork difficult, he knew what to do when he got stuck on work, but at the same time, learning was difficult.

Student A specified that he was doing well on tests, and that he was clever. His response was not so positive for liking having work to do and knowing how to solve problems that he met. He indicated that he usually thought carefully about what he had to do, and that thinking about his work helped him to do it better. In general, Student A stated he didn't like using his brain.

Overall Student A thought that he was good at discussing things, he felt reasonably confident in doing his work, he didn't get anxious doing new work, and that he could solve problems. Lastly he noted that he didn't know the meaning of a lot of words.

*Theme identification and analysis.*

The case study of Student A began with a description of his need for assistive technology outlining his inability to access the curriculum prior to its use. He was instructed and trained in how and when to use the specialized equipment. The themes that emerged from the analysis of Student A's case were related to his perceptions of the program and his performance in it.

Student A: a) Enjoyed using the computer, and b) Felt it made him a better student. His mother thought that: a) Some specific skills were augmented using his computer, b) There were some social aspects of the computer use, c) Computer use impacted his self-esteem, and d) He was able to complete tasks he would once have not been able to complete with confidence. Student A's teachers contributed that he: a) could access more of the curriculum, b) had become a different child, c) could show what he knew and perform at a higher level, and d) became a leader for other students.

Student A's testing results show little gains in standardized test scores which would indicate insignificant improvements in most areas, with a possibility of improved spelling capabilities. In the opinion of the participant, AT use impacted his motivation to do his work and his confidence, he also felt that it had an impact on his self-esteem. The MALS scores suggested a self-concept in the average range upon completion of the AT program.

*Case Study Two: Student B*

The second case study was that of a 10-year-old girl, Student B. Born in China, she was adopted by a Dutch family. She was raised in China until, when she was 5 years old, her adoptive family returned to the Netherlands to live permanently. Student B's mother tongue was Dutch but she also spoke Mandarin Chinese and English. Student B had some learning issues.

Her previous educational experiences were in Hong Kong where she attended an International School.

When her family relocated to the Netherlands, Student B attended a DIPS school (Dutch International Primary School), with instruction provided in English. Student B's learning scenario was more complicated than a regular student; she had previously been diagnosed as having Dysphasia. Dysphasia, a member of the 'Aphasia' family of language disorders is less well known in comparison to Dyslexia. Aphasia can be defined as "an impairment of language, affecting the production or comprehension of speech and the ability to read or write" (National Aphasia Association, 2007). Wood (1960) describes Dysphasia "as a disorder of spoken language either in its reception or expression" (p. 15). Hicks (2007) added to this definition by explaining that Dysphasia "is an impairment in communication. It can involve an inability to speak with fluency or sometimes to understand others." (§ 1) In the classroom, individuals with Dysphasia may have:

Difficulty discriminating between sounds, understanding word meaning, comprehending written word, and discerning complex sentence structures. Problems can arise regarding recall of words, and using language correctly in context. (Tyquin Group, 1999)

Student B was a diligent worker both in class and with the Special Educational Needs teacher. The course of this working relationship lasted from May 2007 until the data collection of this study in June / July 2008.

*Outline of student B's experience in the AT program.*

Student B started using assistive technology when she was in primary school. She shared that the main reason why she was using it was it "helps us understand the work". She explained

that she mostly used it for the subject language and homework, mostly for writing. Her mother recollected that:

(My) Daughter was already diagnosed with Dysphasia when she was three years old.

The special needs teacher helped my daughter. Then you brought in Assistive Technology and we really believed in it. It is part of the world around us; my daughter was really capable of using the technology.

Student B thought that using the assistive technology helped her “a little bit” in completing work for her classes. She shared that when the teacher marked the work that she completed using the assistive technology, she usually “got a good mark”. Student B’s mother described how they “scanned all the textbooks in the summer. She used it to go through the texts, through the words that she didn’t know. It was kind of forward for her...it worked really well.”

Student B’s mother described how her daughter made her own choices about which programs and resources she used for what purpose:

She was completely independent in doing things. It also gave her a kind of instrument that helped her through. After the first months, I noticed that she could also do it sometimes without the technology . . . (She) sometimes skipped the use of the assistive technology because she said ‘I can do it quicker when I do it in my way’.

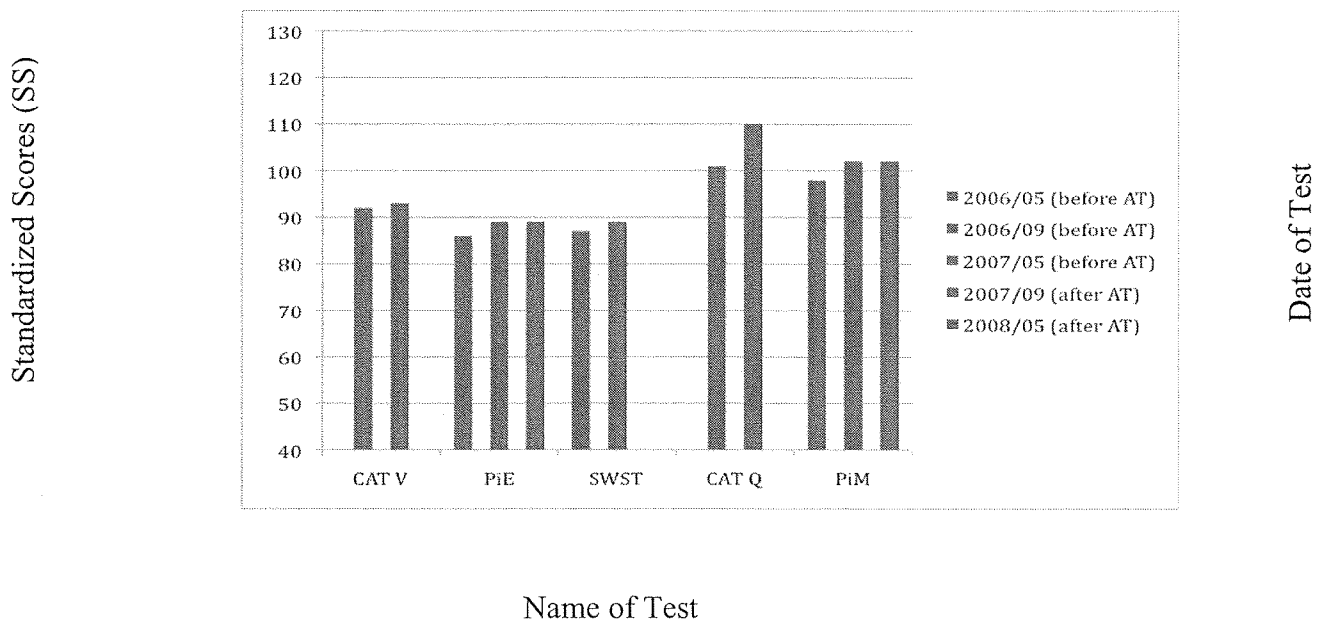
Overall, Student B’s classroom experience was positive when using the assistive technology; it was “easier to meet curriculum expectations using the technology”.

