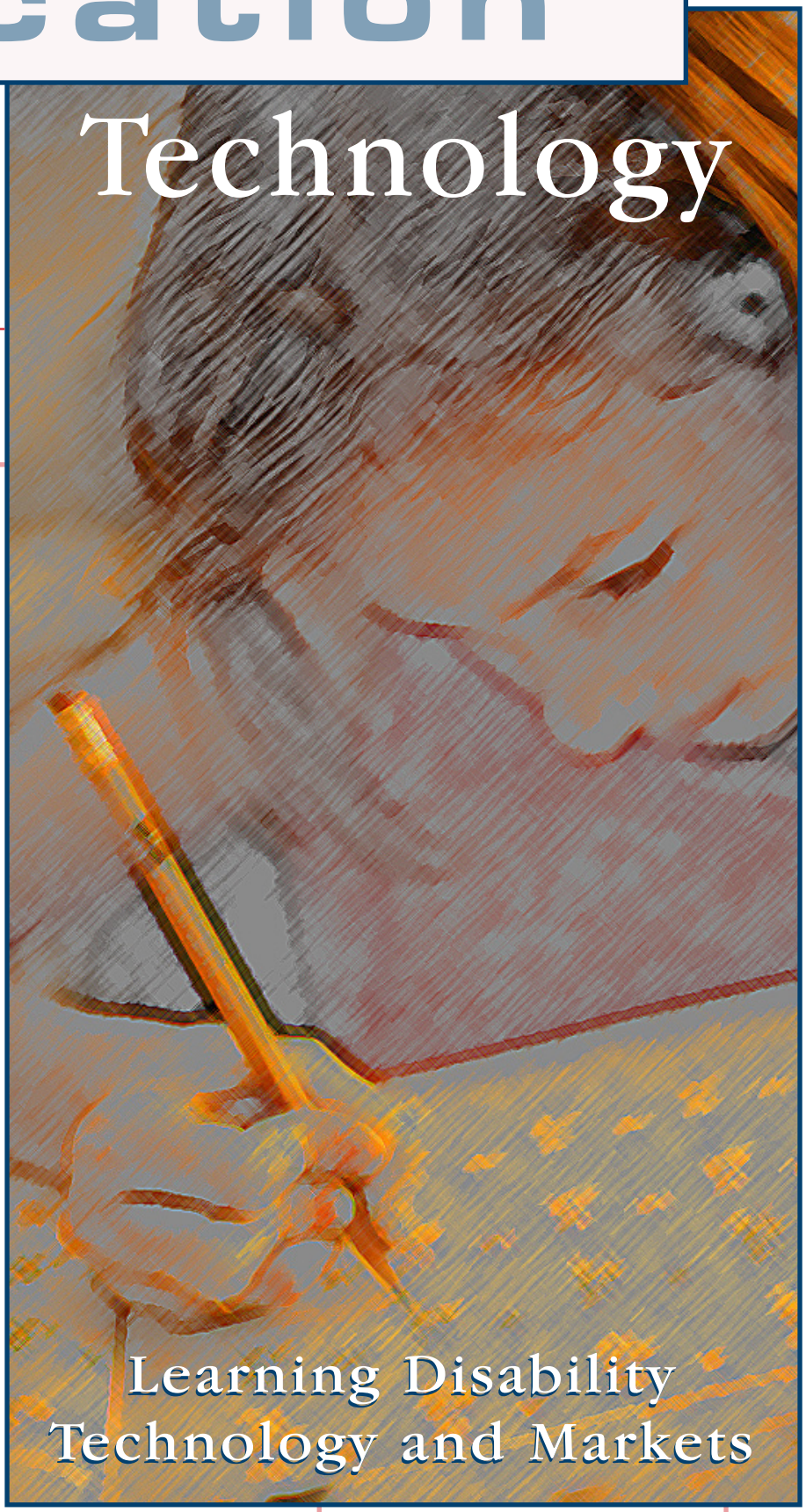
INDUSTRY PROFILE 2006

Education Technology

RERC on Technology Transfer
University at Buffalo



Learning Disability Technology and Markets

Acknowledgement

The Industry Profile on Education Technology: Learning Disabilities Technologies and Markets

By Wendy Strobel*, Sajay Arthanat, Jennifer Fossa, Susan Mistrett, and Jennifer Brace

This is a publication of the Rehabilitation Engineering Research Center on Technology Transfer, funded by the National Institute on Disability and Rehabilitation Research of the Department of Education under grant number H133E030025. The opinions contained in this publication do not necessarily reflect those of the Department of Education.

Editor: Jonathon Hendrix
Format Editor: Michelle Tipps-Ankrah
Graphic Designer: Laurie Yarnes

* Wendy Strobel, the communicating author, can be reached by phone at 716.829.3141 x140 or via e-mail at wstrobel@buffalo.edu

Rehabilitation Engineering Research Center on Technology Transfer (T^2RERC)
Center for Assistive Technology
School of Public Health and Health Professions
State University of New York at Buffalo
3435 Main St.
322 Kimball Tower
Buffalo, NY 14222
Phone: 716.829.3141
Fax: 716.829.2420
Voice/TDD: 800.628.2281
http://cosmos.buffalo.edu/t2rerc/

Table of Contents

Section	Page Number
Abstract	3
Introduction	4
Chapter One: Introduction to Learning Disabilities	
General Description	5
Types of Learning Disability	8
Life After High School	21
Chapter Two: Demographics	
Review of Demographics for Learning Disabilities	34
Impact of Learning Disabilities in the U.S.	38
Chapter Three: Education Technology	
Introduction	41
Technologies	42
Instructional Technologies	42
Learning Technologies	50
Reading	50
Writing	63
Mathematics	74
Emerging Technology	88
Chapter 4: Legislation, Funding, and Education Technology	
Legislation and Funding for Innovation and Transfer	114
Legislation and Funding for Technology Provision and Delivery	117
Appendix	
Manufacturer Index	132
National Organizations and Associations	143
Conferences	149

The Industry Profile on Education Technology: Learning Disability Technology and Markets

Authors: Wendy Strobel*, Sajay Arthanat, Jennifer Fossa, Sue Mistrett, and Jennifer Brace

Abstract

Learning disability (LD) is defined by the Individuals with Disabilities Education Improvement Act (IDEA) of 2004 as:

> "a disorder in 1 or more of the basic psychological processes involved in understanding or in using language, spoken or written, which disorder may manifest itself in the imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations (P.L. 108-446 § 602)."

As implied by the definition, LD permeates every aspect of a person's life. Often times, the impact becomes obvious as children begin to face the rigors of education. While people with LD often learn to compensate for the challenges they face, the underlying LD does not go away as they enter adulthood. However, life outside of school often provides a great deal more freedom in choosing career paths, compensation strategies, and learning opportunities.

Technology holds great promise for people with learning disabilities. There are many useful tools available in the marketplace today. Text to speech engines, electronic spell checkers, and universally designed products that are used every day by people with and without disabilities. This document provides an overview of the education technology industry as it relates to technologies for people with LD. The contents have been designed to provide information for technology development, manufacture and sale. The Introduction will present some of the fundamental concepts of learning disabilities to ensure that the industry has a clear understanding of the challenges faced by people with learning disabilities. The technologies section provides an overview of the current state of the technology.

Introduction

The *Industry Profile Education Technology: Learning Disabilities Technologies and Markets* is a reference document for technical and clinical research, product development, market analysis and segmentation, and general education. It provides an overview of the current state of the education technology industry as it relates to students with learning disabilities. A great deal of the information is also applicable to the general population of students as well as students who are at risk of failure in schools. The secondary market information provided in the Industry Profile is designed as a reference tool and a basis upon which to publish our primary market research for technologies for students with learning disabilities. The *Industry Profile Education Technology: Learning Disabilities Technologies and Markets* is also available in an accessible format on our website at http://cosmos.buffalo.edu/t2rerc/.

Please note that this IP is presented in a format that is different from those compiled in the past. These changes were made as a result of feedback on a survey conducted on the *Industry Profile on Visual Impairment.* We have attempted to capture the essence of the education industry for students with learning disabilities with the sections that are readers recommended were most helpful. The *Industry Profile Education Technology: Learning Disabilities Technologies and Markets* is presented in four chapters and an appendix that provides additional information for the reader:

- Introduction to Learning Disability
- Market Information
- Technology Section
- Legislation and Funding
- Appendix:
    - Manufacturer Listing
    - Organizations and Conferences
    - National Organizations and Associations

Each section contains many subsections that provide a great deal of detail on each specific area. We will be assessing the presentation of this format as well and changes you suggest will be integrated into future Industry Profiles.

The authors would like to thank the School of Public Health and Health Professions (SPHHP) and the Center for Assistive Technology (CAT) at the University at Buffalo for their support and collaboration in preparing this document. We would also like to thank the staff and faculty of the T^{2}RERC.

Chapter One: Introduction to Learning Disabilities

General Description

Currently, knowledge of learning disabilities is mostly limited to parents and teachers of children with a learning disability (LD), and professionals. Societal misconceptions about LD are very common and could impose detrimental consequences on individuals with a LD in terms of their personal expectations, educational participation, employment opportunities, and benefits received from state and national level funding programs (Stacey, 2001). In order for people with a LD to succeed within the current educational culture, it is highly important for the whole society to embrace the realities of LD. LD is significantly distinct from more common disorders such as mental retardation, and attention-deficit hyperactivity disorder (ADHD).

LD is a neurological disorder that imposes difficulties in participation at school, work, and other basic life activities. Many individuals with a LD have a limited ability to receive, process, store, and respond to information. In schools, LD may undermine a child's fundamental development in one or more areas including listening, reading, mathematics, writing, speaking, and fine motor skills. LD is a heterogeneous group of disorders that impose difficulties in a variety of academic and social skills (Cutting & Denckla, 2003). It is important to understand that LD is not a disease, but a neurological disorder that spans an individual's life from childhood, adolescence and into adulthood. Therefore, individuals with a LD may not only lack age-appropriate academic skills, but may also have difficulty acquiring learning skills for transition to the subsequent developmental phase of life. Although many adults with a LD develop adequate strategies to overcome functional limitations, many experience difficulty in succeeding in the work world (Gerber, Ginsberg & Reiff, 1992).

In 2001, the United States Department of Education reported that LD affects nearly 5% of children in public schools, and an estimated 2.9 million students are currently receiving special education services for learning disabilities (National Center for Learning Disabilities [NCLD], 2004a). Alarmingly, it is also estimated that almost one-third of children with some form of LD remain undiagnosed (Shaywitz, 2003).

Origins of Learning Disabilities

It is important to keep in mind that the origin of LD is different from that of learning problems associated with visual, hearing, motor impairments, mental retardation, emotional disturbance, environmental, cultural or economic disadvantages (Learning Disabilities Association of America, 2005). While this fact is well researched and validated, the exact cause of LD remains unclear. Many scientists have attributed the occurrence of LD to genetics, high-risk pregnancies and exposure of the developing brain to chemical toxicity. The genetic basis of LD has been validated by reports of prevalence of LD in families. However, the genetic mapping of LD is an area that is still under exploration. In a study at University of South Florida, environmental toxicity, or

exposure of the fetus to chemical toxins and alcohol during pregnancy, was deemed as a key cause for children born with a LD (Pressinger, n.d.). This finding is supported by the increase in prevalence of LD in accordance with the rise in environmental pollution and toxicity in the last two decades.

As mentioned above, the question of *why LD happens* has not been clearly established in the literature. However, researchers have been able to elucidate *what happens in LD* or its underlying neurological pathology. Examining the brain-behavior mechanisms using advanced methods such as functional magnetic resonance imaging (fMRI) has provided scientists with insights into the neurological involvement of LD. In most cases, it has been reported that the basic anatomical structures of the brain remain intact. Nonetheless, in LD there seems to be a disruption in information processing because of impairment in the neural wiring that transmits messages across these structures in the brain (Shaywitz, 2003). Comparison of brain images between children with and without LD reveal that the neural activation patterns during learning tasks are significantly different for these two groups, which indicates the disparity in neural processing. For children with a LD, the activation pattern is reduced because of lower blood flow to specific areas of the brain. In addition, their brain cells are reported to metabolize glucose at lower levels than children without LD. Moreover, children with a LD have been found to have fewer and smaller brain cells in specific areas of the brain, and a condition called dysplasia termed as movement of brain cells into the wrong region of the brain (Pressinger, n.d.).

Receiving Services for Learning Disabilities under the Law

According to Individuals with Disabilities Education Improvement Act (IDEA) 2004, LD may manifest itself in the imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations, including conditions such as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. The classification provided by the law is quite broad and little guidance was given on how LD was to be measured functionally in schools. For many years, educators and clinicians used the Intra-Individual Differences Model to determine if a learning disability was present. In other words, when a child demonstrated a discrepancy between achievement and intellectual ability he was assumed to have a LD. Using this "discrepancy formula" to positively diagnose a LD often required a student to fail academically before he could be diagnosed with a LD and, as a result of that diagnosis, begin to receive the services mandated by law that would enable them to succeed (Horowitz, 2005). For the first time in IDEA 2004, this requirement was removed. Now schools have the *option* to use a process based on systematic assessment of the student's response to high quality, research-based general education instruction as is promoted by the No Child Left Behind Act of 2001. Continuing research on the identification and development of research-based instructional interventions is planned (NCLD, 2005b).

A Review of the Models of Assessment for Learning Disabilities

Taking into account the complexity of defining and diagnosing LD, it would be worthwhile for teachers and clinicians to keep in mind a few guidelines by which LD can

be classified and treated. The following section reviews two models that highlight the shift in focus of LD definition from IQ-achievement discrepancy (Intra-Individual Differences Module) to a response to intervention based approach (Problem-Solving Model).

Intra-Individual Differences Model (Discrepancy Formula)

The Intra-Individual Differences Model (as the term suggests) indicates the within child discrepancies in ability as a marker for LD. In other words, there is a failure on the part of the child to achieve a level of expected academic performance in one area based on his or her abilities in other areas (Kavale & Forness, 2000). This model is emphasized by "unevenness in development". The child with a LD will have intact abilities in many areas while having limited abilities in others which results in underachievement in some areas of academic or social performance (Fletcher, Morris & Lyon, 2003). For example, the child may excel when curriculum is presented verbally but will fail in subjects that involve reading. This indicated that the child is indeed intelligent but either cannot read effectively or is unable to determine the meaning of what he/she has read.

This model differentiates the type of LD and also distinguishes LD from other developmental disorders such as mental retardation and attention deficit hyper activity disorder (ADHD) (Fletcher et al., 2003). Application of the intra-individual differences model in research has established that children with a LD can be effectively grouped into subtypes with strong implications for assessment and remediation (Catts, Hogan, & Fey, 2003; Aaron, Joshi, Palmer, Smith, & Kirby, 2002). This model of assessment supports the use of the discrepancy formula in which a child with adequate intellectual development may still fail to reach an expected level of performance based upon learning abilities. The weakness of this model is that it relies on theory-based LD classifications and extensive testing to identify and treat learning deficits. Therefore, it fails to provide a clear framework for intervention and monitoring of instructional outcomes on the child (Fletcher et al., 2003). This method has been the primary model for conceptualizing and diagnosing LD supported in schools and by federal legislation over the last few decades. Although the discrepancy between IQ and achievement is a clear marker for LD in areas of reading, writing, and math (Stuebing et al., 2002), findings from classification research on LD do not validate that LD can be clearly discerned in terms of expected and unexpected underachievement (Lyon, Fletcher, Shaywitz, Shaywitz, & Torgesen, 2001).

The merit of the IQ-achievement discrepancy concept has been an issue of contention in the field of LD. Many research studies have questioned the reliability of solely relying on IQ-achievement discrepancy scores as a method for labeling LD (D'Anguilli & Siegel, 2003; Siegel, 2003; Francis et al., 2005). Researchers conclude that instead of relying on patterns of intelligence scores, clinicians may use patterns of achievement scores as a reliable method for diagnosing LD (D'Anguilli & Siegel, 2003). It is also vital to take into account the environmental, socio-economic and gender issues that affect learning abilities of children (Molfese, Modglin, & Molfese, 2003**;** Siegel, 2003). It is important to note that LD may appear along a continuum and cannot be considered categorically discrete from other forms of underachievement.

Problem-Solving Model/Response to Intervention Model

The problem-solving model, which is sometimes called the Response to Intervention (RTI) model, is based on the changing abilities of the child over time, as opposed to the within-ability discrepancies. This model is established as an intervention framework for LD and is an empirical approach to understanding methods for improving the learning skills of the child. The problem-solving model is not reliant on existing LD classifications for identifying and treating learning deficits. Instead, the model utilizes curriculum-based assessments that indicate the academic performance of a child. The model emphasizes constant monitoring of a child's progress. Determination of LD is based solely on the child's success or failure to respond to a particular intervention. The strength of the problem-solving model is that it clearly delineates who needs intervention for LD and which approach to intervention would be effective. The model departs from sub-typing LD based on any classifications and supports the concept of individualized intervention for children with a LD (Fletcher et al., 2003). While adopting the RTI model, it is recommended that teachers monitor the student's progress with short assessments as often as every two weeks (Samuels, 2005).

In considering alternative models for identification, the focus should be on assessments that are related to instruction. The limitations identified should indicate that intervention is required. The RTI has been advocated as a model that can help identify and monitor learning problems in children at an early age and facilitate much needed early intervention (Samuels, 2005). For these reasons, models that incorporate response to a research-based intervention should be given priority in any effort to identify students with LD. Identification models that incorporate response to intervention represent a shift in special education toward the goals of better achievement and behavioral outcomes for students identified with LD because the students who are identified under such models are most likely to require special education and related services. Some concerns with the RTI model is that its focus is limited to students in elementary school with problems in reading. Critics contend the RTI concepts do not take into account other age groups and types of LD. In addition, the model may burden school teachers who may already be experiencing a heavy workload and who may not be trained adequately to administer educational evaluations (Maloney, as cited by Samuels, 2005).

Types of Learning Disabilities

LD can be broadly classified as an academic skill disorder and developmental speech-language disorder (LD Online, 2005a). Academic skill disorders result in learning disabilities that delay academic achievement in the areas of reading, writing, and arithmetic, while developmental speech-language disorders result in a delay in developing skills for articulation, reception, and expression of language. It is important to note that the simple classification of the types of learning disabilities apply only in theory. In reality, many people with learning disabilities will have difficulties in more than one area. Information in the following sections focuses on the three main manifestations of academic skill disorders: learning disabilities in reading, writing, and mathematics.

Learning Disability in Reading

Reading is defined by the No Child Left Behind Act of 2001 as:

> "…a complex system of deriving meaning from print that requires all of the following:
>
> (A) The skills and knowledge to understand how phonemes, or speech sounds, are connected to print.
> (B) The ability to decode unfamiliar words.
> (C) The ability to read fluently.
> (D) Sufficient background information and vocabulary to foster reading comprehension.
> (E) The development of appropriate active strategies to construct meaning from print.
> (F) The development and maintenance of a motivation to read (20 U.S.C. 6368 §1221)."

As illustrated by this definition, the act of reading requires a child to have a fairly large skill set. An inability to perform in any one of these functional areas can significantly impede the child's ability to succeed in school, primarily because reading (or obtaining meaning from print) serves as the foundation for the majority of all learning activities that are conducted in schools. Children with reading disabilities have functional limitations in language that can lead to trouble understanding words, sentences, or paragraphs. Deficits in basic reading skills, reading fluency and reading comprehension are direct manifestations of reading disorder.

Developmental reading disorders are the most common and highly researched of all learning disabilities. Reading disabilities affect nearly 80% of children with a LD (Shaywitz, 2003; Cutting & Denckla, 2003), which is nearly 2%-8% of children in elementary schools (LD Online, 2005a). It was reported that nationwide only 63% of the students with or without disabilities are able to read at the basic skills level, and only 32% read at the proficient or expected level (Donahue, Finnegan, Lutkus, Allen, & Campbell, 2001). Although some school-identified procedures report that the prevalence of reading disability is three to four times higher in males than females, individual testing by research methods have demonstrated that both boys and girls have more or less equal chances of acquiring reading disabilities (Shaywitz, 2003).

Early Warning Signs That Your Child Might Have a Learning Disability in Reading

Children with reading disability may have difficulties in one or more of the following areas (LD Online, 2005a):

1) Focusing attention on reading materials;
2) Recognizing the sounds associated with words;
3) Understanding words and grammar;

4) Building ideas and images;
5) Relating those ideas to existing ones;
6) Storing new ideas into memory.

It is important to understand the early signs and symptoms of developmental reading disorders, as early intervention may help a child succeed in school. Learning disabilities in reading may first manifest themselves as developmental speech disorders. Children who have a reading disability may speak their first words at the age of 15 months, as opposed to 1year of age (Shaywitz, 2003). Although this gap may not be significant, it is said to be a clear indication of problems with articulation or learning of new phonemes[1]. This phenomenon may lead to mispronunciations of words such as "*aminal for animal"* and "*lephant for elephant"*. Eventually, as the child begins to read, he or she will have problems making associations between letters and corresponding sounds. Research on children's reading has also demonstrated that children who display early signs of a LD in reading may have difficulty discerning and expressing words that rhyme (Shaywitz, 2003). It is important to recognize that the children displaying some of these early warning signs have intact thinking and reasoning abilities in the absence of being able to phonologically perceive words. For example, a child may understand the meaning of a common word when it is spoken to him, but he will experience difficulty reading information and then expressing it in speech.

In elementary school, a child with a LD in reading may make consistent reading and spelling errors including reversing letters (b/d), inverting letters (m/w), transposing letters (felt/left), and substituting words (house/home) (LD Online, 2005b). The child may also have difficulty pronouncing words and may reverse or substitute parts of words. In later life, the process of reading will be noticeably slow and laborious. As they mature, children with reading disabilities generally slowly begin to associate letters with their proper sounds. However, the recognition is limited to only a few letters in a word. Consequently, when the child comes across a word, he or she will find it extremely challenging to recognize the word as a whole. In order to familiarize themselves with words, children with learning disabilities in reading may require more frequent exposure to certain words in order to clearly make representations of their letters and corresponding sounds. Many children with reading disabilities accommodate themselves by seeking to derive meaning of the word based on the context that it is presented in. However, this accommodation is not always effective, particularly with words such as "*in, on,* and, *that,"* which do not relate to the context of what they are reading. This strategy is also difficult to use when students fail to recognize large numbers of words as they may find in a new subject at school. In higher grade levels, the child's reading comprehension may be undermined by his or her inability to pay attention to the reading material and memorize what was read (Schwab Learning, 2003). During retrieval of what was read, children with reading disabilities often accommodate their functional limitations by using words such as "*things* or *stuff,"* which lack meaning and specificity (Shaywitz, 2003).

[1] Phoneme refers to the smallest phonetic unit in a language that conveys a distinction in sound and meaning. For example, the *c* of *cat* and the *b* of *bat* in English.

Intervention for Learning Disability in Reading

It is well established that early intervention plays a major role in enhancing reading skills among children with reading disabilities. It is worthwhile for parents and educators to have a general awareness of the normal linguistic, intellectual, and academic developmental markers of children. Identification of the aforementioned warning signs is the key to early intervention. It is critical to understand that every child can read, but the proficiency at which each child reads will vary significantly depending on whether a child is diagnosed with a disability in reading. When the early warning signs occur, a formal evaluation and diagnosis by a child psychologist is an important step in the remediation of a reading disability. The remediation program can then be effectively promoted by fundamentally targeting the child's age-appropriate developmental needs (Shaywitz, 2003).

Shaywitz (2003) describes the "*sea of strengths*" model, which focuses on alleviating the child's weaknesses and capitalizing on his or her strengths. Initially, the parent must focus on facilitating the child's representation of phonemes. Encouraging children to read aloud and allowing them to make strong associations of the letters and their sounds can help remediate early phonological weakness. Later, parental intervention can be facilitated by teaching the child to integrate the established phonemes in different words and phrases with graded difficulty. When the child confronts reading difficulties in school, accommodations play a pivotal role in LD intervention.

Accommodations must compensate for the phonological weakness and at the same time effectively using the child's multiple learning strengths including reasoning, analytical skills, creativity, thought process, and above all, the available parental support. Identifying these strengths and enhancing them are critical to the child's effective utilization of accommodations and could mean the difference in a child's academic success and failure (Shaywitz, 2003). Accommodations could be effectively provided in one or more forms: simplification of the learning tasks; change in teaching strategies; integration of learning technologies (both assistive and instructional); and modification of the learning environment. Simplifying the task of reading may include providing extra time for reading and separating large sections of reading into multiple parts. Teaching can be augmented using multiple modalities such as verbal instruction and use of graphical information such as pictures and figures instead of text. The reading environment can be further enhanced by reducing noise, unwanted distractions and providing reading materials in electronic format for use with computers. Integration of appropriate technologies (both high-tech and low-tech) in the area of reading is beneficial in terms of learning and instruction. The application principles and types of technologies for reading are highlighted in later sections of this document. Note that the aforementioned accommodations are not exhaustive and several accommodations listed in literature can be applied based on the student needs, the learning environment, and the educator's and school administrator's discretion.

It is also important for schools to focus on late-emerging signs of reading disabilities even when early intervention was provided. In some cases, it was reported that reading

disabilities are not only manifested by the inability to phonologically process the letters in words, but also with the inability to cognitively comprehend the meaning of the word (Leach, Scarborough, & Rescorla, 2003). Therefore, educators also need to utilize an intervention method that determines whether the problem in reading is attributable to processing letters in words or to comprehension of words.

Learning Disability in Writing

Learning disabilities in writing, or dysgraphia, is a form of LD that affects an individual's writing abilities and is manifested by difficulties in hand writing, spelling, or organizing and composing ideas (NCLD, 2004b). Dysgraphia can also be a result of graphomotor dysfunction, which reflects difficulties with mechanical aspects of writing such as graphically representing letters and words when handwriting, capitalization, punctuation, spelling, and formatting (MacArthur, 1999). Problems with handwriting are attributed to impaired fine motor control and coordination. Handwriting difficulties can be evidenced by problems in representing letters graphically and maintaining the appropriate spacing between words (Amundson & Weil, 1996).

Education at all levels is reliant on being able to graphically represent language and information. An inability to write skillfully can substantially undermine a child's academic development, as writing skills are a pre-requisite to expressing knowledge, thoughts, and ideas. Children with a learning disabilities in writing tend to be more concerned with writing mechanics (i.e. formation of letters) rather than with the content, thereby failing to gain knowledge from written assignments (Jones, n.d.). In addition, difficulties with writing can affect the student's motivation and self-esteem leading to an aversion for written expression. Sound writing skills are also important for readers to effectively comprehend the information being conveyed.

The problems associated with a LD in writing have been represented along a hierarchy of skills (Richards, 1999). It is postulated that lower level skills are a prerequisite to acquiring higher level writing skills. The basic underlying processing skills for writing include development in a variety of memory, motor, and language areas such as acquisition of physical components of writing, speed of motor performance, active working memory, and language formulation and ideation. Mechanical and content skills form the subsequent layer of the hierarchy. The mechanical skills span from the fundamental skills such as automatic letter form, use of space, basic spelling, capitalization, and punctuation to more mature mechanics, including writing speed, clarity of expression, and use of appropriate grammar. The content skills relate to organizing and expressing ideas. The upper-most level skills include ability to use different writing styles, flexibility in the writing process, consideration of the reader's perspective, and enthusiasm in writing (Richards, 1999). Although the underlying mechanism of writing disability is established, parents, and especially educators, need to be aware of how writing difficulties are manifested on paper.

Early Warning Signs That Your Child May Have a Learning Disability in Writing

Children with a LD in writing may demonstrate deficits even at the preliminary stage of composition, which is planning, and at later stages such as revising and editing written material. Children with writing disabilities have difficulty planning and organizing their thoughts and ideas for written compositions (Graham & Harris, 2003). On paper, children with writing disability will have difficulty in content generation. Their writing will be short and incomplete and will lack elaboration and detail. The reasons for this inadequacy have been cited as difficulties with sustaining the writing effort, inability to access one's knowledge base, and impairment in the mechanics of writing (Graham & Harris, 2003). Conceivably, these difficulties will be mostly observable in the mechanical or graphomotor aspects of the individual's writing.

Handwritten work will be generally illegible with inconsistencies in skills in print and cursive, upper and lower case, size, and shape and slant of letters. Inconsistencies can also be observed in spacing of letters and words, and placement of the text with reference to the margin and lines on pages (Jones, n.d.). Handwriting in children with a LD in writing also manifests itself in the child's inappropriate grasp of the writing utensil combined with an awkward positioning of the wrist, body and the writing page.

Difficulties with the thought process involved in writing will be evident when the child omits parts of letters and words or sometimes the whole word in text. In order to coordinate the entire writing process, the child may accommodate by using self feedback strategies such as talking to oneself, or carefully monitoring the hand while writing. Although these compensation strategies will make the writing more legible and complete, the writing task will continue to be very slow and tedious. Often times, the child will display extremely high levels of frustration when completing writing tasks. Most importantly, inconsistency will be noticeable in the child's written content and his verbal language skills (Jones, n.d.).

While editing, children with a LD in writing fail to augment the quality of their compositions. They often avoid correcting the content and grammatical errors in the text. Revisions are mostly subjected to word substitution, correction of mechanical errors such as spelling and enhancement of legibility. Samples of edited compositions reveal that students with writing disability only correct 20% of the written content, and 70% of the corrections were focused on capitalization, punctuations, spelling, format, and legibility (MacArthur, Graham & Schwartz, 1991).

Intervention for Learning Disability in Writing

Intervention for LD in writing can only be promoted with a strong understanding of the hierarchical skills and sub-skills of writing (Richards, 2002). Identification of impaired skills is the first approach to intervention. These skills need to be specifically augmented or accommodated in order for children to gain proficiency in the tasks associated with writing. The overall writing skills can be augmented in children in areas of handwriting, planning and organization, and self-regulation.

Research has highlighted that handwriting instruction positively impacts written composition by children with a LD in writing (Berninger et al., 1997). Intervention to improve fine and gross motor skills can promote better handwriting. Gross motor enhancement is essential for postural control in terms of aligning one's trunk, head, and upper body during writing, while fine motor control needs to be augmented for better grasp and dexterity with the writing instrument. Promotion of sensory integration therapy by means of engaging children in gross and fine motor activities has been shown to improve sensory awareness, sensory processing, and perceptual skills involved with writing (Keller, 2001). At home, parents can encourage children to perform activities directed towards improving their gross and fine motor control (American Occupational Therapy Association, Inc & American Occupational Therapy Foundation, n.d.). These activities may include sports (i.e. catching a ball), simple board games, crafts, and creative tasks. Professionals such as occupational therapists and special educators can focus on engaging children in activities specifically tailored for remediation of handwriting deficits. In cases when the approach of augmentation fails to yield benefits, accommodation for handwriting may be a more logical intervention. Accommodation within the context of handwriting involves the use of human assistance, low-tech tools, and technology to replace the mechanical and graphomotor demands of handwriting. Elimination of the mechanical demands of handwriting by provision of dictation or use of writing technologies has been reported to produce notable improvement on children's composition skills (Graham & Harris, 2003). Although the use of a human note taker may create dependence, the application of different technologies for writing has been considered as an effective tool in LD intervention. These technologies are discussed in detail in subsequent sections. Nonetheless, it's imperative that additional writing intervention supplement higher order skills in writing.

Writing skills are greatly dependent on thought process, content knowledge, planning, and organization. It is important to note that children with functional limitations in writing can be taught to employ the same writing strategies used by skilled writers (Graham & Harris, 2003). In addition, educators can create a learning environment where children are able to self-regulate their writing. Self-regulation is an instructional approach that is child-centered and flexible in terms of allowing the child to choose the content topic, write in a pleasant and supportive writing environment, write at one's own pace, share one's work, and be reinforced for proper planning and organization (Graham & Harris, 2003). Self-regulated writing does not develop innately in children with weakness in writing, and educators must actively facilitate this development. Graham & Harris (2003) review five critical characteristics of self-regulated strategy development (SRSD) instruction for advancement of writing:

1) Extensive teaching to boost knowledge of the content area;
2) Interactive learning between teacher and student with the student sharing the active role;
3) Individualized instruction and feedback geared to address the specific writing needs of the student;

4) Criterion-based instruction as opposed to time-based instruction in the sense that the instruction must not proceed to the next phase until the student has mastered the self-regulation strategy in the preceding phase; and
5) Introducing new strategies and upgrading previously learned strategies to advance writing skills.

It is important to note that children with a LD in writing will develop an aversion for writing unless the writing is performed with a purpose or goal in mind. In order to avoid reluctance and encourage practice, these children can be initially provided with writing topics that are not exclusively academic, but within their area of interest such as writing about their hobbies and favorite games or movies. Students need to be given adequate time to plan and organize their thoughts for writing. An effective strategy on this front is to organize the content by representing it on a visual map or drawing so that the content can be later outlined in writing in a systematic format. When children fail to manually create a visual representation of their writing content, technologies that function as visual organizers can be introduced. There are many paper-based graphic organizers available to facilitate this task. Software tools are also available to aid in this task. Programs such as Inspiration and Kidspiration, or Draft:Builder (as described in later sections) are found to be effective tools for planning to write. Use of proper vocabulary and accurate spelling are also crucial to sound writing. As part of planning, children can be encouraged to list and memorize the words they will use in their composition. Reading these words aloud prior to writing can also improve writing fluency and will prevent the child from struggling to spell each and every word (Richards, 2002).

For children with severe vocabulary deficits and spelling problems, the use of different types of word processors and electronic dictionaries has gained significant popularity in recent years. It is of primary importance that educators discern the exact point in instruction at which such technologies can be introduced, as there are controversies about their impact on the child's natural learning process. Traditionally, educators have been somewhat resistant to the idea of utilizing technologies with the concern that they impede the learning process and create a sense of dependency on the part of children. However recent research on technologies for writing has confirmed that compensatory technologies also have a positive impact on the learning process of children (Bryant, Bryant, & Raskind, 1998; Raskind & Higgins, 1995). Finally, children need to be taught to skillfully proofread and edit their writing for clarity, accuracy, and legibility. This process requires enforcing the syntactical aspects of writing, including use of sentence structure, punctuation, subject-verb agreement, verb-tense consistency, and capitalization (Richards, 2002).

Learning Disability in Mathematics

Although learning disability in the area of math has received much less attention than those in reading and writing, it remains a serious impediment to academic and social development of children. Math skills are essential not only in school arithmetic and computing, but also in real-world situations involving problem-solving, and decision-making. Dyscalculia is the term used to describe the LD affecting an individual's ability

to understand and manage math and numbers. LD in math can manifest itself with a broad variety of symptoms, ranging from difficulty understanding or identifying a number, such as the time on a clock, to an inability to comprehend algorithms in mathematical equations, or even difficulty with directions such as those on a map. Sequences of events, understanding money and how to make change, and name and facial recognition are also common symptoms that affect some who have a learning disability in math. Based on some study samples, an estimated 5%-7% of children have been reported to have a learning disability in math (Gross Tsur, Manor, & Shalev, 1996; Shalev et al., 2001). LD in math may be caused by a deficit in processing information relating to the different domains in mathematics. Learning and mastering math involves a hierarchy of cumulative skills that need to be built up as the child progresses through different grade levels.

In early childhood, even before the child learns to add or subtract, basic skills must first be mastered. Shape-identification, pattern-recognition, and number-recognition are amongst the basic concepts to be learned by children as they begin to study math. These skills exclusively relate to the ability to recognize symbols and count numbers. Much like reading, math requires a student to identify numbers and to benchmark their value to other numbers. On a higher level, mathematics is a cognitive process that requires the dual coding of imagery and language. In other words, mathematics is not merely a set of numerical figures, but an internal language that generates images that reflect the basis for thinking with numbers and conceptualizing their functions and their logic (Bell & Tuley, 2003).

As the child transitions from elementary grades and subsequently to high school level, math skills are predominantly needed not only for subjects such as algebra and geometry, but also for learning sciences such as physics and chemistry. Learning to perform the basic arithmetic functions of addition, subtraction, multiplication, and division requires significant information-processing and problem-solving skills. The concept of number sense is important. Number sense refers to “a child's fluidity and flexibility with numbers, the sense of what numbers mean and an ability to perform mental mathematics and to look at the world and make comparisons” (Gersten & Chard, 1999, para. 15). An effective number sense is required for applying the mathematical world of numbers and numerical expressions to real-world quantities and day-to-day mathematical tasks.

In general, children with a LD in mathematics are found to have a limited understanding of the conceptual knowledge of numbers in terms of their functions and logic. The two factors that account for deployment of math skills are the speed of information-processing and utilization of strategies to compute numbers. Reaction time for computing mathematical tasks has been considered an indication of the speed of information-processing. The reaction time is also a clear indication of the effectiveness of strategies used by children to compute math tasks. In early studies, it was noted that children with a LD in mathematics not only exhibited a delayed reaction time, but also employed inefficient strategies to complete even simple math tasks (Geary, Widaman, Little, & Cormier, 1987). Unlike children without LD in mathematics who use a direct retrieval method to compute addition and subtraction, children with a LD in mathematics

commonly use a *counting-all-numbers* procedure to determine solutions to simple arithmetic questions (Geary, 2003). Based on a review of two decades of research, it was substantiated that children with a LD in mathematics were developmentally delayed in learning and employing problem-solving strategies to perform arithmetic. They also displayed some fundamental differences in memory-retrieval. It is well established that children with arithmetic difficulties have a deficit in working memory (McLean & Hitch, 1999), and instead use finger-counting as a working memory aid to keep track of the counting process (Geary, 2003).

Early Warning Signs That Your Child May Have a Learning Disability in Mathematics

Signs of LD are more apparent in areas of reading and writing, than in mathematics. However, the prevalence and magnitude of learning disabilities in math should not be underestimated by parents and educators. In addition to the 5%-7% prevalence of children with a LD in mathematics (Gross-Tsur et al., 1996; Shalev et al., 2001), a significant number of these children also have an LD in reading or ADHD. Nearly 26% of children with a learning disability in math also had symptoms of ADHD, and an estimated 17% also had LD in reading (Gross-Tsur et al., 1996). Other reports suggested that approximately half of the children with a LD in math have co-morbid difficulties in reading and spelling (Geary, 2003). Since early intervention in LD has established effectiveness and is dependent on identification of early signs, parents and educators need to be aware of this co-morbidity, and check for signs of LD in mathematics associated with other types of LD.

As indicated before, children with a deficit in learning mathematics may have noticeable difficulties with recognizing and counting numbers at preschool age. In terms of the basic arithmetic functions, to a large extent these children will rely on developmentally immature strategies such as finger-counting rather than direct retrieval from memory. Although this approach is a means of accommodation, it is a clear indication of the difficulties with working memory and the lack of knowledge around numerical concepts (Geary, 2003). When direct retrieval is performed, there is a tendency toward high error rates. The problems of delayed reaction time and errors with counting get compounded while solving multi-step arithmetic tasks such as two- or three-digit additions. These children may exhibit significant difficulties in sequencing multiple steps in complex arithmetic procedures. When attempts are made to perform computations in writing, children with a LD in mathematics have difficulty aligning digits, which may also be linked to difficulties with writing. Children also may have visual-spatial processing difficulties in representing numerical and mathematical information and relationships.

Intervention for Learning Disability in Mathematics

Although LD in mathematics is currently the least examined among all types of learning disabilities theoretical models and research literature in the area provide ample insights for developing intervention framework for enhancing the learning of mathematics in children (Geary, 2003). In summary, children with a LD in mathematics:

1) Lack a conceptual understanding of numerical information;
2) Have problem-solving deficits;
3) Depend on problem-solving procedures that are developmentally delayed, inefficient and inaccurate for addressing arithmetic tasks; and
4) Have cognitive processing disorders with regards to retrieval of arithmetic information from memory.

Therefore, the goal of intervention is to identify the magnitude of the affected attributes and target them for remediation or accommodation. In order to improve the conceptual understanding of mathematics, teachers are encouraged to integrate mathematical concepts in all areas of learning. Reed (1995) describes and lists activities and tools that teachers can use to connect mathematics to science, social studies, arts, and language. It is important for educators to teach children to apply mathematical concepts in both concrete and abstract contexts. Conceptual knowledge of numeracy is required not only to perform concrete arithmetic operations, but to apply those concrete skills in real life as abstract concepts. The use of manipulatives (objects that can be touched and moved by students to introduce or reinforce a mathematical concept) can be enforced to bridge the gap between concrete and abstract mathematics. It was reported several years ago that although the use of manipulatives had been found to be effective, teachers were not actively using them in arithmetic education (Hartshorn, 1990). More recently, parallel to the value of phonemic awareness for reading, researchers have stressed the importance of facilitating the concept of number sense for enhancing math skills in children (Gersten & Chard, 1999). Environmental influences involving interactions and informal support from parents, siblings and peers prior to school age have been indicated to facilitate number sense in children (Bruer, 1997). In order to enhance direct retrieval from memory and reduce the reliance on procedural strategies such as counting, experts have recommended increasing the practice of mathematics in children. Early research demonstrated that even increasing the frequency and duration on arithmetic tasks can directly affect retrieval memory and declarative knowledge (Pellegrino & Goldman, 1987; Hasselbring, Gain, & Bransford, 1988). It will be worthwhile for educators and students to include several of these recommendations from research findings within an established standard for teaching mathematics.

The standards for math pedagogy have been developed and revised by the National Council of Teachers of Mathematics (NCTM) in the publication titled “Principles and Standards for School Mathematics” (National Council of Teachers of Mathematics [NCTM], 2005). The NCTM standards emphasize conceptual understanding and problem-solving as opposed to procedural knowledge or rule-driven computation. The six principles of NCTM provide an essential guide for teachers, administrators, and school districts for setting standards for mathematics curriculum (NCTM, 2005, para. 2).

1) Equity. “Excellence in mathematics education requires equity—high expectations and strong support for all students”. The premise is that all students, regardless of their strengths and weaknesses in learning, can be effectively guided to advance their knowledge of mathematics. All students must have a coherent, challenging

mathematics curriculum that is taught by competent and well supported mathematics teachers.