Student B’s mother described how “she had to bring the computer back and forth, and in one sense, she was very proud of it. She didn’t really care about having special treatment.” Her

mother thought using the technology made “it easier to meet the curriculum expectations, giving her more confidence.”

*Impact of AT on class performance using standardized test scores.*

The following standardized test scores were collected from the student records of Student B spanning 2 school years including the time frame from May 2006-July 2008. As with Student A, testing was conducted in regular intervals and testing results below are noted in SS, standardized scores based on the scoring system used related to the normative curve. A score between 90 and 110 is considered average.



*Figure 3.* Academic performance of student B.

The CAT V (Cognitive Abilities Test Verbal), PiE (Progress in English), and SWST (Single Word Spelling Test) have been placed adjacently in Figure 3 to depict consistency of scores in all areas of related subjects, and potential improvement in scoring. Student B’s performance in these tests was as follows: language related tests: CAT V (Verbal), 91,92, and

93, the PiE (Progress in English), 86, 89, and 89, and the SWST (Single Word Spelling Test), 87, and 89. In the mathematics related tests, Student B showed little improvement on the CAT Q (Cognitive Abilities Test Quantitative), and PiM (Progress in Maths): CAT Q, 101, 101, 110, the PiM, 98, 102, to 102.

In the CAT Q results, Student B's initial score in was 101. Subsequent testing resulted in the same score of 101. The last result showed a gain to a score of 110. This improvement in mathematics scores may point to a role played by technology in the academic results attained by this student. With the ongoing exposure to having assistive technology required to better accomplish organization and planning, Student B would potentially be able to better complete academic tests that involve similar skills; in this case, the CAT Q. This practice potentially assisted Student B in performing better on this test and attaining a higher result than previously.

#### *AT and Self-Esteem*

This section of the data presentation considers the relationship between academic performance and self-esteem referring to information collected from the one-on-one interviews with Student B, and her mother relating to her classroom experience using assistive technology and how it impacted her.

Student B communicated that using the assistive technology helped her with her homework, although she wasn't sure if using the technology helped improve her feelings about school in general. Her mother said it helped with homework "especially in the first four or five months... it contributed to the way she wanted to do her homework. It is an instrument for children nowadays also that it's not 'very special'." She said that for her daughter, "it was a very useful instrument."

Student B didn't think that the technology had much impact on her motivation to do her schoolwork but she thought that it had increased her hopes for the future "a little bit".

Student B's mother said that there were two periods: the first when she was really using the technology a lot, and then a transition time. The transition time that Student B's mother referred to was a period of time whereby Student B determined how and where the use of AT could be applied to her work. This was done independently. "At first, it was a kind of system for her, very useful because she knew exactly what to do. She worked very independently with it." In the transition phase, she used it "at moments she needed to, and for other work she had to do for the other assignments, she preferred not to use it." Student B's mother thought that her daughter had shown a preference for her own learning needs. "One of the very important effects of using the technology was she learned more about herself as a learner, decided when she needed it, and could distinguish between when she needed it."

Student B wasn't sure if using the assistive technology had an impact on her confidence level, however she did acknowledge that using the assistive technology did make her feel "a little bit better" about herself. She added "because if we get work from the teacher I know that the computer will help you....and you don't have to ask your parents even though they're not home." She described how it made her more independent. Her mother concurred; "I think it was a good impact on her confidence. I think together with the great support she got from the special needs teacher. I think that it all goes together." She added "and then the best equipment that you can have including the state of the art technology. Something like Kurzweil is an amazing program."

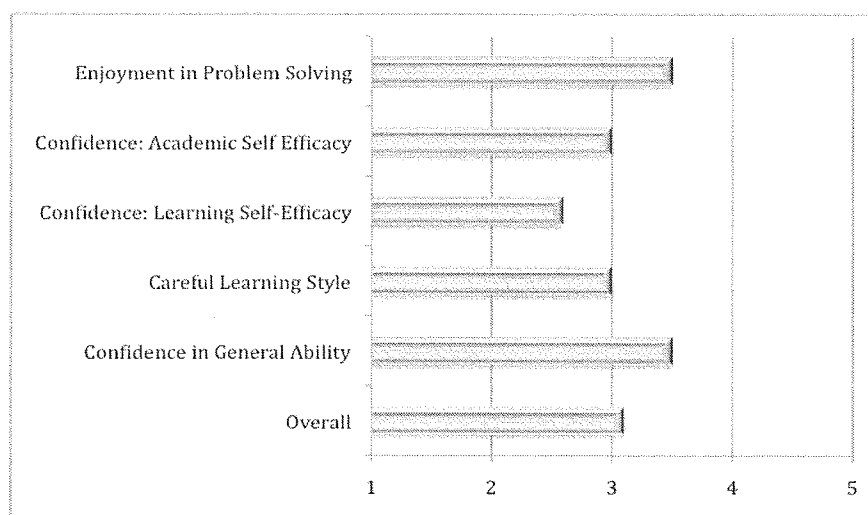
When describing if using the assistive technology had an impact on her child's hopes for the future, Student B's mother responded,



Yes, I think so, and I think when I give this answer I think about the Assistive Technology but I also think about using the computer at home. In general, it really helps her. I think it is amazing how she can go between levels and just check if she knows it, or check in the dictionary if I know this word or not.

When considering whether or not using the assistive technology increased her daughter's feelings of self-esteem, Student B's mother responded that "yes, I can be positive."

The following paragraphs will outline for the reader how learning disabilities and self-esteem interrelate via the presentation of the MALS questionnaire results of Student B. As part of the data collection for this study, Student B completed a questionnaire called the MALS, the Myself as a Learner Scale. The scores reported below indicate the individual's self-perception regarding their academic self-concept. (MALS Manual, 2000)



*Figure 4.* Student b: Results of MALS questionnaire

Student B's overall score was a 3.1 out of 5. Her total MALS score was 61, where the National Average Score Range is between 60-82 Student B's score was just into that 'average' range.

Student B indicated that she enjoyed having problems to solve and that problem solving was fun. She said that she didn't need a lot of help with her work, but that she had difficulty working out what to do next if she got stuck in her work. She wasn't sure if learning was difficult or not.

Her confidence in her learning ability was not strong. She thought that learning was easy and that she was clever. She felt she was good at doing tests, and liked solving problems and doing difficult work. Student B shared that she didn't usually think carefully about her work, but she understood that if she did think carefully, it might help her do her work better. She indicated that she knew how to be a good learner, but wasn't sure if she liked using her brain.

Overall Student B felt confident in doing her work, she did not get anxious, and she felt she was good at solving problems. She wasn't sure if she was good at discussing things, and most notably, she shared that she didn't know the meaning of a lot of words.

*Theme identification and analysis.*

Student B a) enjoyed using the computer, b) felt that it helped her understand her work, and c) felt it helped her get good marks. Her mother thought that using the AT a) made her daughter more independent, b) improved her access to the curriculum, and c) gave her more confidence. Student B's academic results were consistent despite the increased complexity of curriculum. AT was used to help Student B complete her homework, and the participants suggested that it provided assistance in increasing her hopes for the future. Her mother felt that she was more independent and confident as a result of the AT use.

### Cross Case Analysis

Creswell (2007) described cross-case analysis as "examining themes across cases to discern themes that are common to all cases" (p. 245). The cross case analysis will begin with

the results of interviews with the children's teachers in which they were asked to describe the students and their attitudes and abilities before the introduction of the AT program and at its conclusion at the time of this study. Teacher interviews will provide a framework for the cross case theme analysis of 1) AT and Classroom Performance and 2) AT and Self-Esteem.

### *Teacher Perceptions*

In the following paragraphs, the perceptions of the teachers who interacted with Student A and Student B will be discussed both prior and after their use of assistive technology.

#### *Prior to Using Assistive Technology*

In June of 2008, interviews were conducted with 6 teachers, some in pairs of team teachers and some individually, as a part of the data collection to support the case studies. Teachers were interviewed following the implementation of the AT program to gain insight into their involvement with the 14 students both prior to and after using the technology. The teachers described their initial impressions of the students:

The students were very self-aware of their problems. They did not want to participate in class and needed a lot of support. Overall, the students were more insecure in general.

Sometimes they did not want to participate in class. (Transcript 6, Teacher 3)

One of the class teachers said, "You can see symptoms, or characteristics, the kind of thing that might indicate a learning disability" (Transcript 8, Teacher 6). Another teacher described the students as experiencing difficulties and displaying "escape tactics, task avoidance, inability to pay attention, clowning around, and other such activities to distract from the difficulties they were experiencing to approach their work." She continued by describing the students as "almost shy, sort of evasive, not participating as much as they might; generally not very confident learners" (Transcript 7, Teacher 4).

Before the AT began teachers were unsure of how the students were meeting classroom curriculum expectations. Several teachers thought that when the students spoke the teachers knew they had the information, but the students could not convey it through the regular approach of curriculum delivery. Consensus from the teachers was that the students needed many strategies to do their work including “using a clock timer, agenda, and graphic organizers.” The students needed “extra support, and help with organization” (Transcript 8, Teacher 6). Some of the students were described as “having language barriers, and not able to do memory work” (Transcript 7, Teacher 4). The special education teacher shared that she thought “they could not perform up to the level of the expectations simply because of the difficulties in accessing the prerequisites of skills that were necessary before they started the actual assistive technology program” (Transcript 5, Teacher 2). In addition, a class teacher shared that “the students didn’t have the skills to put it down on paper. Like some of them needed help with memory and mnemonics; strategies for remembering things” (Transcript 8, Teacher 6).

The teachers agreed that prior to the introduction of the AT program the students could not keep pace with the rest of the class. One teacher said, “Often a separate activity or program had to be provided” (Transcript 7, Teacher 4). Another teacher said “I had them do the same work, but with different input from the teachers or with help from other students” (Transcript 5, Teacher 1). She continued that “you try as a teacher to move along with the core group of the class, but these students need extra instruction, they need more tools to help them do, to do the same work” (Transcript 5, Teacher 1). In one particular student’s case, the class teacher shared that “before the assistive technology, you could see dismay, frustration, mainly frustration.” She continued,

You could very often see that if he didn't get the extra help or if you didn't give him the extra guidance to start off, he is lost and he will sit there. If you let him, he would sit there for hours; nothing would get accomplished. (Transcript 8, Teacher 6)

When we spoke about homework, the situation was similar. The quality and quantity of homework was also of concern to the teachers. One teacher stated, "Less homework was being turned in. The work was often of a lower quality, not very well organized, and sometimes not done or handed in at all" (Transcript 5, Teacher 1). Another shared that "homework was always a struggle; there was often excuses, poor quality work, not fully finished, difficulty with sort of, coming up with reasons why it couldn't be done, or lack of understanding. There was a very low success rate in terms of homework content and what was accomplished" (Transcript 7, Teacher 4). Another added, "Often it was handed in on time, but not always completed properly enough. The things that we were looking for were not always there" (Transcript 8, Teacher 5). Conversely, the special education teacher thought that there was a big contrast between SEN (Special Educational Needs) intervention and the classroom. She felt

The children I did have were functioning well with homework. It was because parents were often aware of it, of their problems. The homework was geared exactly to the program that the particular child needs. In the SEN department, you can be far more specific. On a one-to-one basis their homework was satisfactory." (Transcript 5, Teacher 2)

The teachers concurred that before using assistive technology the students needed more help. "They got more guidance, either from the teacher or from one of their peers" (Transcript 6, Teacher 3). Most teachers thought that SEN had given them suggestions and strategies of how to help them in class. Teachers described some of the supports they offered the students:

“providing clear instructions, schedules, calculators, graphic organizers, agendas, clocks, etc”  
(Transcript 8, Teacher 5).

This was the situation prior to the implementation of the AT program. I will now discuss the comments of the teachers following the conclusion of the assistive technology program.

#### *After Assistive Technology*

Teachers contributed that “the Students (A and B) used assistive technology for the writing / editing process, for research, for looking up vocabulary, for playing mathematical games, for sharing information with others, for all kinds of research opportunities.” (Transcript 5, Teacher 1) (Transcript 7, Teacher 4). Teachers mentioned specific programs such as Kurzweil and Kidspiration as having been used by Students A and B to “visualize for them and break reading down into steps. It can read step by step. It was like having a model reader.”

Their teachers felt that Student A and Student B “were not held back as much by their problems. The amount of work had increased as well as the level.” Teachers shared their opinions regarding the specific learning issues that assistive technology use made easier for Student A and Student B. The special education teacher stated that

I think the spelling and access to the correct spelling saves a lot of time for the children otherwise they would be fumbling around through dictionaries and thesaurus but this way, they can recall that information, and edit it on the computer straight away.