2) Curriculum. "A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades". This principle considers mathematics a subject that builds on past learning and requires students to continuously build connections and skills. Students must also perceive relationships among important mathematical ideas as they progress through each grade level.
3) Teaching. "Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well". This principle emphasizes flexibility in teaching mathematics in a way that will optimally engage the student in learning. The approach requires selecting and using suitable curricular materials, utilizing appropriate instructional tools and strategies to support learning, and aiming for continuous self-improvement.
4) Assessment. "Assessment should support the learning of important mathematics and furnish useful information to both teachers and students". The basis for assessments is that instructors should be periodically gathering information about their students by means of multiple modalities such as questions, interviews, writing tasks, and other means and not simply by class tests. Assessments should not only focus on the level of understanding of mathematical concepts, but also on the procedures used by the student for problem-solving.
5) Technology. "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning". Educators and school administrators must ensure that the right technologies are introduced at the right time for the right kind of accommodation. Further information on principles and types of technologies for LD in mathematics is provided in subsequent sections.

In research sponsored by the United States Office of Special Education Programs (OSEP) it was reported that teachers who implemented activities, lessons, and strategies guided by the NCTM standards experience a more positive response from students with learning disabilities in math (Office of Special Education Programs [OSEP], 2002). More information on the NCTM standards is available in the book titled *Principles and Standards for School Mathematics: An Overview* or by visiting the NCTM website: http://standards.nctm.org/. Although much remains to be achieved, significant advances have been predicted in the area of LD in mathematics for the future decade in terms of examining its cognitive and neural mechanisms, co-morbidity with reading disability and ADHD, and development of assessment instruments (Geary, 2003).

Relationship of Learning Disabilities & Attention Deficit Hyperactivity Disorder (ADHD)

Although LD and ADHD impact children's social and academic domains similarly, a common misconception among people is that LD and ADHD are interlinked and can be used interchangeably as a diagnosis. Research comparing the two disorders validates that LD and ADHD have distinct neuropathology and symptoms, therefore requiring specific

interventions. Failure to differentially diagnose LD and ADHD can lead to the provision of wrong intervention (Aaron et al., 2002).

ADHD is a neurological disorder that is attributed to the deficiency of a specific neurotransmitter called norepinephrine and/or its precursors, dopa and dopamine, in a particular set of brain circuits. The three main symptoms of ADHD, hyperactivity, distractibility, and impulsivity, occur in the individual depending on which brain circuits are involved (Silver, 2002). These symptoms prohibit the child from allocating or executing attention skills needed to learn or perform various activities, which is indicative of ADHD as a problem in self-control and deployment of executive function in the cognitive domain (Cutting & Denckla, 2003). Children with ADHD are described as having difficulties in sustained and selective attention (Barkley, 1997). These deficits predispose them to process information sluggishly and inadequately, leading to subsequent problems in retrieval of the same information through memory. The presence of ADHD in children can be traced back to their history, which will be marked by frequent episodes of hyperactivity and impulsivity. Once identified, ADHD can be effectively managed by cognitive-behavioral therapy and pharmaceutical intervention involving drugs that facilitate the production of the deficient neurotransmitter and those that reduce the breakdown of the neurotransmitter. On the other hand, LD, as discussed in previous sections, is a processing disorder caused by a disruption of the neural wiring in the brain. LD cannot be managed by psychiatric intervention and instead requires management in the form of skill remediation, compensatory strategies, and accommodations using various learning technologies (Silver, 2002).

Based on the intra-individual differences model, Aaron et al. (2002) tested and validated a methodology involving a series of performance measures to differentiate between children with ADHD and LD in reading. Tests on listening comprehension, in addition to those on reading comprehension, helped identify ADHD. Based on the length of the reading material, it was noted that children with ADHD perform poorly on lengthy reading passages requiring sustained attention, while performing well on short multiple choice questions involving shorter attention spans. Overall, children with ADHD produce significantly higher variance in scores than children with a LD in tests requiring continuous performance. This phenomenon is possibly attributed to the fact that children with ADHD exhibit a fluctuating attention pattern leading to inconsistency in their response to items in the test.

Although ADHD has been diagnosed in isolation in 3% of children in the United States (Center for Disease Control, 1998), reports suggest that ADHD can occur co-morbidly in 30% to 40% of children with a LD (Silver, 2002). In other words, in spite of ADHD and LD being distinct disorders, they appear together in many children. Therefore, the challenge is to determine whether the child has ADHD, LD or both. The intra-individual differences model, as discussed before, is an effective approach to differentially diagnosing whether a child has LD, LD with ADHD, or only ADHD. Discerning ADHD and LD during evaluation is complicated because of the difficulty in identifying whether, for instance, the inability to read is because of a problem with word decoding or with sustaining attention. The solution perhaps exists in the complication itself; children with

ADHD will have problems in gathering information by reading as well as listening. Children with a LD typically display this problem only in reading (Aaron et al., 2002). In making a differential diagnosis between ADHD and LD, clinicians will need to rely on a wide range of performance measures of the child.

Learning Disability: Life After High School

No matter the official diagnosis, people who experience the functional limitations associated with disabilities must overcome many obstacles in order to succeed in school, post-secondary education, and work. Both remediation and accommodation should begin during the K-12 educational system. Assisting children in the development and implementation of effective strategies to address their functional limitations is the key to success later in life.

The transition to the post-secondary environment calls for the person with a LD to take on more of the responsibility, not only in providing evidence for the disability, but also for bringing accommodation needs to the attention of professors and other staff at the post secondary institution (PSI) (Stodden & Conway, 2002). In many cases, the lessons learned early in life ensure that accommodation for a disability will become part of the daily routine. In addition, the role of technology changes from remediation, a focus in kindergarten through 12th grade (K-12), to accommodation, which is more important post-school. While in K-12 schools, much of the responsibility to provide accommodation falls upon the school. The Individualized Education Plan (IEP) must describe the services and accommodations that the child is eligible for, and it is the responsibility of the school and teachers to ensure that they are available to the student with a LD. The responsibility at the employment level is even greater in that the person must first choose whether or not to disclose the LD and then explain which accommodations are necessary to complete the essential functions of the job.

As described above, each type of LD is commonly associated with a series of functional limitations. In addition, a number of functional limitations are common to people with a LD in general. These include (Li & Hamel, 2003):

1) Difficulty with social relationships;
2) Perceptual difficulties;
3) Test anxiety; and
4) Poor study and planning skills.

These functional limitations challenge people with a LD as they move into more independent environments after high school.

Learning Disabilities in Post-Secondary Institutions

For students in post-secondary institutions (PSI), the right to accommodation is ensured by the Americans with Disabilities Act (ADA) and Section 504 of the Rehabilitation Act of 1973 (Section 504). Title II of the ADA requires that people with disabilities receive

equal opportunity to benefit from programs, activities, and services of, among other things, public education (Department of Justice, 2004). Section 504 states that "no qualified individual with a disability in the United States shall be excluded from, denied the benefits of, or be subjected to discrimination under" programs and/or activities that receive federal financial assistance (P.L. 93-112 § 794). Section 504 applies to otherwise qualified individuals, and as a result it does not guarantee the automatic acceptance of people with disabilities into post-secondary institutions or work places. However, it does allow for "reasonable accommodation" to be considered when determining eligibility.

These pieces of legislation have allowed people with learning disabilities to enroll in post-secondary institutions in greater numbers than in previous years (Levine & Nourse, 1998; Weintraub, 2005). In particular, they have fostered the growth of disability services on college campuses around the country. These offices provide a number of services to students with disabilities, including (Mangrum & Stirchart, 2003):

1) Diagnostic testing;
2) Remediation;
3) Tutoring;
4) Special courses;
5) Counseling;
6) Advocacy;
7) Advisement; and
8) Auxiliary aids and services.

In order for a student with a LD to be eligible for these services, he must verify to the PSI that he has a qualifying disability. In PSI, it is not enough to prove the existence of a disability; the disability must limit one or more major life activities. The burden of proof necessary is defined by provisions in the ADA and Section 504. The proof is usually provided via documentation from a licensed professional that includes a diagnosis of the student's disability, functional limitations, and current substantial limitations to learning (Northwestern University, 2005). Students who are enrolled at the post-secondary level are not required to disclose their disability to the institution if they do not require accommodation.

At the post-secondary level, it is the student's responsibility to notify professors of what accommodations are necessary. Therefore, it is beneficial for the student to have a working knowledge of academic strengths and weaknesses when choosing classes, advocating for accommodation, and when studying. Ideally, the student will have developed these competencies in secondary school.

According to the National Center on Secondary Education and Transition (NCSET) (Stodden & Conway, 2002), the discrepancy between the requirements for accommodation in secondary education and post-secondary education are so vast that this awareness may not be developed before a student leaves the secondary school environment. NCSET recommends that provisions be made to educate students and

parents on the changes in service provision between these two environments during high school transition planning.

It is important to note that it is not necessary for a PSI to alter acceptance criteria for a student with a disability. The laws that govern PSI services are eligibility laws and not entitlement laws, in order to be accepted a student must be qualified to complete the course of study with or without reasonable accommodation. Applicants with disabilities should review the acceptance criteria of PSI to ensure that they are qualified for the programs offered as they may vary widely between types of post-secondary institutions (i.e. between research universities and liberal arts colleges) (Vogel, Leonard, Scales, Hayeslip, Hermansen, and Donnells, 1998). Resources such as *Peterson's Guide to Colleges for Students with Learning Disabilities or ADD, 7th Edition* (available at http://www.petersons.com/books/collegeld.asp) are excellent sources of information for prospective post-secondary students with a LD. A study conducted by Vogel et al (1998) stated that while almost half of PSI they surveyed made no change to regular admissions procedures, one fifth of the admissions officers modified their admission standards.

Learning Disabilities in the Workplace

People with a LD face the same challenges as any adult who enters the workforce, with the added challenge of overcoming the assorted functional limitations associated with their disability. For instance, Stacey (2001) reported that students with a LD often described a very high level of stress on the first days at work. The lack of training and feedback on how to perform a job can incapacitate a new employee with a LD who often requires mentoring, training, and immediate feedback to succeed. In addition, people with a LD must decide whether to disclose a disability, how to accommodate their needs on the job, and how to address social situations in the workplace.

Vocational Training

For many students with a LD, the move toward academic achievement and post-secondary education can present a problem when seeking vocational training in secondary schools. The passage of the recent IDEA amendments and No Child Left Behind Act of 2001 (NCLB) are creating an atmosphere in which it is expected that all students will attend some form of PSI. As a result, opportunities for vocational training are disappearing (Weintraub, 2005). The National Association of State Directors of Career Technical Education Consortium (NASDCTEc) (2003) stated that some states were already experiencing a decline in enrollment in career technical education (CTE) as the demand for academic courses increased under NCLB.

The continuation of CTE is vital to the success of many students, including those who are disadvantaged economically or educationally and those who have disabilities. Recent data indicates that 7 years after graduation, the economic advantages of CTE were evidenced in participant's earnings (NASDCTEc, 2004). Students who continues CTE:

1) Earned approximately 2% (or $450) for each additional CTE course taken;

2) Realized $1350 in additional earnings when they concentrated their training on a specific occupational area.

This report further stated that students who took both academic and CTE courses received the greatest earnings. The fact remains that CTE is an essential component of lifelong success for many students, including those with learning disabilities (NASDCTEc, 2004). As a result, it is vital to maintain vocational programming in secondary schools. Despite this demonstration of need, data from the U.S. Department of Education reports a continuing drop in enrollment in CTE courses (Hurst and Hudson, 2001). In 2001, the U.S. Department of Education cited a drop-out rate for students with a LD of 27.1%, which is well above the 11% of students without disabilities who dropped out of high school in the same year. Student enrollment in college preparatory classes between 1982 and 1998 increased by over 30% (from 8.7% to 38.9%) and enrollment in vocational education decreased by over 8% (from 33.7% to 25%). The largest declines in vocational education occurred in the trade and industry (5%) and business (6.8%) areas (Hurst and Hudson, 2001). Proposed changes to the Carl D. Perkins Vocational and Technical Education Act of 1998 may help to address this decline. The programs proposed in the Carl D. Perkins Secondary and Technical Education Excellence Act link secondary school CTE programs with industry certification, 2- and 4-year degree programs, and registered apprenticeships. The passage of NCLB led many to think that Perkins fund money, the major source of funding for CTE, would be routed to fund NCLB Title I reading programs. The proposed Perkins Excellence Act clearly states that Perkins fund money cannot be transferred to pay for Title I programs under NCLB (Sclafani, 2004).

In some cases, CTE programs are being redesigned for the current economy. For example, South Carolina recently passed a state law titled the Education and Economic Development Act of 2005. The law is designed to address economic changes as the state moves to a technology- and research-based economy from a manufacturing-based economy. South Carolina has a poor graduation rate for its students with estimates as low as 51% (Green and Winters, 2005. The new law requires freshmen entering high school to choose a career major. Sixteen career clusters have been identified by the state, and high schools must implement at least 3 of these programs beginning in 2007-2008 school year (Richard, 2005). This project is in its infancy and no data has been recorded to verify the program's effectiveness in South Carolina schools.

Post-Secondary School

Many students with a LD who choose to pursue academic careers in post-secondary institutions reap the benefits of greater salary post-school. Recent research has indicated that people with a LD have college completion rates similar to students without disabilities (Madaus, Foley, McGuire, & Ruban, 2002). A study conducted by Madaus, Ruban, Foley, & McGuire (2003) found that the mean income of people with a LD who did not attend post-secondary education was far lower (approximately $17,900) than that of their peers who attended a PSI. In fact, the salaries of college graduates with a LD were commensurate with the general population. Dickenson and Verbeek (2002)

reported that many people with a LD were part of a "marginal workforce" (p. 176) where the rewards of work were likely to be lower.
People with a LD are entering many fields upon graduation from post-secondary education. Some of the career fields reported by people with a LD include business, education, health care, and technology (Madaus et al, 2002). Many people with a LD report that their LD can affect job performance. A survey conducted by Madaus et al (2002) found that 90% of the people with a LD surveyed reported the following functional limitations presented problems on the job [Note: These groups are not mutually exclusive]:

1) Writing skills;
2) Information processing;
3) Reading comprehension;
4) Time management; and
5) Organizational skills.

The study also reported that the following accommodations were used to address these functional limitations:

1) Setting goals and priorities;
2) Using time management;
3) Using time outside of work to complete tasks;
4) Problem-solving/brainstorming with colleagues;
5) Seeking a quiet work environment; and
6) Using proofreaders to edit written material.

Madaus et al (2003) reported that additional accommodations also helped people with a LD to succeed on the job. These included using assistive technology, assessing task demands and developing a schedule that reflects the demands, seeking social assistance, and using social skills to garner the support of co-workers. Many people with a LD are able to develop successful strategies to address their functional limitations. When these strategies are used effectively, the job satisfaction reported by people with a LD remains high (Madaus et al, 2003).

Many of the accommodations discussed above can be implemented independently by the person with a LD on the job. For accommodations that require approval by an employer, the employee with a LD must decide whether to disclose their disability to their employer. Disclosure of disability is a personal choice and yet, in order to be eligible for accommodations under the law, a person with a disability must reveal the disability. It is important to note that in order to have a qualifying disability under the law; the person with a LD must experience a substantial limitation to a major life activity, such as working or learning. Despite the availability of accommodations under the law, many people with a LD choose not to disclose because they fear discrimination in hiring practices (Dickinson and Verbeek, 2002). Madaus et al (2002) listed the following reasons for not disclosing a LD:

1) Do not see a benefit or need to disclose;
2) Fear a potentially negative impact on relationship with supervisors or co-workers; or
3) Worry it would threaten their job security.

The percentage of people with a LD who choose to disclose their disability is relatively small. A study conducted by Silver, Strehorn, and Bourke (1997) reported that the majority of people who did choose to disclose did so to a co-worker or a supervisor.

The growth of universally designed tools allows many people with a LD to use mainstream technologies to accommodate themselves on the job. The ubiquity of technology in the workplace makes many of these tools common in American workplaces. Calculators, automatic spell checking, text-to-speech programs, and auto-summary features are a few of the commonly available technologies that can aid people with learning disabilities on the job. These common technologies put people with a LD in a position to easily overcome functional limitations.

The K-12 system is in an excellent position to educate children on the existence of these helpful technologies. The growth of technology related programs in American schools must start with the education of these simple to use tools. Children who are able to use technology to accomplish tasks throughout the lifespan are at a distinct advantage in terms of succeeding later in life. They become familiar with the technology from a very young age so it is far less daunting a task to learn to use it effectively to compensate for the functional limitations that their disability presents.

References

Aaron, P.G., Joshi, R.M., Palmer, H., Smith, N., Kirby, E. (2002). Separating genuine cases of reading disability from reading deficits caused by predominantly inattentive ADHD behavior. *Journal of Learning Disabilities 35*(5), 425-436.

American Occupational Therapy Association, Inc & American Occupational Therapy Foundation.(n.d.). *Helping your child to better handwriting*. Retrieved June 16, 2005, from http://www.ldonline.org/ld_indepth/writing/handwriting.html

Amundson, S., & Weil, M. (1996). Prewriting and handwriting skills. In J. Case-Smith, A.S. Allen, & P.N. Pratt (Eds.). *Occupational therapy for children* (pp 524-541). St .Louis, MO: Mosby.

Barkley, R.A. (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin, 121*, 65-94.

Bell, N., & Tuley, K. (2003). *Imagery the sensory-cognitive connection for math.* Retrieved June 17, 2005, from http://www.ldonline.org/

Berninger, V., Vaughn, K., Abbott, R., Abbott, S., Rogan, L., Brooks, L., Reed, E., & Graham, S. (1997). Early intervention for spelling problems: Transfer from handwriting to composition. *Journal of Educational Psychology, 89,* 652-666.

Bruer, J. T. (1997). Education and the brain: A bridge too far. *Educational Researcher, 26*(8), 4-16.

Bryant, D. P., Bryant, B.R., & Raskind, M.H. (1998). Using assistive technology to enhance the skills of students with learning disabilities. *Intervention in School and Clinic, 34*, 53-58.

Catts, H.W., Hogan, T.P., Fey, M.E. (2003). Sub-grouping poor readers on the basis of individual differences in reading-related abilities. *Journal of Learning Disabilities 36*(2), 151-164.

Center for Disease Control (1998). *Attention Deficit Disorder and Learning Disability: United States 1997-1998*. Retrieved June 13, 2005, from http://www.ldonline.org/ld_indepth/add_adhd/add_ld.pdf

Cutting, L.E., & Denckla, M.B. (2003). Attention: Relationships between attention-deficit hyperactivity disorder and learning disabilities. In L.H. Swanson, K.R. Harris, S. Graham (Eds.). *Handbook of learning disabilities* (pp.125-139). New York: Guilford Press.

D'Angiulli, A., & Siegel, L.S. (2003). Cognitive functioning as measured by the WISC-R: Do children with learning dis*abilities have distinctive patterns of performance? Journal of Learning Disabilities, 36*(1), 48-58.

Department of Justice (2004). *A guide to disability rights laws.* Retrieved November 15, 2005, from http://www.usdoj.gov/crt/ada/cguide.pdf.

Dickenson, D.L. & Verbeek, R.L. (2002). Wage differentials between college graduates with and without learning disabilities. *Journal of Learning Disabilities, 35*(2) 175-184.

Donahue, P, L., Finnegan, R. J., Lutkus, A. D., Allen, N. L., & Campbell, J. R. (2001). *The nation's report card: Fourth-grade reading* 2000. *Executive summary.* Retrieved June 9, 2005, from http://nces.ed.gov/nationsreportcard/pubs/main2000/2001499.asp

Fletcher, J.M., Morris, R.D., Lyon, R.G. (2003). Classification and definition of learning disabilities: An integrative perspective. In L.H. Swanson, K.R. Harris, S. Graham (Eds.). *Handbook of learning disabilities* (pp.32-56). New York: Guilford Press.

Francis, D.J., Fletcher, J.M., Stuebing, K.K., Lyon, G.R., Shaywitz, B.A., & Shaywitz, S.E. (2005). Psychometric approaches to the identification of LD: IQ and achievement scores are not sufficient. *Journal of Learning Disabilities 38*(2), 98-108.

Geary, D.C., Widaman, K.F., Little, T.D., & Cormier, P. (1987). Cognitive addition: Comparison of learning disabled and academically normal elementary school children. *Cognitive Development, 2,* 249-269.

Geary, D. C. (2003). Learning disabilities in arithmetic: Problem-solving differences and cognitive deficits. In L.H. Swanson, K.R. Harris, S. Graham (Eds.). *Handbook of learning disabilities* (pp.199-212). New York: Guilford Press.

Gerber, P., Ginsberg, R., & Reiff, H. (1992). Identifying alterable patterns in employment successful adults for highly successful adults with learning disabilities. *Journal of Learning Disabilities, 25,* 457-487.

Gersten, R., & Chard, D. (1999). *Number sense: Rethinking arithmetic instruction for students with mathematical disabilities*. Retrieved June 23, 2005, from http://www.ldonline.org/ld_indepth/math_skills/gersten_dyscalculia.html

Graham, S., & Harris, R. (2003). Students with learning disabilities and the process of writing: A meta-analysis of SRSD studies. In L.H. Swanson, K.R. Harris, S. Graham (Eds.). *Handbook of learning disabilities* (pp.323-344). New York: Guilford Press.

Green, J.P. & Winters, M.A. (2005). Public high school graduation and college-readiness rates: 1991–2002. *Working Education Papers, 8*. New York: The Manhattan Institute. Retrieved June 22, 2006, from http://www.manhattan-institute.org/html/ewp_08.htm

Gross Tsur, V., Manor, O., Shalev, R. S. (1996). Developmental dyscalculia: Prevalence and demographic features. *Developmental Medicine and Child Neurology*, 38, 1, 25- 33.

Hartshorn, R. (1990). *Experiential learning of mathematics: Use of manipulatives*. Retrieved June 23, 2005, from http://www.ldonline.org/article.php?max=20&id=737&loc=70

Hasselbring, T. S., Gain, L., & Bransford, L.D. (1988). Developing math automaticity in learning handicapped children: The role of computerized drill and practice. *Focus on Exceptional Children, 20*, 1-7.

Horowitz, S.H. (2005). The discrepancy formula: How the aptitude-achievement formula keeps educators from doing their jobs. Retrieved September 30, 2005, from http://www.ldonline.org/ld_indepth/assessment/horowitz_discrepancy_formula.html

Hurst, D. & Hudson, L. (2001) Changes in high school vocational course taking in a larger perspective. *Education Statistics Quarterly*, *3*(1). Retrieved November 28, 2005, from http://nces.ed.gov/programs/quarterly/vol_3/3_1/q4_1.asp

Individuals with Disabilities Education Improvement Act Amendments of 2004, P.L. 108-446, 20 U.S. C. § 1400 et seq.

Jones, S. (n.d.). *Accommodations and modifications for students with handwriting problems and/or dysgraphia*. Retrieved June 15, 2005, from http://www.ldonline.org/ld_indepth/writing/dysgraphia.html

Kavale, K.A., & Forness, S.R. (2000). What definitions of learning disability say and don't say: A critical analysis. *Journal of Learning Disabilities, 33,* 239-256.

Keller, M. (2001). Handwriting club: Using sensory integration strategies to improve handwriting. *Intervention in School and Clinic*,*37*(1), 9-12.

LD Online (2005a). *Types of LD: Developmental speech and language disorders.* Retrieved June 9, 2005, from http://www.ldonline.org/abcs_info/ld_types.html

LD Online (2005b). *Early warning signs of learning disabilities.* Retrieved June 9, 2005, from http://www.ldonline.org/ld_indepth/general_info/ccld_early_warning.html

Leach, J., Scarborough, H., & Rescorla, L. (2003). Late emerging reading disabilities. *Journal of Educational Psychology, 95* (2), 211-224.

Learning Disabilities Association of America (2005). *Learning disabilities: Signs, symptoms and strategies.* Retrieved June 8, 2005, from http://www.ldanatl.org/aboutld/parents/ld_basics/ld.asp

Levine, P. & Nourse, S.W. (1998). What follow-up studies say about post-school life for young men and women with learning disabilities: A critical look at the literature. *Journal of Learning Disabilities, 31*(3), 212-233.

Li, H., & Hamel, C.M. (2003). Writing issues in college students with learning disabilities: A synthesis of the literature from 1990 to 2000. *Learning* Disabilities Quarterly, 26 (1), 29-46.

Lyon, G.R., Fletcher, J.M., Shaywitz, S.E., Shaywitz, B.A., Torgesen, J.K. (2001). Rethinking learning disabilities. In C.E. Finn, Jr., A.J. Rotherham, & C.R. Hokanson, Jr (Eds.). *Rethinking special education for a new century* (pp.259-287). Washington, DC: Thomas B. Fordham Foundation and Progressive Policy Institute.

MacArthur, C. A. (1999). Overcoming barriers to writing: Computer support for basic writing skills. *Reading & Writing Quarterly: Overcoming Learning Difficulties, 15*(2), *169-192.*

MacArthur, C., Graham, S., Schwartz, S. (1991). Knowledge of revision and revising behavior among students with learning disability. *Learning Disability Quarterly, 14*, 61-74.

Madaus, J.W., Foley, T.E., McGuire, J.M., & Ruban, L.M. (2002). Employment self disclosure of post-secondary graduates with learning disabilities. *Journal of Learning Disabilities, 35*(4), 364-369.

Madaus, J.W., Ruban, L.M., Foley, T.E., & McGuire, J.M. (2003). Attributes contributing to the employment satisfaction of university graduates with learning disabilities. *Learning Disabilities Quarterly, 26*(3), 159-169.

Mangrum, C.T. & Stritchart, S.S. (2003). *Colleges with programs for students with learning disability or attention deficit disorder: More than 750 college programs in the United States and Canada for special needs students (7th ed.).* Princeton, NJ: Peterson's Thompson Learning.

McLean, J.F., & Hitch, G.J. (1999). Working memory impairments in children with specific arithmetic learning disabilities. *Journal of Experimental Child Psychology, 74*, 240-260.

Molfese, V.J., Modglin, A., & Molfese, D.L. (2003). The role of environment in the development of reading skills: A longitudinal study of preschool and school-age measures. *Journal of Learning Disabilities, 36*(1), 59-67.

National Association of State Directors of Career Technical Education Consortium (2003). *The No Child Left Behind Act of 2001: Opportunities for career technical education*. Retrieved November 30, 2005, from http://www.careertech.org/publications/NCLBandCTEApril2003.doc

National Association of State Directors of Career Technical Education Consortium (2004*). 2004 national assessment of vocational education (NAVE): Summary Document.* Retrieved November 30, 2005, from http://www.careertech.org/publications/NAVE_Summary.doc

National Center for Learning Disabilities (2004a). *Fact sheets: LD at a glance*. Retrieved June 8, 2005, from http://www.ld.org/LDInfoZone/InfoZone_FactSheet_LD.cfm

National Center for Learning Disabilities (2004b). *Fact sheets: Dysgraphia*. Retrieved January 7, 2005, from http://www.ncld.org/LDInfoZone/InfoZone_FactSheet_Dysgraphia.cfm

National Council of Teachers of Mathematics (2005). *Overview: Principles for school mathematics*. Retrieved June 23, 2005, from http://standards.nctm.org/document/chapter2/index.htm

No Child Left Behind Act of 2001 (P.L. 107-110) 20 USC 6301 § 301

Northwestern University (2005). *Documentation of disability.* Retrieved November 15, 2005, from http://www.northwestern.edu/disability/policies/documentation.html.

Office of Special Education Programs (2002). *Strengthening the third "R": Helping students with disabilities achieve in mathematics.* Retrieved June 23, 2005, from http://ericec.org/osep/recon11/rc11sec1.html

Pellegrino, J. W., & Goldman, S. R. (1987). Information processing and elementary mathematics. *Journal of Learning Disabilities, 20*, 23-32.

Pressinger, R.W. (n.d.). Environmental causes of learning disabilities and child neurological disorders: A review of research. Retrieved June 8, 2005, from http://www.chem-tox.com/pregnancy/learning_disabilities.htm

Raskind, M. H., & Higgins, E. L. (1995). The effects of speech synthesis on the proofreading efficiency of postsecondary students with learning disabilities. *Learning Disability Quarterly, 18*, 141-158.

Reed, M. K. (1995). *Making mathematical connections in the early grades*. Retrieved June 21, 2005, from http://www.ldonline.org/article.php?max=20&id=736&loc=70

Rehabilitation Act Amendments of 1973, Section 504. (P.L. 93-112) § 794.

Richard, A. (2005). South Carolina launches career-preparation initiative. *Education Week*, 25(13), 23.

Richards, R.G. (1999). *Understanding why students avoid writing*. Retrieved June 15, 2005, from http://www.ldonline.org/article.php?id=923&loc=27

Richards, R.G. (2002). *Strategies for the reluctant writer*. Retrieved June 16, 2005, from http://www.ldonline.org/article.php?id=925&loc=27

Samuels, C.A. (2005, November 30). RTI method gets boost in special education. *Education Week*, p. 1 &19.

Sclafani, S. (2004*). Preparing America's future. Summary: The Carl D. Perkins Secondary and Technical Education Excellence Act of 2004*. Retrieved November 30, 2005, from http://www.ed.gov/policy/sectech/leg/cte/04summ.doc

Schwab Learning (2003). *Dyslexia: An overview*. Retrieved June 9, 2005, from http://www.schwablearning.org/articles.asp?r=43&f=search

Shalev, R.S., Manor, O., Kerem, B., Ayali, M., Badichi, N., Friedlander, Y., Gross-Tsur, V. (2001). Developmental dyscalculia is a familial learning disability. *Journal of Learning Disabilities, 34*, 59-65.

Shaywitz, S. (2003). *Overcoming dyslexia*. New York: Alfred A. Knopf

Siegel, L.S. (2003). IQ-Discrepancy definitions and the diagnosis of LD: Introduction to the special issue. *Journal of Learning Disabilities, 36*(1), 2-3.

Silver, L. (2002). *What is ADHD? Is it a type of LD*. Retrieved June 13, 2005, from http://www.ldonline.org/ld_indepth/add_adhd/what_is_adhd.html

Silver, P., Strehorn, K.C., & Bourke, A. (1997). The 1993 employment follow-up study of selected graduates with disabilities. *Journal of College Student Development, 38*(2), 520-525.

Stacey, W.A. (2001). The stress of progression from school to work for adolescents with learning disabilities…What about life progress? *Work, 17*, 175-181.

Stodden, R.A. & Conway, M.A. (2002). Supporting youth with disabilities to access and succeed in post-secondary education: Essentials for educators in secondary

schools. *National Center on Secondary Education and Transition Issue Brief, 1*(5). Retrieved November 15, 2005, from www.ncset.org.

Stuebing, K.K., Fletcher, J.M., LeDoux, J.M., Lyon, G.R., Shaywitz, S.E., & Shaywitz, B.A. (2002). Validity of IQ-discrepancy classifications of reading disabilities: A meta-analysis. *American Educational Research Journal, 39*, 469-518.

Vogel, S.A., Leonard, F., Scales, W., Hayeslip, P., Hermansen, J., & Donnells, L. (1998). The national learning disabilities postsecondary databank: An overview. *Journal of Learning Disabilities, 31*(3), 234-247.

Weintraub, F. (2005). The evolution of LD policy and future challenges. *Learning Disabilities Quarterly, 28*(2), 97-99.

Chapter 2: Demographics

Overall Population of School-Aged Children

The most commonly reported percentage for the prevalence of learning disabilities within the U.S. is 5% of the total population (National Research Council, 2001). However, some estimates suggest that as many as 1 in 5 people (20%) of the total population have some form of LD. School-aged children are the most commonly discussed group in learning disability research publications, however learning disabilities are not ameliorated by age and will affect individuals in different ways throughout their lives. Applying the 5% figure to the 2004 estimated population of the U.S. projects 14.7 million people have some form of a LD (U.S. Census Bureau, 2004).

Enrollment in Schools

There were more than 92,000 public schools in the U.S. as of 2003, and the number has been growing by approximately 1% per year for the last 3 years (Editorial Projects in Education, 2005). Within these schools there are more than 48 million students in grades Pre-K through 12 being taught by over 3 million teachers. An additional 5 million students are estimated to be enrolled in private schools (U.S. Department of Education, National Center for Education Statistics, 2005), and approximately 1.5 million to 1.9 million children are home educated (Ray, 2000). In total, there are over 55 million students being educated in grades Pre-K through 12.

High-Incidence Disabilities in U.S. Schools

In 2003, it was estimated that 13.4% of all elementary and secondary students had some form of a disability - translating to more than 7.4 million students (U.S. Department of Education, National Center for Education Statistics, 2004). As shown by the data illustrated in Table 2.1, and confirmed by numerous alternate sources, nearly half of all disabilities recorded in schools are specific learning disabilities (Snyder, Tan & Hoffman, 2004; NICHCY, n.d.). The data in Table 2.1 also indicates that the prevalence rates across all categories of disabilities are steadily increasing. The most notable increases were in the categories of autism and traumatic brain injuries, and developmental delay; however, these increases are attributed to changes in definitions leading to more cases falling into this classification, rather than an increase in actual incidence. The main purpose of this chart is to highlight the high incidence of learning disabilities as compared to other disabilities within the U.S.

Table 2.1: Total Number of Students Ages 3 to 21 with Selected Disabilities for the School Years between 1999 and 2002 (In thousands)

Type of Disability	1999-00	2000-01	2001-02
All Disabilities	**6,190**	**6,296**	**6,407**
Specific learning disabilities	2,830	2,843	2,846
Speech or language impairments	1,078	1,084	1,084
Mental retardation	600	599	592
Emotional disturbance	468	473	476
Autism and traumatic brain injury	80	94	118
Developmental delay	19	28	45
Preschool disabled	582	592	612

Adapted from: Snyder, Tan, & Hoffman, 2004

Elementary and Secondary School Population

Aside from the statistics reported in Table 2.1, other federal agencies report prevalence figures for students served by IDEA and students who report that they have been told that they have a learning disability. For example, the U.S. Department of Education data states that an estimated 2.7 million students between the ages of 3 and 17 who have a specific learning disability were served by an IEP during the 2003 school year (Ideadata.org, 2004). However, as demonstrated in Table 2.2, the IDEA data and the figures reported by the National Center for Health Statistics (NCHS) are significantly different. According to the NCHS, more than 4.5 million children between the ages of 3 and 17 have been identified as having a learning disability (Dey & Bloom, 2005).

Table 2.2: Students with Learning Disabilities: 2003

	Ages 3 to 5	Ages 6 to 11	Ages 12 to 17	Total: Ages 3 to 17
IDEA data	14,160	971,095	1,749,494	2,734,749
NCHS	165,000*	2,017,000**	2,379,000	4,561,000
"Gap Kids"	150,840	1,045,905	629,506	1,826,251

*NCHS age category is 3 to 4 years old
** NCHS age category is 5 to 11 years old
(Ideadata.org, 2004 and Dey & Bloom, 2005)

Data variations are the result of a number of inconsistencies amongst the methodologies used for these two studies, particularly in methods of data collection and definitions used to classify a student as learning disabled. The IDEA data uses figures based on the number of children who are reportedly served by an Individualized Education Program (IEP). Complicating the IDEA figures are state-to-state variations on the definitions of disabilities. Alternately, the NCHS data uses self-reporting techniques, and asked students if they had ever been told that they have a learning disability. These figures suggest that although a number of students have been identified at some point in their lives as having a learning disability, they are not necessarily receiving special education

support from their schools. In fact, only 59% of the students identified by the NCHS data reportedly receive services for a LD under the IDEA. These statistics demonstrate the enormous population of "at risk students" or "gap kids," which includes struggling students who do not have severe limitations resulting from their LD, but who are affected by it nonetheless. Educators must attempt to acknowledge these students to avoid enabling them to fall through the cracks. Once an at-risk student is identified they can be monitored for progress, and provided with appropriate supports when necessary.

Secondary School Completion and Drop-Out Rates

Between 1987 and 2003, there was a 17.9% increase in high school completion for students with learning disabilities, bringing the overall completion rate to 74%. A corresponding reduction in the dropout rate was also recorded, bringing the overall dropout rate for students with learning disabilities to 26% (Wagner, Newman, Cameto, Levine, 2005). The changes in the completion and dropout rates for students with learning disabilities demonstrate the advancements in education for students with learning disabilities. In comparison, students in the general population have somewhat higher completion rates (86.5%) and lower dropout rates (10.7%) than students with learning disabilities (Kaufman, Alt, & Chapman, 2004). However, between 1987 and 2001, there was an increase of only 1.8% in the completion rate for all students, and a 2.0% decrease in the dropout rate. Thus, the rate of improvement for the overall population was lower than that which was noted for students with learning disabilities. The challenge for educators will be to raise the completion rate and lower the dropout rate for all students, while ensuring that students with learning disabilities continue to move towards parity with their non-learning disabled peers.

Employment after Secondary School

In 2003, approximately 78.5% of students with learning disabilities had worked for pay at some point in time since leaving high school, an increase of 16.3% from 1987 (Wagner, Newman, Cameto, Levine, 2005). It should be noted that there was a significant decrease in the number of individuals working full-time (35 hour per week or more), dropping from 61.7% in 1987 to 38.4% in 2003. This drop in full-time employment can likely be correlated with the increase in the number of students pursuing post-secondary education, signifying that more students with learning disabilities are attending post-secondary institutions while also working part time. Additionally, these individuals experienced a notable shift in the type of jobs held, transitioning from clerical and maintenance jobs to retail positions. This change is also indicative of the increasing employment within part time jobs that can be held while pursuing a post-secondary education. For those who are working, an estimated 87.3% of these individuals earned more than the federal minimum wage, which represents an increase of 9.2% as compared to the number of workers earning more than the federal minimum wage in 1987.

Post Secondary Institutions

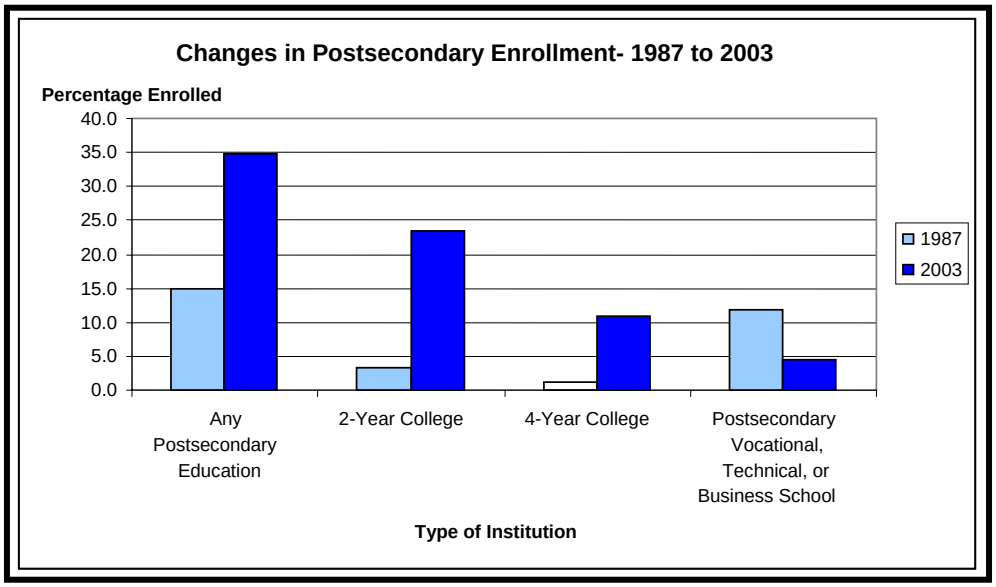
Post-Secondary Enrollment

Nearly 16 million students enrolled in post-secondary degree programs in the U.S. Nearly 90% of the 12.2 million students enrolled in public post-secondary schools are pursuing an undergraduate degree. The other 10% are split between public graduate degree programs (9%) and public first-professional degree programs (1%). The remaining 3.7 million students are enrolled in private degree granting institutions, with 73% pursuing an undergraduate degree, 21% studying for a graduate degree, and nearly 5% earning a first professional degree (U.S. Department of Education, National Center for Education Statistics, 2003).

Students with Learning Disabilities in Post-Secondary Education

As illustrated by Figure 2.1, approximately 35% of all students with learning disabilities who completed high school enrolled in some form of post-secondary education- an increase of nearly 20% from 1987. Two-year colleges saw the greatest increase, with approximately 23.4% of these students enrolled in this type of institution. Four-year colleges also experienced a significant increase, bringing in 11% of students with learning disabilities who were attending any postsecondary institution. Postsecondary vocational, technical, and business school attendance experienced a drop across disability categories, with the largest decreases seen in students with learning disabilities (7.4% decrease) and speech/language impairments (10.2% decrease). There is a growing trend amongst all students who complete high school toward pursuing higher education. As a result, the decrease in vocational and technical school enrollment is not limited only to students with disabilities, but rather is seen throughout the entire population (Hurst and Hudson, 2001).

Figure 2.1- Post-Secondary Enrollment of Students with Learning Disabilities



Adapted from: Exhibit 4-2 from Wagner, Newman, Cameto, Levine, 2005

Impact of Learning Disabilities in the U.S.

Students who do not continue their education past high school will find that a noticeable difference in average salary level between students with and without a LD. According to the U.S. Department of Commerce (2003), the median salary for the overall population of those who did not pursue post-secondary education was approximately $21,056. However, the average salary of people with a LD who have the same level of education was only $17,900. Higher education generally leads to increases in earnings, and this is true for people with and without a LD. In fact, the salaries of people with a LD who attended a post-secondary educational institution were commensurate with national averages (Madaus, Ruban, Foley, & McGuire, 2003). It appears that those people with a LD who completed post-secondary schooling have learned how to successfully overcome their limitations and continue to apply those skills throughout their lives. An estimated 80% to 90% of employees who have a LD made accommodations for their disability. The majority only required a quiet work environment (35%) or close attention to proofreading (35%). Other accommodations included catching up outside of work (32%), and using assistive technology (AT) (24%). Additional proof of the efficacy of these accommodations was published in 2002, stating that of college graduates who have a learning disability, 87% were employed full-time and satisfied with their employment (Madaus, Foley, McGuire, & Ruban, 2002).