(Transcript 5, Teacher 2)

She added,

I think the effect on the reading comprehension, and with the use of the keyboard, they are becoming a lot more visually aware of spellings, and I think it has also helped with their decoding.” (Transcript 5, Teacher 2)

The teachers agreed that the students in question appeared to feel better about their school experience. They described these students as having increased confidence, pride of accomplishment, positive work attitude, and the capacity to deal with concepts at a higher level. One teacher shared

They could do things they were so hesitant about before the use of technology and other people actually looked up to them. I think for the students their problem has turned into something positive rather than negative. (Transcript 5, Teacher 1)

The teachers of Students A and B offered their opinions on the effects of using assistive technology on learning. They suggested that Student A and Student B were able to work more independently. For example they stated that using the technology to complete homework “gave them a lot of self-confidence and motivation to do their homework. They had pride in the output, that the work they were able to produce was a much higher calibre than ever before” (Transcript 7, Teacher 4). Homework became a positive experience for them “because they were no longer shy or scared to hand it in” (Transcript 5, Teacher 1). A class teacher offered,

I think it helped the students become aware of their abilities whereas the lack of success in the past, frustrations, anxiety, difficulties were blocking their ability and their own self-realizations of their capabilities. With the technology, it proved to them and to others what they were able to do. (Transcript 7, Teacher 4)

One class teacher offered information that potentially points to the nature of the relationship between the use of AT and improvement in self-esteem.

I think it helped the students become aware of their abilities whereas the lack of success in the past, frustrations, anxiety, difficulties were blocking their ability and their own self-realizations of their capabilities. With the technology, it proved to them and to

others what they are able to do...and even surprisingly so at times. (Transcript 7, Teacher 4)

In light of the above it is suggested that the results of using assistive technology in both Student A and Student B's learning were improved confidence and feelings of self-esteem. The teachers provided additional support for this claim, as there was a unanimous agreement that indeed students using assistive technology felt better about their schoolwork.

There was a sense of pride, accomplishment; they could now do things that they were so hesitant to do before the use of technology, and other people actually looked up to them because they got to walk around with an actual laptop. (Transcript 5, Teacher 1)

Another teacher added that she thought the benefits were "social, emotional, and academic."

(Transcript 7, Teacher 4) The overall conclusion was that the students "felt better about themselves as learners." (Transcript 8, Teacher 6)

#### *AT and Classroom Performance*

The discussion of AT and classroom performance will revisit the students' motivation, in-class performance and standardized test scores.

#### *Motivation*

Both program participants felt that using the assistive technology had an impact on their motivation to do their schoolwork however, Student B felt minimal impact. Both students were more motivated because they saw better results by using the computer (quality of work improved, better organization, neater presentation). Their teachers felt there had been an increase in motivation to do schoolwork. One teacher said that motivation was the most obvious thing she noticed in the students (Transcript 6, Teacher 3). Another teacher shared that the motivation extended beyond the classroom as was associated with "doing their schoolwork, their homework,



the projects they were creating, their blogs, interacting with other students in other international countries, previous friends...” She continued, “The actual task of the teacher became to pull back on the enthusiasm and help them concentrate on certain tasks.” (Transcript 8, Teacher 5) The teachers agreed overall that there was a high interest in the use of the technology.

#### *In-class Performance*

Teachers and the students concurred that using the technology helped improve classroom performance. Students felt it was easier to use the technology to show what they knew. Teachers reported that the standard and quality of work submitted by the students had improved. Both students and teachers shared that overall, it was easier for them to access the curriculum using AT.

#### *Student A and Student B’s Standardized Test Scores*

An important goal of the assistive technology program was to assist the students in achieving greater success. Laptops were used to complete the standardized tests but not the specialized software, which might jeopardize the validity of the test results. Even though both the students and their teachers believed that the AT program had that effect of achieving greater success, this was not born out in the standardized testing scores. Specifically speaking, Student A’s Single World Spelling Test results showed that initially he scored a 69, where at the end of the testing realm, he improved to a 78. This was the only area in which there could be any demonstrated improvement. Student B’s performance in the academic tests similarly showed some progress over time with the results: 101, 101, 110.

The perceived improvement in classroom performance of Student A and Student B may yet have had an impact on their academic performance. At the time of this study, there were only slight improvements in Student A’s spelling scores and Student B’s math scores. Student A’s

results suggest that he experienced some progress in spelling. Through the repetition of using the laptop and spell check function, Student A had ongoing reinforcement of proper spellings and of his assigned spelling words. It is suggested that this constant reinforcement assisted Student A in his improvement in spelling scores.

Student B's results suggest that the use of the technology assisted her achieving a higher score in maths. She had previously been diagnosed as having Dysphasia. She had difficulty in communicating orally and in expressing her ideas. It is suggested that the repeated use of the technology assisted her in overcoming one of the barriers, the ability to read and write; expressive language, that she experienced due to her diagnosed disability, which in turn may have resulted in the higher test score.

Research suggests that the use of word processors in writing activities can give students access to spelling and grammatical checks of specific issues, which can typically be difficult for students with learning disabilities (Keates, 2002). Graphic organizer programs can facilitate organizing and planning assignments for students. Having the assistive technology required to better accomplish spelling, organization and planning, Student A and B would potentially be able to better complete academic tests that involve similar skills.

#### *AT and Self-Esteem*

##### *In-class Performance and Feelings about School*

It was suggested earlier that both Student A and Student B experienced improvements in their in-class and homework performance. Student A thought that using the technology helped him feel better about school in general whereas Student B wasn't sure if it did or not. Student A described using the assistive technology as more fun. Student A's mother shared that he worked faster now and had a larger vocabulary.

The students' parents felt the AT improved their children's attitudes. Student A's mother felt that because the technology helped her son complete his work, he had a good attitude about completing it. Student B's mother explained that using the technology allowed her daughter to become more independent, develop her self-confidence, and also gave her the ability to choose when she needed to use the technology to support her learning, and when she did not.

Both students felt better about school as a result of using assistive technology. They believed that it gave them better results, the quality of their work improved and it was more fun. Student A's mother responded with a strong "Yes" when asked if Student A's feelings about school in general were affected by using the assistive technology.

*Use of Assistive Technology and Effects on Confidence and Self-Esteem*

Both students benefitted from participating in the assistive technology program by learning technical skills, improving their vocabularies, and making fewer mistakes in their writing. Student A shared that there had been a dramatic impact on his confidence levels in completing work. Student B wasn't sure she felt stronger as a student or not. Both parents interviewed stated that their child had indeed improved in their level of confidence.

It is suggested that both students experienced a change in self-esteem. Student A was happy to know he had a tool besides other people who could assist him in his schoolwork. Student B shared that using the technology gave her independence from relying on others to do her work. Student A's mother described her son as feeling 'very well now' and Student B's mother was positive about the outcome of using the assistive technology and its impact on her daughter's self-esteem. The teachers who were interviewed shared many examples of how the students had displayed increased self-esteem: the impact on behaviour, a reduction of avoidance

strategies, self-reflection, experiencing a uniting effect, and students feeling powerful about their learning experience.

Student A felt using the assistive technology had really improved his hopes for the future where there were totally new possibilities available now, but Student B described the impact on her future as being ‘a little bit’. Student B realized that using the technology could assist her in doing things she previously might have had difficulty with. Student A’s mother shared that her son now considered more possibilities for his future as a result of his participation in the assistive technology program. Student B’s mother’s response was that she felt her daughter had not only learned how to manage some of her own learning needs, but simultaneously developed technical skills that could be applied to her future.

#### *Discussion of Student A and B’s MALS Questionnaire Results*

As noted previously in the literature review, when comparing mainstream students to those with Learning Disabilities, it has been found that children with LD experience higher rates of poor self-esteem than their mainstream peers (Heyman, 1990; Humphrey, 2002; Lyons, 2007).

The results of the MALS questionnaire indicate that both Student A and B felt average overall in regard to their self-esteem following their participation in the assistive technology program. As noted in the within case analysis, Student A’s total MALS score was 64 and Student B’s total MALS score was 61 where the national average score range was 60-82 with a total possible score of 100. In the previous section, it was proposed that this feeling of being ‘average’ in terms of self-esteem is the result of assistive technology helping the students improve academic performance such that both students showed improved self-confidence.

The data provided in this study indicated that Students A and Bs' academic performance improved whilst they were using AT. It also indicated that Students A and B, their teachers and parents all felt that self-esteem improved as a result of using assistive technology.

### **Conclusion**

The cross case analysis of the two case studies was drawn from an examination of data collected from interviews with each student, their parents, and teachers, standardized testing results of each student, results of the MALS questionnaire, and reference to an existing journal of the researcher. Commonalities were drawn from each case, which provided suggested indices of the nature of the relationship between the participants' school performance, their use of assistive technology, and impact on their self-esteem. Conclusions will be drawn in the final Chapter 5, culminating all data sources and evidence towards the suggested outcomes of this study

## CHAPTER 5: CONCLUSION

This study evolved from a theoretical framework that was based in the research findings that indicated that students with learning disabilities often possess low self-esteem (Smith, 1994; Heyman, 1990; Humphrey, 2002; Tracey, 2006; Lyons, 2007), the use of assistive technology helps students with learning disabilities improve the quality of their work (Roblyer & Schwier, 2003; Hopkins, 2004; Ashton, 2005; Edyburn, 2005; Meiring & Normal, 2005; Sitko, Laine, & Sitko, 2005; Dell, Newton, & Petroff, 2008), and improvements in school performance are associated with improved self-esteem (Covington, 1989; Lewis, 2005). This work proposed that AT-related improvement in the quality of classroom performance might have had a positive effect on the self-esteem of particular students with LD.

Multiple data sets were collected for two case studies (interviews with students, teachers and parents, standardized test scores of the participants, and MALS questionnaire results.). Within-case and cross-case analytical techniques were applied to examine the data sets. The two themes that emerged were related to: (a) AT and Classroom Performance, and (b) AT and Self-Esteem.

### *Theme 1: AT and Classroom Performance*

#### *Before Using Assistive Technology*

The teachers indicated that prior to the development of the AT program, Student A and Student B had obvious difficulties completing their schoolwork and had developed behavioural coping mechanisms to distract themselves from the realization that they were experiencing academic difficulties. Not able to cope with the demands of the curriculum using their own devices, the students were functioning far below what was expected and required a significant amount of support to complete regular tasks. To paraphrase one of the teachers, these students

could not perform up to the level of the expectations simply because they could not access necessary skills. In order to help them meet some of the expectations of the curriculum, teachers provided support to assist them in managing their workloads. Student A required assistive support in reading and for spelling. Student B needed assistance with the organization of ideas when preparing homework and written pieces.

### *On Using Assistive Technology*

Student A reported that he enjoyed doing his work when using assistive technology and his mother shared that he was “more motivated to do his work”. While Student B felt that using the technology didn’t have impact on her motivation to do the work her mother noted that using assistive technology “was very useful for her.”

Both Student A and Student B felt that using the assistive technology in completing their schoolwork was better than doing it without support. Student A described AT as being everything he needed to do his work whereas Student B described how using the technology would assist her in attaining a result of a ‘good mark’.

### *Standardized Test Scores*

During the AT program Student A showed some increases in his spelling scores. His Single World Spelling Test results show that initially he scored a 69, where at the end of the testing realm, he improved to a 78. The same student showed little improvement in: the Cognitive Abilities Test (Verbal), 73 to 75, and the Progress in English Test 75,76, 77.

Student B did not demonstrate overall improvements in performance in the standardized test scores over time. Her Cognitive Abilities Test scores were (V) 91,92, and 93, her PiE (Progress in English), 86, 89, and 89, and her SWST (Single Word Spelling Test), 87, and 89. On the CAT Q math test results, a slight improvement resulted from a score of 102 to 110.

*Summary of Theme 1*

Prior to the AT program, Student A and Student B experienced significant difficulties meeting the curriculum expectations. During their time in the AT program the students, parents and teachers expressed their opinion that through the technology the students experienced greater access to the curriculum, an increase in motivation to engage in school work and improvement in class performance. The teachers noted that Students A and B achieved better results, that they were able to produce more by using the technology and that “they were not held back as much by their problems. The amount and level of their work has increased.” (Transcript 5, Teacher 1)

Specific areas where the teachers noted work improvement included spelling, grammatical structure, reading comprehension, organization and use of active vocabulary and reduction of coping mechanisms (task avoidance).

*Theme 2: AT and Self-Esteem*

*Before Using Assistive Technology*

The researcher observed Student B prior to using Assistive Technology as being “quiet, and reluctant to talk or share ideas.” Teachers described both students as being “more insecure compared to the others,” (Transcript 6, Teacher 3) and felt that Student A and Student B both experienced “frustration as learners, and the lack of self-esteem that goes with it.” (Transcript 7, Teacher 4). In describing her son’s feelings about himself previous to using AT student A’s mother reported that; “he would say ‘retarded’ ...a Dyslexic child can feel like he is good for nothing.”

*On Using Assistive Technology*

*Confidence.*



Student A reported that there had been positive impact on his confidence levels in completing his work. He said that “using AT made him feel better; it gave me a bit more hope not to have to redo a class.” Student B wasn’t sure she felt stronger as a student or not but the parents of both students indicated that their children had improved in their level of confidence. Student A’s mother reported that her son “grew up in his self-confidence and we feel he is a young adult now; he is very capable and he can do many things.” Student B’s mother shared that the use of AT

Had a good impact on her confidence. Together with the great support she got from her teachers; I think that it all goes together... and then with the best equipment that you can have including the state of the art technology.

One class teacher commented,

I think it helped the students become aware of their abilities whereas the lack of success in the past, frustrations, anxiety, difficulties were blocking their ability and their own self-realizations of their capabilities. With the technology, it proved to them and to others what they were able to do, even surprisingly so at times. (Transcript 7, Teacher 4)

Another teacher shared that, “one of the good outcomes is that the students have explored and become risk takers. They are not worried about making mistakes on the computers.” (Transcript 5, Teacher 2)

Student A’s mother suggested that using the assistive technology “helped her son in his ability to complete his work”, and that he had a positive attitude about completing it. Student B’s mother explained that using the technology allowed her daughter to become more independent, develop her self-confidence, and also gave her the ability to choose when she needed to use the technology to support her learning, and when she did not.