In the coming years, more products will become available to aid students with learning disabilities. Trends towards universal design are promising, eliminating the stigma associated with AT devices by making products that are usable by and attractive to all students. As students with learning disabilities become aware of the methods and products available to help them overcome their limitations while in school, it is likely that their educational attainment levels will rise, propelling them into post-secondary education, and ultimately, rewarding and profitable careers.

References

Dey, A.N., & Bloom, B. (2005). Summary health statistics for U.S. children: National Health Interview Survey, 2003. National Center for Health Statistics. Vital Health Stat 10(223).

Editorial Projects in Education. (2005). Education counts: Number of public schools. Retrieved September 21, 2005, from http://edcounts.edweek.org/createtable/viewtable.php

Hurst, D. & Hudson, L. (2001) Changes in high school vocational course taking in a larger perspective. Education Statistics Quarterly, 3(1). Retrieved November 28, 2005, from http://nces.ed.gov/programs/quarterly/vol_3/3_1/q4_1.asp

Ideadata.org. (2004). Table AA15: Racial/ethnic composition (number) of students ages 6-12 served under IDEA, Part B by disability, 2003. Retrieved October 6, 2005, from http://www.ideadata.org/tables27th/ar_aa15.xls

Kaufman, P., Alt, M.N., and Chapman, C. (2004). Dropout rates in the United States: 2001. Retrieved November 30, 2005, from http://nces.ed.gov/pubs2005/2005046.pdf

Madaus J.W., Foley T.E., McGuire J.M., & Ruban L.M. (2002). Employment self-disclosure of post-secondary graduates with learning disabilities: Rates and rationales. Retrieved February 7, 2006, from http://www.ingentaconnect.com/content/0022-2194.

Madaus, J.W., Ruban, L.M., Foley, T.E., & McGuire, J.M. (2003). Atributes contributing to the employment satisfaction of university graduates with learning disabilities. *Journal of Learning Disabilities*, 26(3), 159-169.

National Research Council. (2001). Fact sheets: LD at a glance. Retrieved July 19, 2005, from http://www.ncld.org/LDInfoZone/InfoZone_FactSheet_LD.cfm

NICHCY. National Dissemination Center for Children with Disabilities. (n.d.). Learning disabilities: Fact sheet 7. Retrieved September 28, 2005, from http://www.nichcy.org/pubs/factshe/fs7txt.htm

Ray, B.D. (2000). Home education research: Fact sheet IIe of NHERI. Retrieved October 7, 2005, from http://www.nheri.org/modules.php?name=Content&pa=showpage&pid=18

Snyder, T.D., Tan, A.G., and Hoffman, C.M. (2004). *Digest of Education Statistics 2003*, (NCES 2005–025). U.S. Department of Education, National Center for Education Statistics. Washington, DC: Government Printing Office.

U.S. Census Bureau. (2004). Table 1: Annual estimates of the population for the United States and States, and for Puerto Rico: April 1, 2000 to July 1, 2004. Retrieved September 6, 2005, from http://www.census.gov/popest/states/tables/NST-EST2004-01.pdf

U.S. Department of Commerce, Bureau of the Census. (2003). Current Population Survey, March 2002, previously unpublished tabulations. Retrieved February 7, 2006, from http://nces.ed.gov/programs/digest/d03/tables/pdf/table389.pdf

U.S. Department of Education, National Center for Education Statistics. (2003). *Table 2: Enrollment in educational institutions, by level, and control of institution: Selected years: Fall1980 to Fall 2005.* Retrieved November 7, 2005, from http://nces.ed.gov/

U.S. Department of Education, National Center for Education Statistics. (2004). Digest of education statistics, 2003. Retrieved December 1, 2005, from http://nces.ed.gov/fastfacts/display.asp?id=64

U.S. Department of Education, National Center for Education Statistics. (2005). *Common Core of Data, 2002-03, Preliminary 0g.* Retrieved September 21, 2005, from http://nces.ed.gov/ccd/quickfacts.asp

Wagner, M., Newman, L., Cameto, R., Levine, P. (2005). Changes over time in the early postschool outcomes of youth with disabilities. Retrieved November 29, 2005, from http://www.nlts2.org/pdfs/str6_completereport.pdf.

Chapter 3: Education Technology

Introduction

School district decision makers struggle to provide the most relevant technologies to teachers that will make their jobs more efficient and productive and that respond to legislative initiatives. Teachers must not only select technologies that will make their instruction more effective for all of their students, given the diverse learning needs of classroom populations; they must also identify technology tools that will allow each student to gain and demonstrate knowledge. This is a challenge that the text-based curriculum in American schools is making very difficult to overcome.

Today's classrooms are comprised of more diverse learners than ever before. Reflecting recent educational and societal movements, over 95% of students with diagnosed disabilities participate in the general education classroom alongside their peers (USDE, 2001). A majority of these students have specific kinds problems that cause them to have trouble learning. A learning disability is a general term used to describe a student with specific learning problems that effect reading, writing, listening, speaking, reasoning, and doing math (NICHY, 2004). A major problem for these students is that the majority of materials, including textbooks, workbooks, worksheets, trade books and written tests, are provided in inaccessible standard print format that students with LD and those at-risk of failure in schools cannot comprehend.

For independent learning, students with learning disabilities may require the material to be presented using sound, text and images in alternate, multi-media formats. Alternative format is defined as "any medium or format for the presentation of instructional materials, other than a traditional print textbook" (Chafe Amendment, 1996). Alternative formats include: Braille, large print, open and closed captioned, audio, or an electronic file in an approved format. No single medium is preferred by all students. Therefore, the challenge for schools across the nation is how to provide authentic access to the existing general education curriculum for students with disabilities.

Students with a LD and those labeled at-risk for failure in schools are also likely to leave the school environment without a diploma or certificate of completion, placing them at a greater risk of long-term failure in society (Grumline & Brigham-Alden). By modifying how information is provided, educators can ensure that all students can access information in ways that are understandable to them. Given that children today have grown up with technology, it is an effective and efficient way to provide instruction in the K-12 environment (Peterson-Karlan & Parette, 2005).

Universal Design for Learning (UDL) is an approach to instruction, learning, curriculum development, and assessment that uses technology to respond to a variety of individual learning differences. A central focus of UDL is to promote the development of new curricular materials and learning technologies that are flexible enough to accommodate the unique learning styles of a wide range of individuals, including children with

disabilities. Some examples of UDL include: accessible Web pages; digital versions of textbooks and other curricular materials; captioned and/or narrated videos; word processors with word prediction; speaking spell checkers; talking dialog boxes; voice recognition; and picture menus (CAST, 2005a).

Due to recent legislation and societal trends, many commercial technology developers now include features enabling a wider range of diverse learners with different abilities, languages and learning styles can successfully use their products for learning. Software features such as changeable displays, text highlighting, keyboard commands, progress monitoring and speech options are more frequently included in the design of mainstream education technology products. Many of these features were primarily found in assistive technologies (AT); those designed for individuals with disabilities. By including them in new products, they not only improve the opportunities for children to learn, but also increase the potential market share of small AT companies. When a company designs for all using UDL principles, they can also sell to all. This allows them to take advantage of the larger pots of technology monies available to American schools.

The boundary between assistive technology and education technology is becoming blurred in American schools. Assistive technologies are often seen as tools for students with disabilities in core functional areas such as vision, mobility, and communication. In order to maintain funding mandates for students with disabilities who require technology, any technology that is needed by a student with a learning disability to participate in the general curriculum is considered AT (Edyburn, 2000). Many companies are embracing the principles of universal design for learning that supports that idea than any technology used in classrooms should enhance the academic performance of all students. In spite of this trend in the industry, there is still an artificial distinction between what is considered education technology and what is considered assistive technology. As students with and without disabilities learn together in the same classrooms, all students should have the opportunity to benefit from an expanded inventory of well designed technologies.

The following technologies are categorized into three sections: instructional technologies, learning technologies including assistive technologies, and emerging technologies. Although they are listed separately, they overlap in how they are used. As teachers begin to integrate the technologies into curricular activities, results and feedback from the students provide the necessary information of what technologies work best to address the daily instruction and learning tasks.

Technologies

Instructional Technologies

Instructional technology products are selected by school districts and individual classroom teachers to support the instructional process. By setting up flexible learning environments, these technologies help to address diverse learning needs of students. The principles of UDL provide guidelines for instruction that is designed to offer multiple means of representation, expression, and engagement (CAST, 2005b), by incorporating

multi-sensory components. The selection of these technologies must take into consideration the needs of all classroom learners and result in technologies that are most adaptable to any need.

Presentation Technologies

Interactive Whiteboards

Interactive whiteboards combine the power of the computer, its software and the internet into the classroom environment effectively and easily. They provide a way for students to interact with each other and computer-based material. Similar in size to a standard chalkboard, any software application or website can be projected on the whiteboard for large or small group instruction. For example, tables in Microsoft Excel can be brought up in math lessons to make bar or pie graphs and tables, or a microscope can be connected to the computer screen in science lessons to display insects or hair strands. Whiteboards can be used as simple touch screen technology where a teacher or student touches the board to interact with the software or website. Notes and annotations can be added over the software pictures and videos from the Internet. They can then be saved to a computer or printed. Recording the lesson in this way allows the teacher to capture and synchronize multi-media voice, screens and annotations for later review. Whiteboards can make the classroom environment more engaging for all students by presenting information in multiple formats to meet the needs of many individual students.

Interactive whiteboards are manufactured by companies such as Smart Technologies (http://www.smarttech.com/), which makes SMART Boards and Polyvision (http://www.polyvision.com/), which makes the Lightning Interactive Whiteboard. Other products, such as the Mimio Xi made by Virtual Ink (http://www.mimio.com/meet/xi/), attaches to any whiteboard up to 4 feet by 8 feet in size to create an interactive board. The Mimeo Xi is portable.

Classroom Amplification

Classroom amplification with soundfield systems amplify and disperse the teacher's voice evenly throughout the classroom, while filtering environmental noises. These systems help to ensure that every student, regardless of seating location, consistently hears and understands what the teacher is saying. Most sound field systems amplify the teacher's voice 8 to 10 dB above other sounds in the room (Wilson, n.d.), which helps to reduce distracting sounds for all students. Studies show that students learn 30% more in classrooms with audio amplification (Listen Technologies Corporation, n.d.). According to DiSarno, Schowalter, and Grassa (2002), the signal-to-noise ratio in classrooms typically measures well above the American Speech, Language and Hearing Association (ASHA) recommended levels resulting in substandard acoustical environments for learning. Studies indicate that amplification systems allowed teachers to gain and maintain student attention and resulted in less need to repeat oral instruction. In addition, teachers reported less vocal strain and fatigue (DiSarno, Schowalter, and Grassa, 2002). The integration of amplification systems in the classroom benefits children with learning

disabilities and creates a more conducive environment for learning for all children in the classroom. Although personal systems have been available for students with hearing impairments for years, recent studies have shown that all students benefit from classroom-based amplification systems. While FM systems and infrared systems, provide benefits similar to soundfield systems, they are more expensive to install and more stigmatizing for individual students (DiSarno, Schowalter, and Grassa, 2002).

Classroom amplification systems are produced by a number of companies. Phonic Ear (http://www.phonicear.com/default.asp) offers the FrontRow Pro products, which use infrared signals to wirelessly transfer the teacher's voice to speakers around the classroom. The FrontRow division of Phonic Ear focuses on improving the learning environment in elementary and secondary classrooms. Listen Technologies Corporation (http://www.listentech.com/) and Centrum's Radium system (http://www.centrumsound.com/sf-radium.html) also produce soundfield systems. The Radium system allows free movement around classroom; a second transmitter can be passed around to students for group discussions.

E-Learning

E-Learning is education or training provided via communications technology (Wikipedia, 2006). Online classes and e-learning opportunities are offered in many areas of instruction at the college and professional development levels. At the K-12 level, the National Association of State Boards of Education (NASBE) recommended that schools create policies to engage K-12 students in online learning opportunities (NASBE, 2001). Learning Point Associates (2002) reports that access to online learning in K-12 environments has experienced steady growth through funding supplied by the Technology Literacy Challenge Fund and the Federal Communication Commission's (FCC) e-rate program (see the legislations and funding section for additional information). In keeping with the principles of UDL, the internet provides learning opportunities that are centered on the learner's strengths and needs (Web-Based Education Commission, 2000). However, when instituting an online learning environment, the quality of the course content and interaction must be monitored to ensure that it is both engaging and of high quality. Current studies on online classes have not proven that the benefits outweigh the risks of non-engagement as a result of a poorly designed course (Jones and Paolucci, 1997).

Few studies of the effectiveness of online learning environments in the K-12 environment have been conducted. Companies such as Class.com has emerged as a leader in providing standards based curriculum for secondary schools. Class.com, which was originally created with a U. S. Department of Education Star Schools grant, offers high school curriculum for students with a focus on those who are at-risk of failure in schools. The company provides a classroom environment that removes competition with peers and facilitates self-paced learning (Class.com, 2004). Class.com recently formed a partnership with Blackboard Learning Systems to provide its secondary school curriculum with the Blackboard software platform for web-enabled classrooms (Blackboard Inc., 2005b).

A great deal of research on e-learning has been conducted at the post-secondary level. A study conducted by Rovai and Barnum (2003) identified teacher-student and student-student interaction as a key factor in determining the success of an online class. The Study stated that online teaching environments such as Blackboard and WebCT created a suitable environment for the creation of effective online courses, but it was the way in which the teaching environments were used that determined effectiveness and not the teaching environments themselves. Rovai and Barnum (2003) further stated that participation in active online discussions indicated positive outcomes, which according to the authors, "affirms the importance of providing opportunities for online students to learn by active interaction with each other and with the instructor (p. 70)." Research shows that online courses are becoming increasingly popular. A study performed on behalf of Blackboard, Inc. found a tenfold increase in the number of courses offered from the spring semester of 2003 to the fall semester of 2005 (Blackboard, Inc., 2005c). More K-12 institutions use Blackboard, or similar online learning environments, for professional development for school staff and teachers and to enhance course materials for students.

There are a number of products available for the creation and presentation of online courses. Blackboard Learning System™ (2004) is designed to address three key areas: instruction, communication, and assessment. In the realm of instruction, Blackboard offers features including course management, content authoring, syllabus builder, and personal information management to track schedules, tasks, and messages. A feature known as Course Cartridges®, resulted from collaborations between major publishers and Blackboard to create pre-packaged content and course materials. Features of the Course Cartridge curriculum include content related readings, regularly updated information, multimedia features, and ideas for questions related to the course content (Blackboard Learning System, 2004). Communication between teachers and students is facilitated in the Blackboard learning environment using threaded discussion boards, group projects, and a virtual classroom environment that supports live interaction and chats. Course assessment is an increasingly important means to track learning in an online environment. Blackboard (2004) supports assessments and surveys that can be delivered through the course software. Assignments can be given in the Blackboard environment and submitted the included electronic grade book for easy tracking. The grade book stores student scores and can support "custom grading scales, grade weighting, and item analysis (p. 3)." Finally, reporting features enable teachers to track which students have completed the course work, and to report on usage data for the course.

WebCT is an online course environment that simplifies course preparation in online environments. Course management features allow the instructor to track student participation and progress, and special student tools provide students with current information on their progress in the course. WebCT also creates an environment in which colleagues can distribute and reuse information within an institution (WebCT, n.d.). Blackboard, Inc. and WebCT merged in 2005 and Blackboard will assume maintenance and improvements on WebCT products (Blackboard, 2005a).

Internet Access

Internet access has become commonplace in today's classrooms. The internet is increasingly used as a primary resource for instruction and learning support (National Center for Education Statistics (NCES), 2002). Digital inclusion for students with learning disabilities, students with literacy difficulties, and English language learners is growing in importance as web-based learning increases in popularity (Texthelp, 2005). Careful consideration must be given to selecting an adjustable, flexible browser and email client which uses the internet to send written messages from one user to another.

Web Browsers

A web browser is a piece of software that allows navigation of the internet and access to text, graphics, hyperlinks, audio, video, and other multimedia (Research Zone, 1999). There are many web browsers available today. Web browsers for classroom environments should have features that adjust for multiple users.

Internet Explorer (www.microsoft.com/windows/ie/default.mspx) is used by approximately 90% of people who use Windows software (Mossberg, 2004). Windows offers a customizable interface allowing users to add and remove the buttons that execute the program's functions when the user clicks on them. By adding and removing buttons, adjust the text size and color on the web pages that users view, and change the layout of the browsing environment. However, it does not offer tabbed browsing, forcing the user to open and navigate between multiple pages. Meanwhile, as stated by Forbes.com (2005b), Internet Explorer has numerous security issues. Information about Internet Explorers security features is available on its website; automatic security updates are offered via a function called Windows Update (Microsoft, 2005).

Opera browser (www.opera.com) offers security in the form of protection from spyware, viruses, and pop-up ads. Tabbed browsing allows the user to open many pages simultaneously and to move between them easily. Although Opera is simple to use in its standard format, it is highly customizable. An optional password tool, called the "Wand" remembers user's passwords. Opera also allows voice commands. Opera browser can be used in lessons where graphics play an important role as it supports scalable vector graphics (Opera, n.d.). Opera Browser claims a 1% share of the market for web browsers. While it does not occupy much of a computer system's memory, it cannot properly display many pages designed for compatibility on Internet Explorer (Forbes.com, 2005c).

Mozilla's Firefox (www.mozilla.org/products/firefox/) browser is used by approximately 90 million people, which is actually about 10% of the web browser market. Firefox is an open source product that features many of the same benefits offered by Opera Browser, including pop-up blocking, tabbed browsing, protection against spyware and ActiveX controls, and RSS. (Note: RSS is a headline system that allows headlines of items on the web, such as news or software updates, to be reported via a web browser [Pilgrim, 2002]). Mozilla Firefox also offers live bookmarks, extensions that allow users to download additional utilities (i.e. automatic form completion), themes that can change the

browser's look, and FastFind, a feature that allows users to find specific words within an open web document. Firefox also offers FoxyVoice, a free text-to-speech option for reading web pages (Mozilla, 2005; Mossberg, 2004). Forbes.com (2005a) reports that Firefox can occupy a user's Windows memory if left open for too long.

Many other web browsers are growing in popularity including Apple's Safari (www.apple.com/safari) that works only in the Macintosh-based computing environment, Netscape Navigator (browser.netscape.com/), K-Meleon (kmeleon.sourceforge.net/), and Camino (www.mozilla.org/products/camino/).

Child-specific web browsers add safety features to web exploration. These include:

- Kidsplorer (http://www.devicode.com/kidsplorer/)
- KidRockets (http://www.softpedia.com/get/Internet/Browsers/KidRocket-Kid-Safe-Web-Browser.shtml)
- KidsBrowser (http://kidsbrowser.com/)
- BumperCar (http://www.freeverse.com/bumpercar2/)

For students with a LD that impacts their ability to navigate the internet with the text-based browsers described above, Ablelink has designed a picture-based interface called Webtrek. Webtrek (http://www.ablelinktech.com/_desktop/webtrek.asp) The browser allows users to select a picture from the web page as a reminder of the site on the user's home screen. Clicking on any of the pictures on the home screen will return the user to that page.

Text-to-Speech for the Web

Many students with a LD benefit from hearing the written text on websites read aloud to them. Several text-to-speech (TTS) products are available that provide this option. The following paragraphs provide examples.

Browsealoud (http://www.browsealoud.com/home.asp) makes it possible for companies to speech-enable their websites. Companies pay annual fees to use Browsealoud technology and the software that the end user requires to hear the page is free (Texthelp, 2005). Many features are available from Browsealoud including dual-color highlight, continuous read, editable pronunciations, and multiple languages. Enhanced browsing features enable readers to determine how they would like the information read to them. The software is compatible with a number of different web formats, including accessible PDF and Flash (Texthelp, 2004).

Many other software products provide speech output. These products have varying capabilities to read text in different forms. Examples of products include ReadPlease (http://www.readplease.com/), a free utility available for download by the user; Kurzweil 3000 (http://www.kurzweiledu.com/products_k3000win.asp) available for both Windows and Macintosh computing environments; and TextAloud MP3 (http://www.textaloud.com/) which speech enables web browsers, email, and other PC applications, but also allows the user to create MP3 or WMA files for use on portable

listening devices like iPods, PocketPCs, and CD players (NextUp Communications, 2005).

Email Systems

Teachers frequently use email to increase writing opportunities for students. They frequently correspond with other classrooms around the country or the world. These collaborative classrooms engage in cross-cultural exchanges, project-sharing and language skills while learning to communicate and navigate with a computer. These programs can also bolster students writing skills. For example, the ePALS (http://www.epals.com/community) on-line classroom community provides a "safe" email community for over 6.5 million students worldwide (ePALS Classroom Community, 2006).

Email programs with enhanced features for people with disabilities include products like V3 Mail and I Can Email. V3 Mail (http://www.v3mail.com/) offers users a way to send video emails. V3 Mail can be sent using a free, internet based email account. This software offers voice messages (MP3) as well as TTS options for students. Digital Pictures can be sent easily as the program permits drag-and-drop and automatic re-sizing of images (8 Bit Software, 2000). The TTS feature also includes translation from several languages. I Can Email, an R.J. Cooper product (http://rjcooper.com/icanemail/) allows users to send email simply using graphics and voice. Anyone receiving messages notices no difference between I Can Email messages and regular email (R.J. Cooper, 2005). Webtrek from AbleLink (http://www.ablelinktech.com/_desktop/) also offers a picture-based search engine and Webtrek Connect, an email system that enables recording and playback of audio messages. The system can also read emails to users (Ablelink, 2005). CogLink, an email program designed for people with cognitive disabilities, offers a simple interface. CogLinks "Help Desk" provides assistance in setting up and using the system. More information on this technology is available at http://www.coglink.com/email/.

Educational Resources on the Web

Educational websites that provide multimedia content are increasingly available for teachers and students to use at home and in school. Many of these websites provide excellent examples of UDL by virtue of their multi-sensory design. When using educational resources on the web, it is important to ensure that all students can access them. Educational websites should respond to keyboard commands for students who have difficulty using a mouse. These web pages should also be TTS-equipped. The key to an accessible website for students is multiple access points to ensure that all children can access the material. For example, sites like BrainPOP offer multimedia (Flash) animated videos on a large number of topics for students in science, math, social studies, health, technology, and English. Each movie offers a multiple-choice quiz to test knowledge, a comic strip, an experiment, a timeline of related events, and a printable activity page. The teacher's section offers lesson plans and links to national standards to ensure that the animated films match with the required curriculum. BrainPOP is a subscription-based

service that 20% of American schools subscribe to. The majority of subscribing schools are elementary and middle schools, but some high schools also subscribe. Teachers who use it to augment classroom instruction and to introduce new topics, report an increase in the engagement of students (BrainPOP, 2005). However, if students need TTS functionality on the non-audio portions of the site, the graphical nature of BrainPOP does not allow this.

Cool Math (http://www.coolmath4students.com/) is a website that provides mathematics lessons for students who need additional support. Cool Math is text-based and can be read with TTS software. The website also provides explanations of math formulas, business math, and currency facts. Additional areas are available for teachers and parents (Coolmath.com, Inc. 2005). The site hosts advertisements.

At Windows to the Universe (http://www.windows.ucar.edu), students can review information on the Earth and Space sciences by selecting one of three reading levels. The site incorporates images, movies, animations, and data sets related to the sciences, making learning meaningful to a broad range of student abilities.

Other websites offer real-time support to struggling learners. For example, idictate.com (http://www.idictate.com/) offers a dictation service with live typists. This site can make students with learning disabilities in writing more independent. This site can remove the student's need for a family member or amanuensis to transcribe the student's written assignments. The company typically charges by the minute and turnaround time varies between 24 minutes and 24 hours (iDictate, Inc., 2000). Webmath is a website that assists students and teachers with math problems ranging from simple math to trigonometry and calculus. Teachers can create auto-graded assignments online for their students. Three relevant features allow students to see math problems solved step-by-step. Students can also ask an expert for an explanation of their problems (Webmath, n.d.). The assistance available on Webmath can prove invaluable to students who have learning disabilities in math.

Other Tools for the Web

Web logs (a.k.a. blogs) are beginning to make their way into the classroom as a means for students to keep online journals. These are free, easy-to-use online forums where students can practice writing, post pictures, and share their writing with others. They may also provide alternative expressive opportunities for students who find speaking difficult.

Blogger.com (http://www.blogger.com/start) is a commonly used website for creating web logs. Many teachers create class websites with tools such as Yahoo! Groups (http://groups.yahoo.com/). The groups serve as forums where a class can post files and share messages. Yahoo! Groups in particular are free and membership can be controlled by the creator of the group. Another web tool that is becoming more popular in schools is Virtual fieldtrips. This tool enables students to experience information that is usually only available on-site. For example, the Library of Congress (http://www.loc.gov/index.html)

virtual field trip site allows students to travel back in time and become a part of American History. Virtual Fieldtrips available at http://www.field-trips.org/trips.htm provides a variety of experiences and resources, including a tour of the Louvre in Paris.

Teachers can also create their own virtual fieldtrips using software like Tourmaker (http://www.field-trips.org/tm/index.htm) or by accessing online environments such as the Utah Education Network (http://www.uen.org/utahlink/tours/). A program called WebQuest allows students to explore the web in a targeted manner for assignment. WebQuest activities can be completed with information that is available from the Internet (March, 1998). A "Best of" WebQuest site is available at http://bestwebquests.com/default.asp.

Learning Technologies

Technologies for Reading

There is a wide range of technology tools that support both content and learning process. Their application is divided according to basic academic areas of reading, writing, math and study tools.

A Definition of Learning Disability in Reading

The curriculum in U.S. schools is centered on text. Students must be able to read in order to succeed in almost any subject. For many students, reading is not a skill that is easily mastered. In order to read effectively, students must be able to decode information, comprehend what they are reading, and retain the information that they have read (WGBH Education Foundation, 2002). A fairly large percentage of the American population, approximately 15%-20%, experience learning disabilities in reading (Senate Bill 5664, 2005). Approximately 70%-80% of all learning disabilities diagnosed are learning disabilities in reading (International Dyslexia Association (IDA), 2005; Kidder, 2004).

Manifestations and Functional Limitations of People with Learning Disabilities in Reading

Typical functional limitations for people with dyslexia include difficulty with phonics (the predictable relationship between sounds in a language), fluency and decoding words, developing vocabulary, comprehending the meaning of material read, focusing attention and organizing ideas, listening, paying attention, and following instructions. Remediation for children with a LD in reading is often the first goal of school based instruction. In many cases, students with a LD in reading who use AT are able to compensate for these functional limitations when they are able to access text in alternate formats such as speech input or output, using digital formats, and automatic digital highlighting of text (Landeros, E., and Spenser, V., personal communication, February 14, 2005). It is hoped that the National Instructional Materials Accessibility Standard (NIMAS) will facilitate this access (see section on Legislation for additional information).

Accommodations for Learning Disabilities in Reading

Strategies to Improve Phonemic Awareness

Difficulty with phonemic awareness will affect the reader's ability to sound out words because of a disconnect between the typical alphabetic patterns and the sounds that correspond with those patterns (National Institute for Literacy, 2004). Phonics technologies typically use methods of sounding out words, teaching the proper blending of those sounds, and reading out loud. Software programs such as Reading Rabbit or JumpStart Phonics use multimedia games to address this functional limitation. When choosing a specific method or program for a student or adult learner, it is also important to ensure that age-appropriate strategies are used.

Products to Improve Phonemic Awareness

One of the most common forms of instruction used for teaching students with a LD in reading is phonics. The National Institute for Literacy (2004) has defined phonics as:

> "a form of instruction to cultivate the understanding and use of the alphabetic principle, that there is a predictable relationship between phonemes (the sounds in spoken language) and graphemes (letters numbers and other symbols), the letters that represent those sounds in written language and that this information can be used to read or decode words (para. 30)."

Numerous companies produce reading software focused on the phonics method. The JumpStart Phonics Learning System by Knowledge Adventure is designed as a multimedia system to aid children ages three through eight in learning to read through phonics. JumpStart includes a series of learning games consisting of practice activities for various skill levels, and also "Read 'n Respond" technology, which allows the user to read into the computer's microphone and interact with the software using IBM's ViaVoice software. JumpStart Phonics, a less complex software from this company (also sold separately) is included in this package as well (SuperKids Educational Software Review, 2004).

Numerous titles focus on the phonics method. The First "R" by Milliken Publishing, is used for teaching alphabet, sounds, blending, main idea, sequencing, and syllables, using short stories activities and games. Using a multimedia approach, words are spoken and displayed (National School Boards Association, 2001). Clifford the Big Red Dog Phonics by Scholastic, Inc allows young users to complete a series of phonic drills broken up by "prize" sessions where they use the prizes they earn to decorate floats, build Ferris wheels, and participate in other activities related to a carnival theme. The game's difficulty increase as the user improves (Superkids Educational Software Review, 2004). 3D Froggy Phonics for ages 4-8 features three modes: learn, watch, or play. This Ingenuity Works, Inc. software enables users to learn the sound of letters and play games to test their skills (Superkids Educational Software Review, 2004). Inclusive TLC's From A to Z allows users of all ages to practice letter recognition, letter sounds, and word

recognition by pressing a letter to see a word, clicking on a picture to hear the word, playing memory games, and completing word building activities (Inclusive TLC, 2004).

Other software companies have innovated by incorporating the capability to read aloud to the computer and get feedback into phonics software. Reader Rabbit's Reading Adventures for ages 4-6 and Reader Rabbit's Reading Adventure for ages 6-9 lets users listen to a passage and can then read it aloud into their computer microphone and record their own passage to compare it to the version read by the computer. This software, by The Learning Company, features 30 storybooks and 15 learning activities (Superkids Educational Software Review, 2004).

Many phonics programs use series of drills to improve reading speed such as Reading Blaster for ages 4-6 and Reading Blaster ages 7-8. Made by Knowledge Adventure, Reading Blaster's kindergarten level drills letter recognition, phonics, sentence construction, rhyming, spelling, and more. Users complete sets of games at five different levels in search of hidden treasure. The software also features flash cards, a word processor, and a star chart to track progress. Reading Blaster for 7- and 8-year-olds uses five levels to drill comprehension, phonics, word order, sentence construction, syllables, and spelling as users attempt to save the planet from an invasion by "Mumblers" who mix up books to keep readers from enjoying them (Superkids Educational Software Review, 2004).

Lexia Inc. also offers a phonics drilling program, Lexia Reading Skill Development. Lexia offers three levels of this software, Lexia Early Reading for ages 4-6 Lexia Primary Reading for ages 5-8, and Lexia SOS (Strategies for Older Students) for ages 9-adult. The early software practices rhyming, sound blending, initial and final consonant sounds without requiring alphabet knowledge. The primary software has five levels for drilling phonics, sight-word recognition, and sound-symbol correspondence. The SOS software improves comprehension, keyboard skills, and decoding. Age-appropriate software for older people who struggle with reading is difficult to find. The Lexia SOS system helps target specific areas in which older students have difficulty (Lexia Learning Systems, 2005). A second program, titled My Reading Coach Gold, from MIND*PLAY*®, offers a phonics-based program with comprehension levels from first-grade to tenth-grade reading levels (MIND*PLAY*, 2005).

Earobics by Cognitive Concepts is a research-based program that provides instruction and practice in the crucial areas of literacy development, including language development, phonemic awareness, alphabetic knowledge, and decoding and spelling (Cognitive Concepts, 2005) on an individual level. Complementary multimedia resources include materials and interactive software where students use headphones and microphones to interact with this product.

Pronunciation tutors, in products such as TextHelp Read & Write Gold and Wordsmith, assist students who struggle to separate words into phonemes by breaking words into parts. The pronunciation tutors in these products allow the student to:

1) Display syllables of a selected word;
2) Represent a selected word using the phonetic alphabet; and

3) Display phoneme equivalents of a selected word.

These products can also benefit students who are learning English as a second language (TextHelp, 2003b).

Strategies to Improve Decoding

People with reading learning disabilities also experience difficulty decoding words (Reading Rockets, 2005). One fundamental part of using the phonics method is teaching decoding skills. Reading Rockets® (2005) defines decoding as "the ability to apply your knowledge of letter-sound relationships, including knowledge of letter patterns, to correctly pronounce written words (para. 1)."

Products to Improve Decoding

D-Code, by Taylor Associates, drills decoding through audio-visual conditioning in order to internalize the decoding process. Designed for reading levels 1-3, including adults, this software drills users to type or record responses as rapidly as possible (Taylor Associates Communications, Inc, 2004). Intellitools Reading: Balanced Literacy also includes over 200 phonics and decoding activities, as well as guided comprehension and vocabulary activities for grades K- 2. Simon SIO (Sound it out) is a program based on research conducted by Ted Hasselbring and Laura Goin (Don Johnston, Inc., 2003). It allows children to practice decoding skills and to move toward word fluency.

Strategies to Improve Fluency

Fluency is another common problem for students with a LD in reading. It is also one of the most important factors in achieving comprehension in reading. The National Institute for Literacy (2004) defines literacy as "the ability to read text accurately, quickly, and with proper expression and comprehension;" it also states that "because fluent readers do not have to concentrate on decoding words, they can focus their attention on what the text means (para. 2)." Technologies for fluency and decoding are usually software technologies that help readers learn to associate symbols and sounds, read silently, and develop the understanding and vocabulary necessary to be fluent readers. Examples of fluency and decoding technologies include Destination Reading by Riverdeep and Jumpstart Phonics by Knowledge Adventure.

Products to Improve Fluency

Destination Reading Primary Bundle is designed to increase fluency through a combination of decoding, vocabulary, and comprehension activities. This Riverdeep Interactive Learning software offers Course I for grades pre-K-1, and Course II for grades 2 and 3. Course I develops phonemic awareness and focuses on emergent literacy for non-readers with little text exposure, and Course II concentrates on comprehension and fluency (Riverdeep Interactive Learning, Ltd., 2005b). Read Naturally is another fluency

package varies levels of phonics and comprehension exercises from beginning to more advanced readers (Read Naturally, 2004).

Reading Plus System Fluency Tools by Taylor Associates offers three fluency software packages, Perceptual Accuracy/Visual Efficiency (PAVE) software for all ages and literacy levels, Guided Reading for levels 1 through adult, and Word Memory for levels 1 through 3. The PAVE™ software provides activities to build the visual skills necessary for silent reading such as accuracy and efficiency. Word Memory fosters word recognition of common vocabulary words, and Guided Reading improves the visual and perceptual skills to increase reading rates, comprehension, and fluency (Taylor Associates Communications, Inc, 2004).

Strategies to Build Vocabulary

Research has shown that a major difference between achieving and non-achieving students lies in vocabulary development (Elley, 1989). Many students with learning disabilities in reading have difficulty with auditory processing and understanding how a sequential string of phonemes combine to make a word. These processing problems can result in, among other things, difficulty learning new vocabulary (University of Reading, 2003). Students must automatically recognize and define thousands of words in order to become fluent readers. An alternative strategy to phonics-based learning is the use of techniques to build sight words (Reading Success Lab, 2005). Methods to build vocabulary can be as simple as word walls or flashcards, or as complex as handheld spell checkers and software programs that engage the reader in educational games to build vocabulary. Examples include Skill Builder Module, World of Words and Picture Power Pack.

Many teachers use word walls, which are a listing of words that children use as they begin reading and writing. The idea is to allow children to become familiar with the posted words so they become more prevalent in writing activities. In some cases, words that appear on the wall are new words that are introduced as part of a lesson in class. Others use the word wall to list commonly misspelled words or words that cannot be spelled phonetically.

Products to Build Vocabulary

Picture Power Pack is a Slater Software program for beginning readers and writers. It includes PixWriter, which allows the users to click on screen vocabulary buttons with a picture and a word to form sentences and stories, and also includes Picture It, which allows the user to use vocabulary buttons to write about programmed pictures or import their own pictures and write about them. The user can highlight words and the computer will speak to them, and the user's work can be targeted to ability level, saved, and printed (Slater Software, 2004).

Reading Plus System Vocabulary Tools features Cloze-plus for levels 1to 8and Reading Around Words for levels 1-adult. Taylor Associates' Cloze-Plus uses vocabulary-in-

context examples as well as meaning completion strategies, and Reading Around Words uses contextual analysis to help the user deduct word meanings and increase vocabulary (Taylor Associates Communications, Inc, 2004).

Franklin Electronic Publishers' line of spell checkers also helps readers of all ages to improve vocabulary, look up definitions, and obtain synonyms and antonyms by checking spelling of words as they write (Franklin Electronic Publishers, 2005). In addition, many of the built in features of MS Word, including the spell check and "look up" features, provide invaluable assistance when reading and writing electronically.

Strategies to Improve Comprehension

Reading comprehension provides the foundation for successfully extracting meaning from printed material. Further, it includes an ability to retain and describe what has been read (Department of Education, 2004). This functional ability to demonstrate what has been learned from reading is a major barrier to students with a LD in reading. In fact, the text-based curriculum in American schools poses a major barrier to the success of many students who struggle with comprehension. Gersten and Baker (1999) suggested that issues that struggling readers face in reading comprehension could be improved by teaching task-persistence and self-monitoring strategies such as repeated reading, story grammar, or self summarizing. Peer-assisted learning strategies (PALS) and other socially mediated instruction were also listed as helpful. In order for a student with a LD to be proficient in reading comprehension the strategies mentioned above must be internalized so that they can be used across the curriculum (Gernsten & Baker, 1999). Most software packages for students with learning disabilities in reading have the underlying goal to promote comprehension in some way, since elements of comprehension also include fluency, decoding, and vocabulary. Examples include Spark Learner and Studentspark, Reading for Meaning, and Ace Reporter.

Products to Improve Comprehension

Reading Plus System Comprehension Tools Comprehension Power is designed for levels 1-adult, and Career Comprehension Awareness for levels 8-adult (Taylor Associates Communications, Inc., 2004). Comprehension Power uses a series of reading selections to introduce 25 basic comprehension skills (Taylor Associates Communications, Inc., 2004). Let's Go Read! Island Adventure for Pre K-K, and Let's Go Read! Ocean Adventure for grades K-1 are two other comprehension tools from Riverdeep. Island Adventure introduces letters, sounds, vocabulary, and word recognition. Ocean Adventure introduces consonant blending and long vowels, and also features voice recognition for users to read aloud to the computer, voice activation to control the computer, and record and playback capabilities so users can hear themselves read. Steck-Vaughn Co. has developed the Quantum Reading Series, a program with four levels available for reading levels 10.5-13.5. This program is designed to build comprehension, vocabulary, rapid reading, and fluency through a series of stories and repeated practice. It's A Safari is a comprehension program for all ages, including adults, who read at reading level 5. This software takes the user through an adventure in Africa

with stories and images. LocuTour Multimedia uses multimedia to introduce new vocabulary and test comprehension (Dimension Therapy Center, n.d.).

Tom Snyder's Reading for Meaning provides practice for readers to infer meaning, identify main idea, and build skills such as sequencing, comparing and contrasting. Reading for meaning is designed for students in grades 3-8. In this program by Tom Snyder Productions, a roving reporter follows four students around with his Kid Cam. This program uses graphic organizers and open ended comprehension questions to ensure that children understand what they are reading (Superkids Educational Software Review, 2004). These tools help the user to explore the reading and develop strategies to ensure that the meaning of the text is understood. Ace Reporter is a program that prompts users to answer who, what, where, when, and why questions while playing a game in which users are the reporters. This MindPlay product, for ages 3-adult, aids in reading for detail, main thought, and critical thinking (MindPlay, 2004).

Read 180 by Scholastic is a comprehensive multi-modal reading support program that directly addresses individual needs through adaptive and instructional software, high-interest literature, and direct instruction in reading, writing, and vocabulary skills. Features designed to accommodate different learners include closed caption for videos, altering the color scheme and increasing text font size and adjusting the speed of certain activities (Scholastic, 2006). Scholastic also offers Thinking Reader, a research-based program that offers curriculum-based instruction that offers prompts and feedback to individual students based on their needs. Thinking Reader assists students who read below grade level to improve their reading comprehension skills (Scholastic, 2006).

My Reading Coach and My Reading Coach Gold allow the user to interact with an on-screen coach who takes them through lessons similar to a one-on-one tutorial session. This program by Mindplay, for ages 7-adult, drills word finding, listen and find, reading, and writing. These tools enable readers to monitor the comprehension of their reading. My Reading Coach Gold also uses graphic organizers, question answering, summarization, and it prompts the user to pay attention to story structure. My Reading Coach is written for more mature audiences (Mindplay, 2005).

ClueFinders makes two programs that build comprehension skills: ClueFinders Reading Adventures for ages 9-12 and ClueFinders Third Grade Adventures. The Learning Company's ClueFinders series teaches comprehension as well as spelling, vocabulary, and grammar. It uses A.D.A.P.T. technology that increases difficulty with the child's skill increases (Superkids Educational Software Review, 2004).

Sunburst Technologies offers the Readers Quest Series, which includes Readers Quest I for grades 3-5 and Reader's Quest II for grades 6-9. In the Readers Quest, users complete pre-reading activities, direct instruction, and automatically scored comprehension questions and written summaries. The programs feature graphics with text, bimodal highlighting and speech output, strategy suggestions, and movies (Sunburst, 2004d).

Strategies for Focusing Attention and Organizing Ideas

The ability to focus attention and plan and organize ideas can assist people with learning disabilities in reading to improve both reading and writing skills (Youth Learn, 2003). Accommodations that assist a person with a LD in reading to focus attention include simple devices like book holders and highlighters, hardware such as reading pens, common technologies such as Microsoft PowerPoint, and high-tech software such as scan-and-read software packages.