*After Using Assistive Technology**Self-esteem.*

Regarding the self-esteem of Student A and Student B, it is suggested that both students experienced a change. Following his participation in the assistive technology program, Student A was happy to know he had a tool besides other people who could assist him in his schoolwork. He also felt using the assistive technology had really improved his hopes for the future that there were totally new possibilities available now. Student B shared that using the technology gave her independence from relying on others to do her work. She added that using the assistive technology allowed her to “not have to ask my parents (for help) even when they’re not home.” According to Student B using the technology assisted her in doing things she previously might have had difficulty with. Despite these realizations, Student B described AT’s impact on her future as being just ‘a little bit,’ and that using the assistive technology did make her feel “a little bit better” about herself.

Student A’s mother was of the opinion that her son was feeling ‘very well now.’ She shared that she thought her son now considered more possibilities for his future as a result of his participation in the assistive technology program. Student B’s mother was positive about the outcome of using the assistive technology and the impact it had on her daughter’s self-esteem. She felt her daughter had not only learned how to manage some of her own learning needs, but had simultaneously developed technical skills that could be applied to her future. It was not surprising then when asked if assistive technology increased her daughter’s feelings of self-esteem, Student B’s mother said, “Yes, I can be positive.” She also said that “I think that it is very important that in the school system, there will be enough supporting staff to give her new ideas on how to use it...to keep on using it. New fresh ideas.”

The teachers suggested that the students displayed increased self-esteem noting “impact on their behaviour, a reduction of avoidance strategies, self-reflection, experiencing a uniting effect, and students feeling powerful about their learning experience.” (Transcript 7, Teacher 4) One teacher shared specifically that “it was not only the motivation but the power they had now (after using assistive technology). The feeling of here I am, I can do it.” (Transcript 6, Teacher 3) Another teacher added that she thought the benefits were “social, emotional, and academic.” (Transcript 7, Teacher 4) The overall conclusion was that the students “felt better about themselves as learners.” (Transcript 8, Teacher 6)

### *MALS Questionnaire Results*

The MALS Questionnaire was collected following the students’ participation in the AT program. It revealed that students A and B felt ‘average’ in terms of self-esteem. In his interview Student A stated, “Before I had the computer, I had not such good results than without the computer because with the computer, it was like I had a second brain or something... It was pretty nice to work with.” Later on Student A shared: “I think it made me feel better...because it actually gave me a bit more hope to not like redo a class.” When asked how he felt about himself after using the assistive technology, he commented, “a bit more happy to know I am like learning new words in a different language in a different country. And the people can help me, and my computer can also help me.” Student B reported that she felt “a little better about herself” after using the AT. She continued “if we got work from the teacher, I knew that the computer would help me.” Student B’s mother shared that her daughter became “completely independent in doing things.” The use of AT gave her “a kind of instrument that helped her through.” Student B’s mother agreed that her daughter had learned more about herself as a learner, and could distinguish how and when she needed to use the technology.

### *Summary of Theme 2*

Prior to using assistive technology, Students A and B had difficulty meeting curricular demands, experienced frustration, and required a significant amount of support to function in the classroom.

Using AT, in the opinion of the students, parents and teachers, led to change regarding confidence, and self-esteem. Student A said “it was quite a bit easier (using the AT) in writing, for example, because there was less stress in doing it with the computer.” He added, “It gave me a bit more hope...it might help get my dreams closer.” Student B wasn’t sure she felt stronger as a student or not. She reported that using the AT “helped her feel a little bit better about herself” and she described how the computer allowed her to do her work more independently.

Following the use of assistive technology, the MALS scores were higher than one would expect for LD students. The opinions of the students, parents and teachers were that AT use was associated with improvement in confidence and self-esteem. When taken together these findings led to the supposition that technology use over the course of the AT program may have impacted the self-esteem of the students.

### *The Relationship between Assistive Technology, Performance in School, and Self-Esteem*

The students, their parents, and their teachers were of the opinion that the use of AT improved access to the curriculum, was associated with increased motivation, and led to improved class performance.

Prior to the AT program, Student A and Student B experienced significant difficulties coping with and meeting the curriculum expectations. They experienced frustration, and required ongoing support to meet classroom demands. AT use was said to impact student

motivation. Student A reported that when using assistive technology, “It was still work, but it was more like fun than sitting at your desk and writing everything down.” His mother shared that he was “more motivated to do his work.” Student B’s mother noted that using assistive technology “was very useful for her.” One teacher shared “there was so much motivation that the task of the teacher becomes to actually pull back on the enthusiasm and help them concentrate on certain tasks.” (Transcript 7, Teacher 4) The students, parents and teachers shared the opinion that the use of AT was facilitative in regard to impacting motivation, resulting in improvements in classroom performance.

The use of assistive technology was also said to provide the students with a tool for learning such that they were better able to complete their schoolwork and show what they knew. As a result, these students experienced greater access to the curriculum. Both Student A and Student B felt that using the assistive technology in completing their schoolwork was better than doing it without support. Student A described AT as being everything he needed to do his work whereas Student B described how using the technology would assist her in attaining a result of a ‘good mark’. Teachers shared that they had observed development and progress from the students, noting that it was “eye opening and surprising...the achievements of the students had improved...they were not held back as much by their problems. The amount and level of their work has increased.” (Transcript 5, Teacher 1)

This finding supports those of Sitko, Laine & Sitko (2005) who reported that students with special needs may feel empowered by adaptive and assistive technology, which can remove barriers and enable them to gain more equitable access to successful learning experiences and accomplish things not thought possible before (pg. 571).

Improvements were seen in daily classroom performance. Student A showed some progress in spelling scores. Student B demonstrated some improvement in the mathematics academic test. The special education teacher reported, “The end of year testing has shown that generally the children (Student A and B) have made progress.” (Transcript 5, Teacher 2)

Theme 2 indicated that the teachers, parents and students thought that the use of AT led to improvement in confidence and self-esteem.

Both students reported increases in confidence. Student A’s teachers reported AT had a positive impact on his confidence level in completing work. Student A was happy to know he had a tool besides other people who could assist him in his schoolwork. Student B shared that using the technology gave her independence from relying on others to do her work.

Self-esteem, that is, the “attitude you have towards yourself, how much respect one has for oneself, and what an individual sees as their personal self-worth” (Perera, 2003, p. 1) was also improved. Student A’s mother described her son as feeling ‘very well now’ and Student B’s mother concurred that she was positive about the outcome of using the assistive technology and its impact on her daughter’s self-esteem. The teachers shared how the students had displayed increased self-esteem by way of: impact on behaviour, a reduction of avoidance strategies, self-reflection, and feeling powerful about their learning experience.