Some hardware that can assist a reader with dyslexia is low-tech, such as everyday products that use color to isolate text and draw attention. Highlighter tape and colored transparencies attract readers' attention to certain passages of text. Pipe cleaners or string can be used to help the readers form story maps that track characters and main ideas in a passage of text. Graphic organizer worksheets help organize ideas and increase comprehension.

Products for Focusing Attention and Organizing Ideas

Multicolored highlighter tape such as that made by Lee Products can be used to highlight important text in textbooks and can be easily removed without damage to the book. Colored transparency sheets can also be used to highlight an entire page of text; using bright colors can help attract readers' attention. Color-coded Hefty Tabs or Post-It Notes flags can be used to mark important parts of passages and assist the reader in indentifying main ideas and other important points (Beacon Ridge, 2004). Book holders and any tools that assist in positioning the books to make them more visible simplify literacy activity for many students (Assistive Technology Training Online, 2005). Other low-tech tools to assist in reading include Wikki Stix or pipe cleaners, both of which can be used to circle text or to create three-dimensional story maps in which the reader records character names, main ideas, etc. (Beacon Ridge, 2004).

Graphic organizer worksheets can assist readers in breaking down the components of a reading passage to increase understanding. Graphic organizers can consist of any diagram that helps the reader understand the main topic and structure of a passage of reading. (Ellis, 1998). Many educational companies produce organizing worksheets, including Scholastic and abcteaching.com (Frazel, 2002).

Inspiration Software Inc. makes Inspiration for grades 6-12 and Kidspiration for grades K-5, which allow users to build graphic organizers to organize ideas (Inspiration Software, Inc., 2005). This software can be used by the student to review what has been read. It can also be used as a multimedia tool when displayed on a SMART Board by the teacher to lead a class discussion that links characters and story lines. It is also useful as a pre-teaching tool to identify main topics and important ideas in reading assignments. While Inspiration and Kidspiration are highly visual, picture-based platforms, it is possible to view material in an outline view that adapts the graphic organizer to a written outline simply and easily. Don Johnston Software, Inc. makes a program to organize ideas in manageable short written pieces. Draft:Builder, Solo enables users to organize

ideas, take notes, and build a draft with a built-in bibliography tool (Don Johnston Software, Inc., 2005).

Strategies for Providing Speech Output

Text-to-speech (TTS) software is among the most widely used tools to assist readers with dyslexia and other learning disabilities. When combined with highlighting of the text as it is read, TTS can aid in focusing attention on the reading task by providing a multimedia interaction. A variety of tools provide speech to foster learning of both concepts and content for people with an LD in reading. Concept tools include products such as LocuTour Multimedia Articulation Software and Premier AT Complete Reading Systems. Products that address content issues include Kurzweil 3000, Text Help Read, and Write Gold. In addition, many free TTS readers (i.e. ReadPlease) are available, but they offer less adjustability. Kurzweil and Text Help enable users to see what is written and highlight individual words as they are read. These programs provide auditory output that aid in recognition of phonemes and letter sounds. Speech output is also useful as a proofreading tool when writing tasks are involved. There are several products that offer a variety of "voices" that can be used to facilitate understanding. Factors in choosing an effective technology to provide speech output include the voice quality, clarity of speech, and adjustable pitch.

Products Providing Concepts and Text-to-Speech Output

LocuTour Multimedia's Articulation software is available in three packages: Articulation I, which deals with consonant phonemes; Articulation II, which deals with consonant clusters; and Articulation III, which deals with words with vowels. Users of all ages can practice words, phrases, and sentences, using on-screen recording and playback using the word, sound, phrase, and exaggerated button (which exaggerates the pronunciation of the targeted sound) to see and hear the word in a variety of ways. Articulation software also prints homework pages and outputs to word processing (Learning Fundamentals, 2005).

Premier Assistive Technologies' Complete Reading System is a package that includes software applications such as Word Predictor Pro and The Ultimate Talking Dictionary from Premier. The product scans and reads using optical character recognition. It also features talking large-print menus, word tracking, and 24 different voice options (Premier Assistive Technology, n.d.a).

For early readers, Computerade Products offers Picture Sentence Key and Picture Sentence Match. Picture Sentence Key students use combine the Meyer-Johnson Pictures Communication System and words to form basic sentences. Connecting terms such as "is" and "are" are inserted automatically, and phrases are read back aloud as each word is highlighted. Picture Sentence Match users match sentences to images of people doing corresponding activities at an easy, moderate, or difficult level (Computerade, 2004).

Don Johnston, Inc., offers leveled books for a range of students, including Start-to-Finish Literacy Starters for beginning readers, Start-to-Finish Library, which includes storylines

for grades 2 and 3 and grades 4 and 5, and Start-to-Finish Core Content where essential information of stories is presented in an understandable format with supports for struggling readers. The Gold library enables word-by-word highlighting. The Blue library features sentence-by-sentence highlighting. The Gold library consists of conversational vocabulary and easily decoded words. The Blue library consists of more formal English, including complex vocabulary and varied structure. The Ukandu Interactive Series and Little Books teach word identification and awareness to younger readers and also features word-by-word highlighting as words are spoken aloud (Don Johnston, 2006).

Riverdeep's Bailey's Book House for grades pre-K-2 improves vocabulary, sound-symbol recognition, and part-to-whole recognition through a series of stories that are read aloud and simultaneously highlighted. Users write stories, play alphabet games, complete tasks, and answer questions from characters (Riverdeep Interactive Learning, Ltd., 2005a).

ULTimate KidBooks by Universal Learning Technologies is available as downloadable freeware from Switch in Time's website: http://www.switchintime.com/. The program is appropriate for all ages and literacy levels. It enables users to convert all standard books into electronic documents that can be highlighted, magnified, colored, and speech-synthesized (Queens University, 2005).

WiggleWorks Scholastic Beginning Literacy System software allows the user to see text in a variety of ways, by allowing the user to add color, sounds and graphics, and by highlighting, reading by the word or sentence. It also offers highly customizable speeds and settings for each individual user. Users read aloud and record themselves, and also create books. It features detailed teacher instruction and support. This software by CAST and Scholastic is intended for beginning readers (Scholastic Inc. 2006).

Products Providing Alternative Access to Text-Based Material

Students with a LD in reading must be provided with alternative access to printed material in order to effectively obtain meaning from print. Creating alternative access to printed text can be as simple as creating text in a word processing document and applying a text-to-speech program. Additional features enable users to change font color, font size or background and highlight words or phrases in order to focus the attention on the content. For information that is only available in printed format (i.e. textbooks or worksheets) there are scanning systems (hardware) with optical character recognition programs (software). The scanner imports the image of a printed page into memory. The optical character recognition (OCR) software converts the image of the printed page into text that can then be stored in a file and edited. Scanning systems can be stand-alone devices with built-in screen readers or they can be components of a computer system. When used together with TTS technology, scanning systems turn the computer into a virtual "reading machine."

Several software programs can scan printed documents, convert the images to text, and display an electronic version on-screen. The computer version looks exactly like the printed one to allow the students to use the computer to read the printed document using TTS software. Scanned text also allows students to add information by typing into the document.

Kurzweil Educational Systems' Kurzweil 3000 Scan/Read software is a scanning, reading, and writing system for people with learning disabilities. Kurzweil 3000 includes the following supportive features:

- Dual highlighting;
- Quick access to word meanings;
- Comprehensive study skills tools;
- Powerful instructional support tools;
- Flexible writing tools;
- Test taking capabilities;
- Online books and encyclopedias;
- Vocabulary list support;
- Natural-sounding synthetic speech options;
- Easy web access;
- Audio file creation;
- Broad access to electronic files;
- Advanced scanning support; and
- Picture dictionary.

This program is available in networked versions in many schools. Kurzweil 3000's offers the option to customize the system for individual users (Kurzweil Educational Systems, 2005). This system works within its own environment; documents must be imported into Kurzweil.

TextHelp' Read and Write Gold is another popular scan-to-read for individual learners. It offers the following features:

- Translation;
- Speech output;
- Phonetic spell checking;
- Homophone support;
- Word prediction;
- Web highlighting;
- Digital Accessible Information System (DAISY) reader;
- Dictionary;
- Word Wizard thesaurus;
- Teachers Toolkit (which allows teachers to determine what tools students can access);
- Scientific calculator;

- Speech maker;
- Pronunciation Tutor;
- Clipboard history;
- Fact folder and fact finder; and
- Speech input.

TextHelp features are presented on a floating toolbar that operate within standard programs like Microsoft Word, Internet Explorer, etc. Additional software products are available from TextHelp that offer less functionality at a reduced cost (TextHelp, 2003a).

Other screen reading products offer speech output for all screen contents such as Premier Assistive Technology Complete Reading System, which features a talking word processor, calculator, and dictionary, scan-and-read capability and word prediction. The software features adjustable reading speeds, bimodal audio and visual output and the option to highlight words as they are read aloud (Premier Assistive Technology, n.d.a). WYNN is software for all ages and literacy levels that provides bimodal learning, using simultaneous highlighting and audio pronunciation, easy internet access, dictionaries, and word prediction. WYNN's product line includes Test Talker test taking software for students and teachers to make reading and answering test questions easier. WYNN is by Freedom Scientific's Learning Systems Group (Freedom Scientific Learning Systems Group, 2006). TextAssist by Mindmaker, Inc. is designed for all ages and literacy levels. This text-to-speech software reads in a variety of voices, pitches, pronunciations, and speeds along with simultaneous highlighting (Mindmaker, Inc, 2003). AspireREADER™, introduced by CAST and Aequus Technologies in 2005, replaces the word version of eReader. It also offers a book reader, an accessible web browser, and an accessible editor.

Digital talking books are growing in popularity in the mainstream marketplace. They have been effectively used in the blind community for some time and have been found to be an effective format for students with a LD in reading. The DAISY Consortium has developed standards for digital books. The audio uses human voice narration to provides simple navigation features that allows readers to skip to specific pages, chapters, sections, and paragraphs. They can also electronically bookmark the material and navigate using an index (DAISY Consortium, 2006). Other book players, such as the EZDaisy Talking Book Player and Scholar Talking Book Player by Telex Communications, Inc. are available for younger people with a LD. These book players are designed for all ages and literacy levels. They feature navigation controls, audio formats including MP3 and CD, speed control, an LCD display. The Scholar includes additional features such as bookmarking and "Go To" (Telex, n.d.). A new and promising technology, the MP3 player, will create an easy-to-use foundation for digitally rendered text. As an added benefit, it is attractive to all students and will not promote the stigma attached to using technology that is specific to disability.

Strategies to Improve Listening Skills

Distractibility and difficulty concentrating are common functional impairments related to learning disabilities in reading (Levinson Medical Center for Learning Disabilities, 2004). Listening, remembering, and following instructions can be difficult people with certain learning disabilities. This difficulty is multiplied when distractions present. Strategies to improve listening skills include providing headphones or other methods of noise reduction and sound amplification like soundfield systems (Scott, 2001). Some examples of interventions that may be helpful in allowing a person with a LD in reading to focus on listening include Earobics Literacy Launch, Fast ForWord, and HearIt amplification system.

Products to Improve Listening Skills

People with learning disabilities in reading often find it difficult to listen in a classroom setting or to listen to and execute a string of instructions (Scott, 2001). One way to assist in listening is to provide the listener with a method of amplification. Amplification tools assist students in classrooms or users in other environments to deal with distractions and concentrate on the person speaking. Sound field systems, which were discussed earlier in this section, amplify the teacher's voice for the entire classroom. If this is not an option, many companies sell personal listening systems including Hearit (http://www.hearitllc.com/) and Lightspeed Technologies (http://www.lightspeed-tek.com/education/index.html).

Software that improves listening skills, such as Earobics Literacy Launch, can help people with learning disabilities in reading (Pasadena Independent School District, 2005). Earobics teaches students to focus on important sounds in the classroom even when background noise competes for students' attention. Earobics systematically increases the volume of background noise (e.g., none/low/high) as the student works with the program. This is a critical skill for students who have difficulty in noisy classrooms. Cognitive Concepts, Inc. offers Earobics Step 1 for reading levels from pre-K to grade 2; Earobics Step 2 for third and fourth grade reading levels; and Earobics Step 3 for adolescents and adults. The program uses a series of components such as songs and chants, letter and word cards, books, internet resources, and cassettes to improve listening as well as phonetic understanding, word analysis, and vocabulary. A pilot study conducted in 2000 showed statistically significant gains across grade levels preK-3 in decoding, spelling and the full range of phonemic awareness skills as a result of the Earobics software (Cognitive Concepts, Inc., 2005).

Another package that includes listening skill exercises is Scientific Learning Corporation's Fast ForWord®, including levels 1, 2, 3, and 4 for readers in grades 1-4. Titles include Fast ForWord Language for pre-reading children, Fast ForWord Language to Reading for beginning readers, and Fast ForWord middle and high school for older readers who need reinforcement. Fast ForWord improves listening, reading and critical thinking skills by helping students focus on memory, attention, processing, and sequencing. The software also drills phonics, spelling, and vocabulary, decoding, word

recognition, and sentence and passage comprehension (Pasadena Independent School District, 2005).

Technologies for Writing

A Definition of LD in Writing

Learning disabilities in writing, often referred to as dysgraphia, are associated with visual spatial and language processing difficulties. Writing is a skill that children develop and acquire over a number of years. First they must master the mechanical skills of writing, how to form letters, words, sentences, and paragraphs. Children must then master the cognitive skills needed to form coherent writing, these skills often include an awareness of grammar, punctuation and how to edit your work (National Center for Learning Disabilities, 2004).

Manifestations and Functional Limitations of People with Writing Disabilities

Learning Disabilities in writing manifest with poor hand writing, spelling, and organizing and composing ideas (National Center for Learning Disabilities, 2004). Dysgraphia can also mark itself as a graphomotor dysfunction, which reflects difficulties with mechanical aspects of writing processes such as graphically representing letters it can also manifest as difficulty in tasks such as handwriting, capitalization, punctuation, spelling, and formatting (MacArthur, 1999). Content aspects of writing, including organization and coherence, can also be affected. Students with a LD in writing generally have poor revision skills and tend to correct only one aspect of their writing as opposed to reviewing the document as a whole (Li and Hamel, 2003). Education at all levels is reliant on being able to represent language and express knowledge graphically. When a student is unable to demonstrate knowledge in a written form, it can severely undermine his ability to succeed in school tasks without appropriate accommodation to ameliorate the problems.

This section describes some of the most commonly used technologies that address the functional limitations associated with a LD in writing. These technologies can be used in isolation or in conjunction with other approaches depending on the severity and extent of the LD and the functional limitations the person experiences as a result. Note that the technologies described below are not exhaustive, but they are the most commonly used and recommended interventions for writing deficits.

Accommodations for Learning Disabilities in Writing

A myriad of assistive technology devices address learning disabilities in writing. The writing aids can be classified based on the functional limitation and age level they address. The focus of the AT intervention in early education is geared toward skill development, often through drill and practice as opposed to accommodating for functional limitations. Several mainstream educational toys, games, creative arts, and software can be introduced to children when they start school to advance their writing

skills. Still, learning disabilities in writing can pose a major challenge to high school and college students because of the breadth of academic tasks they are expected to perform. As a result, a great number of AT products are available for the population of students and adults with learning disabilities in writing.

Strategies to Address Poor Handwriting

Problems with handwriting are mostly attributed to impaired fine motor control and coordination. Legible handwriting is vital to participation in academic activities, given that nearly 85% of fine motor tasks performed at schools involve paper and pencil activities (McHale & Cermack, 1992). Handwriting difficulties are manifested mostly by problems in representing letters graphically and maintaining the appropriate spacing between words (Amundson & Weil, 1996). Some low-technology AT that helps students compensate for handwriting difficulties include simple tools that can be easily incorporated as support materials for the student. These include using a paper with raised lines as a sensory guide for children in elementary school and using pens and pencils with different dimensions and grips to enhance the students' handwriting capability. The tools that enhance handwriting work by improving students'hand functions and fine motor control.

Writing in cursive may prove easier for some people with dysgraphia because eliminates the need to pick-up and replace the pencil on a page (International Dyslexia Association, 2000). One of the specialized low-tech writing aids for younger students with handwriting difficulties is the Loops writing system by OT ideas, Inc. Loops is a kinesthetic writing system designed to allow student's to build their cursive writing skills by grouping letters with similar "lead-in" strokes (OT ideas, Inc, n.d.). The writing system package includes 10 levels of learning. OT Ideas, Inc. also markets a handwriting kit for children intended to enhance their fine motor skills and coordination. Handwriting Without Tears® (2003) is a series of tools and methods designed to facilitate children's development of handwriting skills. These tools emphasize the approach of cursive writing and assist children in systematically learning the pictorial components of each letter before mastering the alphabet holistically.

For children who are unable to improve their handwriting skills, note-taking can pose a significant challenge in education and employment. Many students who have difficulty with taking notes can be provided with teacher notes, a classroom aide, or notes from a classmate. Often times, simple products such as the carbonless notebook, available from Beacon Ridge, can make this task simple for the assistant.

Products to Address Handwriting Deficits

Professionals working with children who have severe handwriting limitations can use strategy and technology for their writing deficits. Often times, people with a LD in writing must use all of their effort to write properly and therefore find it difficult to concentrate on the content of what they are writing about. In classroom or office environments, tape recorders and digital recorders can be used as a simple method to

record lectures and spoken notes for future retrieval. These tools allow the person to focus on what is being said as opposed to what they are writing. An example of a tape recorder that students can use is the multi-channel digital recorder. The Voice It digital recorder offers 40 to 70 minutes of recording time, which can be increased by adding smart media cards. These recorders can be used to record lecture notes or answers to homework assignments (Synapse Adaptive, n.d.c).

The use of electronic writing boards has gained considerable popularity among preschool children. Writing boards augment the development of the child's handwriting and drawing skills. Primarily considered a toy, the device features an inbuilt stylus that pens on a magnetic screen board. The screen board comes with a slide erase feature that clears the screen in one sweep. Flashing lights, music, and sounds are incorporated into these boards as feedback and make writing and drawing an engaging activity. The Doodle Pro™ by Fisher-Price® (2004) is an electronic writing board that has the above mentioned standard features.

Word processing is a highly effective and beneficial tool for people with severe handwriting deficits (Jacobi, 1986; Dalton & Hannafin, 1987; Outhred, 1987). People with a LD in writing often find that word processing offers a powerful solution to their writing needs. For individuals who can type, word processing involving a computer, or an adaptive and portable note-taking device, is an effective technology alternative. The advantage of word processing is that it generates legible written material, thus allowing the person to concentrate on content, editing and collaborative writing (MacArthur, 1988). The use of word processing features like as spell check results in fewer misspelled words (MacArthur, 1998b). In combination with effective writing instruction, word processing can augment the writing skills of students with learning disabilities (MacArthur, Graham, Schwartz, & Shafer, 1995). Typing is an integral aspect of word processing both in terms of speed and accuracy and typing skills and instruction. These are imperative to writing fluency using word processing (MacArthur, 1999). Once a person has mastered the skill of word processing it is often more effective than handwriting as it involves simpler graphemic processing and motor sequencing (Quinlan, 2004). People with a LD in writing may require additional instructions for revising and editing written materials using word processing to ensure that they can make the most of this accommodation and ensure the overall quality of compositions.