Collectively, teachers felt that the AT experience had been positive. The special education teacher relayed “one of the good outcomes is that the students have explored and become risk takers. They are not worried about making mistakes on the computers.” (Transcript 5, Teacher 2) Another teacher added that she thought the apparent and foremost benefits of participation in this program were “social, emotional, and academic.” (Transcript 7, Teacher 4) The overall

conclusion of the teachers was that the students “felt better about themselves as learners” (Transcript 8, Teacher 6) after having used assistive technology.

The literature supports the finding of a symbiotic relationship between confidence and self-esteem: “you can’t have one without the other” (Perera, 2003, p.2). Covington (1989) suggested:

As the level of self-esteem increases, so do achievement scores; and as self-esteem decreases, so does achievement. Furthermore, and perhaps most important, it is concluded that self-esteem can be modified through direct instruction and that such instruction can lead to achievement gains. (p.1)

Lewis (2005) agrees with Covington stating that one of “the benefits of using assistive technology is that students’ self-concept improve” (p. 326). The Independent Schools Inspectorate in England (2009) adds, “As self-esteem and confidence develop, pupils become more articulate, confident in asking questions and able to develop study skills and strategies appropriate to their individual learning needs. Their achievement improves in many curriculum areas.” (p.1)

The opinions of students, parents and teachers reported in this study conform to this body of work. The use of AT may have influenced the self-esteem of students A and B such that they recorded ‘average’ MALS scores instead of the low self-esteem scores that LD students could be expected to report. In a similar manner, the opinions and supportive research connected AT use to self-esteem as follows: assistive technology helped to improve motivation and class performance and test results of students A and B. These improvements had a positive impact on perceived confidence, and self-esteem.

The researcher concurs that the students were successful using the AT and agrees there is potential for future use. Although the standardized test scores of the two students did not confirm that there had been an appreciable improvement in academic performance, the in-depth interviews with the students, their parents, and teachers indicated a perception of improvement. Further, the interviews and the MALS questionnaire (that measured levels of self-esteem) indicate that AT use impacted the students' perceptions of their self esteem such that they were more willing participants in school activities, improved their status among their peers and made them optimistic about their future academic achievements. These results support the use of AT whether or not it improved standardized test scores.

#### *Implications for Practice*

In general, Students A and B shared that they enjoyed working with the assistive technology. When interviewed, they revealed they were able to utilize the technology to support their learning needs. They were successful and this success was apparent in their academic performances. They felt good about themselves. The teachers reported that the experience had been very positive and agreed that there was potential in using assistive technology for students with learning disabilities. The opinions would seem to encourage greater implementation of AT in schools to support students with different learning needs. Additional funding, training, and access to the necessary tools would help to facilitate this.

#### *Implications for Research*

This investigation into the use of assistive technology suggested that the technology helped to improve class performance and motivation, which had a positive impact on academic results. The perception of improvement in confidence self-esteem is said to be related to the improvement in academic performance. The design of this research project was such that the



researcher could not directly confirm that improved class performance impacted test scores. Future research to investigate this matter is required.

Higher self-esteem than was expected of LD students was recorded in the students' MALS questionnaire. While the opinions of those involved in this work were that AT improved confidence and impacted self-esteem, additional research is required to fully investigate the matter. A suitable starting point would be a study that measures self-esteem both prior to and after the use of AT.

In short, analysis of the themes of this study led to the proposal of a relationship that connects AT use to: motivation, classroom performance, slight increases in test scores, confidence and potential impact on perception of self-esteem. Some research is available to support this proposal (Perera, 2003; Covington, 1989; Lewis, 2005 and The Independent Schools Inspectorate, 2009) but in truth, considerable future work is required to elicit the nature of the relationships (if any) that exist between the variables involved.

### *Concluding Remarks*

This study supported the hypothesis that there were strong connections among the following variables: AT use, motivation, classroom performance, confidence and self-esteem. The work presents a very initial look at the connection between the use of assistive technology, school performance and self-esteem in students with learning disabilities. These two case studies provided detailed information on how the AT positively affected the lives of two students, even if it did not specifically support the contention that AT would improve standardized test scores. Fortunately, other countries and school types are implementing similar AT programs. Additional studies of similar programs will provide further knowledge of the impact that using assistive technology might have on students with learning disabilities.

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## APPENDIX A: LETTER OF INFORMATION

[ Lakehead University letterhead]

### LETTER OF INFORMATION FOR POTENTIAL STUDY PARTICIPANTS, PARENTS AND TEACHERS

May 15, 2008.

Dear Potential Study Participants, Parents, and Teachers:

#### **Introduction**

My name is Janet Harwood. I am a Masters in Education student at Lakehead University, located in Thunder Bay, Ontario, Canada. I am currently conducting my Master's thesis investigating the relationship of using assistive technology (AT), how its use may lead to improved school performance, and the subsequent effect on the self-esteem of students with learning disabilities (LD).

#### **General Information**

Information is being collected from students, parents and teachers. Students will complete a digital questionnaire called the Myself As a Learner Scale (MALS) to measure student perceptions of themselves as learners. This will take approximately 20 minutes.

Then I will conduct a 60-minute interview with each student to examine their experiences in using assistive technology.

Parents of the students will be asked to attend a 60-minute interview to provide an additional viewpoint on their child's educational experiences using assistive technology. These will be scheduled at the parent's convenience.

Teachers who have interacted with the subjects of this study will be invited to complete a 60-minute interview to offer their opinions of the students' educational experiences both pre and post introduction of the assistive technology program. All interviews will be videotaped for transcription purposes only.

If possible, I would like to conduct the interviews with the students on Wednesday, April 30, 2008, at approximately 1:00 p.m. All interviews will take place in my Special Education office.

#### **Conditions for Participation**

Participation is strictly voluntary, and at any time during the study students, parents, or teachers have the right to withdraw. There will be no effect on students' academic status. Participants have the right to give or refuse consent to video recording.

### **Risks / Benefits of Participation**

There are no known risks or direct benefits in participating in this study.

### **Access to Information, Confidentiality, and Publications of Results**

All information collected from this study will be kept confidential. The collected information will be used for research purposes only. Pseudonyms will be generated for each participant and neither your name nor personal information, which could identify you, will be used in any publication or presentation of the study results. The data and thesis paper will be securely stored at Lakehead University for seven years. A summary of the results of this study will be made available upon your request.

### **Consent**

Please complete and return the attached consent form if you are willing to participate in this study. If you should have further questions, please contact me at the following phone number (31)(43) 367-4666 x 337 or via email [j.harwood1@ism.portamosana.nl](mailto:j.harwood1@ism.portamosana.nl)

If you have additional inquiries, you are free to contact my thesis supervisor, Dr. Graham Passmore, Assistant Professor at Lakehead University via email at [gpassmore@lakeheadu.ca](mailto:gpassmore@lakeheadu.ca), or regarding ethical concerns, the Office of Research at Lakehead University at (001) (807) 343-8283.

Your cooperation with this research study is greatly appreciated.

Sincerely,

Janet Harwood  
Masters in Education student  
Lakehead University

## APPENDIX B: CONSENT FORMS

[ Lakehead University letterhead]

### PARENTS OF PARTICIPANTS CONSENT FORM

May 15, 2008.

For Parents giving permission for their child to participate:

I have read the attached information letter for this study. By signing and returning this form, I hereby give / do not give consent for my child \_\_\_\_\_ to participate in this study. I authorize the release of past report cards and scores attained through academic testing. I understand that there will be no risks in participating, and that my child can withdraw from the study at any time. Data from the study will be kept confidential. All questions have been answered to my satisfaction.

Choose one:

My child  can  cannot participate in this research study.

I  authorize  do not authorize the release of my child's past report cards and scores attained through academic testing.

For Parents giving their permission for themselves to participate:

I have read the attached information letter for this study. By signing and returning this form, I hereby give / do not give my consent for me \_\_\_\_\_ to participate in this study. I understand that there will be no risks in participating, and that I can withdraw from the study at any time. Data from the study will be kept confidential. All questions have been answered to my satisfaction.

Choose one:

I  will  will not participate in this research study.

Signed: \_\_\_\_\_ (Parent)

Date: \_\_\_\_\_

**APPENDIX B: CONSENT FORMS**

[ Lakehead University letterhead]

**STUDY PARTICIPANTS CONSENT FORM**

May 15, 2008.

For Study Participants:

I have read the attached information letter and agree / disagree to be a participant in this study. I understand that there will be no risks in participating and I can withdraw from the study at any time. All information collected will be kept confidential.

Choose One:

I  will  will not participate in this research study.

Signed: \_\_\_\_\_ (Participant)

Date: \_\_\_\_\_

**APPENDIX B: CONSENT FORMS**

[ Lakehead University letterhead]

**TEACHER CONSENT FORM**

May 15, 2008.

For Teachers giving their permission for themselves to participate in this study:

I have read the attached information letter for this study. By signing and returning this form, I hereby give / do not give my consent for me \_\_\_\_\_ to participate in this study. I understand that there will be no risks in participating, and that I can withdraw from the study at any time. Data from the study will be kept confidential. All questions have been answered to my satisfaction.

Choose one:

I  will  will not participate in this research study.

Signed: \_\_\_\_\_ (Teacher)

Date: \_\_\_\_\_

## **APPENDIX C: GUIDING QUESTIONS FOR INTERVIEWS WITH STUDY PARTICIPANTS**

The following questions will serve as a guide for this researcher when conducting the individual interviews associated with this research study. A series of structured and semi-structured questions will be used to facilitate rich information gathering from the study participants.

### Semi-Structured Questions: Use of Assistive Technology and School Performance

1. Can you describe how you came to use your assistive technology in your learning?
2. Describe how you have used AT in completing your schoolwork.
3. What does it help you to do specifically?
4. What was the effect of using the assistive technology on the work you completed for your classes?
5. How did using assistive technology impact on your overall classroom experience?
6. Was it easier or more difficult to meet the curriculum expectations using AT?

### Structured Questions: Effects of Using Assistive Technology

7. Did using assistive technology help you in completing your homework?
8. Did using assistive technology help improve your feelings about school in general?
9. What impact did using assistive technology have on your motivation to do your schoolwork?
10. Has using assistive technology increased your hopes for your future? Can you give some examples?
11. What impact has using assistive technology had on your confidence?
12. What impact has using assistive technology had on your feelings of self-esteem? Can you describe this?

## **APPENDIX D: GUIDING QUESTIONS FOR INTERVIEWS WITH PARENTS OF POTENTIAL PARTICIPANTS**

The following questions will serve as a guide for this researcher when conducting the individual interviews with the parents of the potential participants associated with this research study. A series of structured and semi-structured questions will be used to facilitate rich information gathering from the parents.

### Semi-Structured Questions: Use of Assistive Technology and School Performance

1. Can you describe how your child came to use assistive technology in his / her learning?
2. Describe how he / she used it to help them in their schoolwork.
3. What did it help him / her to do specifically?
4. What was the effect of using the assistive technology on the schoolwork your child completed for his / her classes?
5. Please comment on how using assistive technology has impacted on your child's overall classroom experience.
6. Was it easier or more difficult to for your child to meet the curriculum expectations using AT?

### Structured Questions: Effects of Using Assistive Technology

7. Did using assistive technology help him / her in completing their homework?
8. Did using assistive technology help improve his / her feelings about school in general?
9. What was the impact of using assistive technology on your child's motivation to do schoolwork?
10. Has using assistive technology had an impact on your child's hopes for the future? Can you give some examples?
11. What was the impact of using assistive technology on his / her confidence?
12. Has using assistive technology increased his / her feelings of self-esteem? Can you elaborate on this?

## APPENDIX E: GUIDING QUESTIONS FOR INTERVIEWS WITH TEACHERS

The following questions will serve as a guide for this researcher when conducting the individual interviews with the teachers of the potential participants associated with this research study. A series of structured and semi-structured questions will be used to facilitate rich information gathering from the teachers

### Semi-Structured Questions: The Student in the Educational Environment Prior to Using Assistive Technology

1. When you first met these students, what were your initial impressions about them as learners?
2. In your opinion, did these children perform up to the expectations of the curriculum being delivered in your classroom? Why or why not?
3. In your opinion, did these children participate in all of the typical exercises / activities set up for students in your class? Why or why not?
4. In your opinion, did these children complete homework regularly? Can you describe the usual quality of that completed homework?
5. In your opinion, did you do anything different from the norm to attempt to assist these children in meeting curriculum expectations?

### Semi-Structured Questions: Use of Assistive Technology and School Performance

6. Can you describe how the student(s) came to use assistive technology in his / her learning?
7. Please describe how they used it to help them in their everyday work.
8. What was your role, if any, in this?
9. What did it help them to do specifically?
10. What was the impact of using assistive technology on the student's academic performance in school?
11. In your opinion, are / were there specific learning issues that the students originally had trouble with that using the assistive technology made easier? Can you provide some examples?

### Structured Questions: Effects of Using Assistive Technology

12. In your opinion, did using assistive technology help the students in completing their homework? How / why?
13. In your opinion, did using assistive technology help improve their feelings about school in general? How / why?
14. In your opinion, do you think using assistive technology helped improve their motivation to do schoolwork?
15. What effect did using assistive technology have on their confidence?
16. What effect did using assistive technology have on their feelings of self-esteem? Can you elaborate on this?