Word processing software available on the market today offers many accessibility features to simplify use. The accessibility features that are available in Microsoft Word offer a very effective environment to support writing. Table 3.1 illustrates some features of Microsoft Word

Table 3.1: Microsoft Accessibility Features

Accessibility Wizard	Sets up the computer for a student with vision, hearing or mobility disabilities and learning preferences. These personal settings will be loaded when the user logs in.
Control Panels	Customize the computer environment by changing: • Display: toolbar and window fonts, size, colors; • Keyboard: key repeat, layout, sticky keys for sequential key press;

	• Mouse: speed, click, tails, pointer; • Speech: text-to-speech, word recognition (Narrator); • Text alternatives: handwriting recognition, annotations; • Internet: customizing options.
Magnifier	Enlarges the pointer and screen information from 2 to 9 times its size.
Narrator	Text-to-speech program that uses synthesized voice.
On-screen Keyboard	Allows user to type on a keyboard on a screen. Several setting options are available.
Utility Manager	Turns on/off ▪ Magnifier ▪ Narrator ▪ On-Screen Keyboard

Several additional features, as described in Table 3.2, are available for students with disabilities:

Table 3.2: MS Word Features and Activities for Educators

Language Bar	
Handwriting	Handwriting option on the language bar highlights notes and passages, and enables users to write in the margins or draw pictures or diagrams. Clicking the Text button enables handwriting recognition that immediately converts users' writing to text.
Microphone	Voice commands or dictation mode are available and require a microphone for use.
Word Speak	Digitized computer voice reads text aloud.
Other Features	
Drag and Drop	Using drag-and-drop enables users to order items, including to: • Put weekly spelling words in alphabetical order. • Put mixed-up sentences from a story into the correct chronological order. • Put events from a time line into their correct sequence. • Put mixed-up numbers in the correct sequence from either low to high or high to low • Put mixed-up steps in a scientific problem into the right order
Fonts	Users can change text appearance by style, size and color of fonts to: • Create customized ruled writing paper. • Create models to copy. • Highlight certain words (nouns, action words, etc.).
Borders	Borders can enhance and highlight information (i.e. notices of classroom events).
Tables	Use the Table feature to make: • Calendars, visual schedules (with pictures), to-do lists, instructions. • Track student behavior. • Create word cards for word walls, with word and word/picture. • Make ruled line paper of various widths.
Clip Art	Enhance classroom themes with use of clip art. Search online for other pictures and copy them to use later. Use to create word and picture writings.
Screen Shots	Take pictures of web pages, or anything on the screen by using the print screen option- helpful to create instructions on software use or web searches.
Templates	Use templates to create quizzes, forms, checklists, guides so that many students can use over and over again
Forms	Use the Forms toolbar to create documents for on-screen tests, activities, reports and multiple choice quizzes for students to complete independently. Forms allow

	a user to *tab* through the fields and make changes/additions. When you save the file as a template, it can be used over and over again.
Auto Summarize	Use Executive Summary for Creating Shortened Text Versions – this can simplify and make writing more enjoyable for students.
Auto Correct	AutoText offers a way to store and quickly insert text, graphics, fields, tables, bookmarks, and other frequently used items. Use it to add the date or complete header to a paper or assignment.
Keyboard Shortcuts	Key commands simplify software control for students who have difficulty using a mouse.
Macros	A macro is a series of Word commands and instructions that are grouped together as a single command to accomplish a task automatically. Instead of manually performing a series of time-consuming, repetitive actions in Word, users can create and run a single macro — in effect, a custom command — that accomplishes the task. In general, macros can: • Speed routine editing and formatting. • Combine multiple commands; for example, file/print/save/close/exit. • Make dialog options more accessible.
Hyperlinks	Hyperlinks connect information within and between files. They can also connect to references on the Internet. Any text, picture, or symbol can be used as a link.
Spelling & Grammar	This feature can be turned on or off. It checks spelling and grammar and provides a dictionary and thesaurus to expand vocabulary usage.
Wizards	Wizards allow for easy task completion through various Microsoft Word activities. By asking a series of questions, the wizards can format elements of the task to alleviate the burden on the users. For example, the *Word Letter Wizard*, provides tips on frequently used letter writing formats. There are many wizards available for Microsoft Word. Some are loaded during set-up and others can be downloaded from online sources. Examples include forms, agendas, calendars, newsletters, brochures, letters, fax, sales letters, manuals, etc.

Some students with a LD in writing need an alternative input device other than word processing in order to write effectively. IntelliKeys® from Intellitools® is an expanded plug-and-play keyboard that can interface with Macintosh or Windows computers Intellitools, n.d.). It enables students with physical, visual, or cognitive disabilities to type, navigate on-screen displays, and execute menu commands using one of six overlays that are included with the keyboard. The keyboard offers overlays with numbers, mouse movement, and alphabetical and QWERTY key layouts that can be slid into the IntelliKeys for instant use. An overlay maker program allows customization and printing of new overlays (Intellitools®, n.d.).

People with learning disabilities in writing who have an inability to write and type can benefit from using touch screens to interact with a computer. Touch screen monitors are easier to learn and intuitive to use for early computer users. The direct selection concept without intermediate interfaces allows users to make use of their natural tactile instincts while interacting with a computer. Touch Screen, Inc. (n.d.) produces a wide range of touch screens for home, commercial and educational applications. Touch screen interfaces can be built-in to the computer monitor, or added-on as accessories to an existing computer monitor. Troll Touch screens (T^2D Inc, 2003) can also be custom retrofitted into the monitor of an existing desktop or laptop direct interfacing. The system is compatible with most PC and Mac applications.

For students with a LD who have difficulty using a standard keyboard because of perceptual or coordination skills, the use of a keyboard with enlarged keys can be effective. BigKeys LX (Grey Stone Digital Inc, 2004) is a standard keyboard whose keys are four times larger than standard keys. This keyboard is tailored for users with advanced keyboard needs. BigKeys Plus (Grey Stone Digital Inc, 2004) is an enlarged keyboard for children who are beginning to learn keyboarding either on an ABC or QWERTY layout. In addition to large keys, the keys are color-coded for enhanced discrimination. Different keyboard layouts such as the Dvorak layout can be adapted for left- or right-hand use.

A variety of portable word processing devices address the writing needs of people with a LD. The AlphaSmart 3000, the Dana and the Neo by AlphaSmart Inc (2004) are portable, alternative note-taking keyboards designed to assist high school and college students in writing. They work in conjunction with other software applets including the Co-Writer, AlphaQuiz, Inspiration, and Get it! Book and Software. Word processing features include calculator functions, keyboarding instruction, classroom quizzing, outlining, and word prediction (AlphaSmart Inc, 2004). The device can transfer text to and from a computer and can interface directly with a printer. A software utility called the AlphaBeam allows wireless transfer of text from an Infrared Model AlphaSmart 3000 to an IrDA-capable computer (AlphaSmart Inc, 2004). The Dana from AlphaSmart Inc also functions as a Palmtop device with the benefit of an expanded laptop keyboard and a touch screen with a stylus for writing. The Dana uses the Palm OSTM operating system, which contains more than 20,000 Palm applications (AlphaSmart Inc, 2004). The device offers enhanced connectivity to the user by allowing wireless infrared transfer of data to an Infrared Data Association2 (IrDA) capable computer, printer or other Palm-powered device. The Dana Wireless model has a built-in Wi-Fi 802.11b (a wireless local networking Ethernet) technology that provides access to the internet without a modem or cable (AlphaSmart Inc, 2004). Neo is another lightweight and portable alternative keyboard and note taking device with an array of computing capability. Compared to the AlphaSmart 3000, the Neo has a 50% larger display and twice the memory capacity (AlphaSmart Inc, 2004).

The Calcuscribe is an alternative keyboard and note taker with word processing and internet applications (Calcuscribe, n.d.). The device is unique as it also offers an interactive calculator that performs advanced math functions. More information on this product is available in the section on technologies for learning disabilities in math.

The QuickPAD Technology Corporation (2002) produces portable word processing devices. The QuickPAD IR-USB is a portable full-sized word processing keyboard that is fitted with an infrared receiver. Thus the device can function wirelessly or as a regular keyboard for any IBM-compatible personal computer or Macintosh. It operates on four AA batteries and can function up to 400 hours, and store nearly 250 individual files in 10

[2] "A voluntary organization of various manufacturers working together to ensure that the infrared communications between different computers, PDAs, printers, digital cameras, remote controls, etc. are all compatible with each other regardless of brand" (Saugus.net, 2004).

separate folders. Other brands in this category include the Lynx, Laser PC6, and Palm PC with external keyboard (Bisango & Haven, 2002).

Many students choose devices that are common in mainstream application. For example, PDAs can be used with a portable keyboard that allows a student to enter notes into portable devices. These technologies offer a solution that does not have any stigma attached as many students associate with AT devices. No matter which word processing tool that a person with a LD in writing chooses, students must also receive continuing support in writing and revision skills (Graham, Harris, and Larson, 2001).

Strategies for Spelling, Vocabulary, and Word Finding

Word processing software often features text enhancement capabilities including spell check, electronic dictionary, and grammatical correction. These tools can be found in computer-based software solutions and in standalone devices. For example, the Franklin Speller Line provides phonetic spell checking to students who have difficulty with spell checking features in word processing programs such as Microsoft Word (Franklin Electronics, 2003).

Products to Address Spelling, Vocabulary, and Word Finding

Effective writing to a great extent is dependent on vocabulary and the ability to use the right words to convey the meaning and semantics of the written information. Electronic dictionaries and thesauruses can assist students in this aspect of writing. Microsoft Word offers an easily accessible dictionary that provides word meanings with a click of the mouse. The dictionary allows writers ensure they have not used a homophone incorrectly in their writing, as is common for people with learning disabilities in writing. Microsoft Words electronic thesaurus helps students find synonyms for target words. Use of an electronic dictionary as part of word processing can be an efficient tool to use during the writing process (Fluharty, 1993).

The internet also offers a wealth of references for students seeking to expand their vocabulary. Internet sites such as Dictionary.com are an easy way to check word definitions. At this site, the user types the word in question into a search engine, which retrieves definitions. As an added benefit for students with disabilities, words that are misspelled will prompt alternative suggestions of the word you had intended to search for. For example, typing in HOLADY prompts the site to offer the following suggestions:

- Holiday
- Holyday
- Holliday
- holy day
- hold
- holidays
- holydays

- holed
- holder

The alternative words provide the user with options that can be easily accessed to determine if they are appropriate. By right-clicking on the alternate word choice, the student can look up the meaning of the work. This is a critical support for students who cannot differentiate between the meanings of similarly constructed words. When attempting to expand the vocabulary of a person with a learning disability in writing, tools such as Word of the Day can be an entertaining way to introduce new words. There are many websites that provide students with a word of the day: WordCentral, for example, is available at http://www.wordcentral.com/, and Superkids allows users to select a word of the day based on grade level, it is available at http://www.superkids.com/aweb/tools/words/wod.shtml.

Products that offer word prediction can also be extremely useful for students with a LD in writing. Word prediction programs use language algorithms to predict students' targeted word based on the first set of letters that are typed in. The program then provides the user with a list of probable target words to choose from. As a result, the student is not required to know or type the whole word. Instead, typing the first one to three letters is enough for accurate word prediction of most words. Word prediction is helpful with spelling and mechanical aspects of writing. It saves the student the frustration of having to remember the spelling of each word and thereby enhances the text entry rate.

Although the rate of writing may be higher when the student writes, legibility and spelling accuracy could be superior when written material is composed using word prediction (Handley-More, Deitz, Billingsley, & Coggins, 2003). Word processing using word prediction was found to be faster than standard typing (Lewis, Graves, Ashton, & Kieley, 1998). Word prediction help students with a LD in writing by supporting spelling and expanded vocabulary usage (MacArthur, 1998a).

Spelling capability in students with learning disabilities is found to be significantly correlated to composition quality across all ages and school levels (Graham, Berninger, Abbott, Abbott & Whitmaker, 1997). Support for spelling can be traditionally sought using a dictionary. However, students with learning disabilities often have significant difficulties recognizing misspelled words. The spell check feature in word processing functions in two ways; it identifies words that are misspelled and tags them, and it suggests a list of target words to replace the misspelled words. Some word processing programs perform auto-correction of misspelled words and some even perform phonetic correction, wherein the word is read to the student for confirmation. Spell checking and correction can augment writing skills of students by enhancing spelling skills and allowing them to use broader vocabulary (MacArthur, 1999). Nonetheless, it is important for instructors to note that students with a LD may require training in the use of the spell correction feature. It must be noted that most spell checkers do not contextually identify errors if words are misspelled as homonyms (such as read in present tense and read in past tense). In addition, the phonetic correction may mislead the writer when the word is

misspelled. For example, homophones such as “herd” and “heard” or “blew” and “blue” may sound the same, but they have entirely different meanings within the text.

Franklin Electronics, Inc. (2003) has developed handheld devices to assist in written language. The company produces a range of handheld electronic dictionaries tailored for all age groups with standard features varying in amount of information and features included in the system. The MWD-1470 by Franklin Electronic Inc. is an example of electronic portable dictionary with a built-in language capability of 100,000 words from the Merriam-Webster® Dictionary & Thesaurus. This device also offers phonetic spell correction, an expanded display, USB connectivity and features such as an organizer, calculator, and interactive games.

Phonetic spell checking is available in software products such as Text Help Read and Write and Read and Write Gold and the Franklin Spell Master Plus device (Iansyst Ltd., 2006). The Text Help (including Wordsmith and Read and Write line) products also offer homophone support. The Wynn Scan and Read from Freedom Scientific Learning Systems Group and the Kurzweil products also offer homophone support (Freedom Scientific Learning Systems Group, 2006).

Strategies to Address Grammatical Correction

Syntax is an essential component of written language. It refers to the way words come together to form meaningful sentences. Students with a LD in writing are most often challenged with maintaining the right syntax within the context of writing and have a difficulty revising written work to improve syntax. In many cases, students with LD in writing fail to address content errors, focusing instead on mechanical errors (Graham, Harris, and Larson, 2001). Grammatical correction, a teaching strategy in which teachers focus on addressing grammar, can eliminate grammatical errors and allow students to address syntax issues when composing text.

Products to Address Grammatical Correction

Word processing programs such as Microsoft Word can scan the written material for any syntactical errors and suggest corrections. The program identifies a variety of common grammatical errors and tags them for subsequent editing. This editing can be performed by using the suggested list of corrections that the program delivers. Users should be aware of why the errors have been tagged and they should know how to select the most appropriate correction from the suggestion list. At times, the grammatical correction tool misses complex grammatical errors and identifies correct sentences as having an error, a phenomenon known as false flagging. Other grammatical correction tools are available in other word processing packages, such as Corel WordPerfect, and in stand-alone packages such as WinProof and StyleWriter (ProofreadNOW.com, Inc., 2002).

Many students with a LD find that text-to-speech programs can help them to accurately identify grammatical errors in their writing. There are many TTS software programs available. Some, such as the ReadPlease system, are available free or very low cost.

Others, such as Kurzweil 3000 or the Text Help System, offer enhanced functionality at a higher cost. Purchase decisions about what software packages might be most helpful should be based on the tools that the student needs to write effectively.

Strategies to Improve Content Aspects of Writing

Students with dysgraphia have difficulty synthesizing, sequencing, and composing their ideas in writing. Teachers can employ simple learning tools such as using picture cues to facilitate thinking. "All Purpose Photo Library Set" and "Best Concept Pictures Ever" (CESA 6 Media Center, 2004) are examples of picture cards that enhance language and vocabulary skills in a wide range of academic topics. The use of videos and games could be an important strategy to promote writing skills. "Fun with Words" and "Paragraphs-Like Scenes in a Film" are short videos that help students build sentence-construction skills by facilitating expressive and organizational aspects of written language (CESA 6 Media Center, 2004). In addition, a wide variety of technologies are available that can help children enhance their writing skills at every stage of their development.

Concept mapping is a concept that uses graphics and keywords to help a person with a LD in writing to organize their thoughts. There are many paper-based graphic organizers that allow a student to capture the relationships among topics before attempting to explain them in writing. For students with a LD, these tools can be very effective in improving writing content.

Teachers may ask students to talk about writing in order to learn what they can express verbally and what they would like to write about. A teacher can record the conversation and play it back for students who struggle while writing. In some cases, voice recognition software can provide similar benefits. However, many students have difficulty training these systems to accurately recognize their voice.

Products to Improve Writing Content

LeapFrog, Inc. (2004a) designs and develops a multitude of learning toys that are geared to improve and speed learning at different transitional phases spanning from infancy to high school age. In particular, the LeapPad® Plus Writing Learning System features an electronic stylus, an erasable writing pad, and a read aloud program to help students improve their writing content. The premise for using LeapFrog products is to make the learning process fun for children, while expanding their thought process in all knowledge areas. LeapFrog products invoke all the required writing skills including motor and linguistic skills (LeapFrog, Inc., 2004a).

The use of programs that include words and pictures in writing can support beginning writing efforts. Clicker 5 by Crick Software has a large picture library and includes a TTS feature. Similar programs include Writing with Symbols (Mayer Johnson, Inc.) and PixWriter (Slater Software).

Clicker 5 (Crick Software, Inc., 2003) writing software is a multimedia tool that enables children to write with whole words, phrases, or pictures. The software, which features an image grid, works as a word processor in conjunction with a keyboard. Images on the grid can be linked to textual information on-screen, or they can be used to enter whole words or phrases. Picture It (Slater Software, Inc., n.d.) is a software program by which teachers can create and upload pictures to represent text thereby helping students to compose documents. PixWriter (Slater Software, Inc., 2004) is writing software with color pictures that can be represented using voice output. Writing with Symbols 2000 (Widgit Software, Inc., n.d.) literacy software aids in writing by means of symbolic illustration of speech. The program provides grammatical and semantic support for writing by automatically illustrating the words as they are typed using a series of symbols that help students discern homophones (such as "hair" and "hare," "pair" and "pear," etc.) and homonyms ("saw" and "saw," "spell" and "spell").

Kidworks Deluxe™ (Smartkids Software, 2004) software stimulates children's creativity and imagination through writing and painting. The program, which is suitable for children between the ages of 4 and 9, lets a child write or illustrate stories, poems, or journals, and then listen as the writing is read back to them in a variety of fun voices or in their own voice. The package includes over 450 resizable stickers, over 100 animated stickers, over 130 picture book backgrounds and 100 sound effects (LD Online, 2004). Storybook Weaver Deluxe is a creative writing tool that allows children to write and illustrate their own storybooks. The software's features include a variety of pictures, words, sounds, and music. A text-to-speech feature reads the story back to the child (Riverdeep Interactive Learning Limited, 2004a).

Concept mapping software provides a method to visually orient ideas and concepts in a variety of subject areas pertaining to science and literature. The ideas can be represented hierarchically in terms of their context or relationships. Ideas, which can be denoted as icons assigned by the user, can be linked graphically by arrows and color-coding. Many products incorporate concept mapping and other easy-to-use tools into effective tools to improve content aspects of writing. Computer-based programs for concept mapping can support TTS features, text outline conversion, and interactive learning. Examples of these products include Kidspiration and Inspiration and SparkLearner and KidSpark. Inspiration 7.5 (Inspiration Software, Inc., 2004) is a visual learning tool that represents ideas visually and dynamically by means of outlines, concept maps, 'webs' and graphical organizers. Inspiration is a helpful tool in areas of science, language, and social studies.

Don Johnston's SOLO is a package of products that focus on improving students' reading, writing skills. SOLO contains the following products: Draft:Builder, Co:Writer, Write:OutLoud and Read:OutLoud. Draft:Builder® Solo software (2004c) assists in planning, organizing, and composing drafts in various content areas. The software assists users in planning and concept mapping, note-taking and resource citing, and composing. Co:Writer® Solo (Don Johnston Inc, 2004b) is word prediction software that can be installed on a computer or note-taking device (Alphasmart), in the form of an applet. The software delivers additional features such as grammar correction and an online dictionary and allows students to focus on the content of their writing. Write:OutLoud® Solo (Don

Johnston Inc, 2004d) is word processing software that talks, providing natural-sounding speech feedback of written text. Its audio-reviewing capability is intended to enhance students' revision and editing skills. The software also includes features such as a homonym finder, spell checker, and a dictionary. A "mark-for-deletion" feature helps students reorganize sentences and paragraphs. It also provides alternate words without altering the original content. Similarly, Read & Write 7 Gold (Texthelp Systems Ltd, 2003a) is literary software with natural sounding speech output supplemented by features such as a phonetic spell check, context-based word prediction, voice-enabled dictionary, speech input, fact finder, and a progress log.

For individuals who are unable to hand-write and type, the application of speech recognition software in conjunction with word processing has great promise. Speech recognition systems function as an input technology to dictate text into a word processing program. These systems allow discrete as well as continuous dictation to display real-time transcript of the text. The software uses adaptive algorithms to adjust to the user's voice and articulation over time. Even in early studies involving students with learning disabilities, the quantity and quality of material composed by dictation was superior to handwritten or word processed compositions (Graham, 1990). In essence, speech recognition allows benefit from word processing without suffering the stress of typing. However, when using speech recognition software for students with a LD, instructors should recognize that speech recognition programs require users to navigate within an interface and memorize and commands, whether verbal, keyboard-, or mouse-based. Therefore, transcription using speech recognition software may burden the user's working memory as the user composes content. Second, the recognition accuracy of speech recognition programs depends on mathematical models that predict words based on user's utterance. Therefore, accuracy levels vary depending on users' vocal skills and the system's prediction capability (Quinlan, 2004).

The Dragon NaturallySpeaking System by Scansoft and Via Voice by IBM are the most widely used speech recognition programs. The Dragon NaturallySpeaking System (Scansoft, Inc., 2004) is available in different versions depending on users' needs. The Preferred and Standard versions are suited for personal usage and comes with access to Microsoft Office applications and the Internet. Professional versions of the software are tailored for organizations that need to provide accommodations for employees with disabilities. ViaVoice by IBM, Inc (n.d.) can function in both Windows and Macintosh operating environments. The system's multiple versions, including Personal, Standard, Advanced, and Pro USB Editions, are designed to meet computer access needs of users whose skill ranges from beginner to professional user. The ADA Workstation and the Literacy and Language Workstation from Synapse Adaptive (n.d.b) functions as a custom configured computer access system that offers a multitude of accessible text input and output functions. The system includes a voice recognition text-entry feature geared for persons with dysgraphia. Some software programs such as Write: OutLoud (Don Johnston, 2004d), Texthelp (2003b) & Windows XP offer built in speech recognition programs.

Technologies for Learning Disability in Mathematics

A Definition of Learning Disabilities in Math

Dyscalculia is a term used to describe a disability that affects an individual's ability to understand and manage math and numbers. Weaknesses in visual processing and sequencing are often at the root of learning disabilities in math. These weaknesses prevent students from conceptualizing numbers or remembering the facts and processes necessary to complete mathematical tasks (Keller, 2005).

Manifestations and Functional Limitations of People with Learning Disabilities in Math

A learning disability in math can manifest in a broad variety ways, ranging from difficulty understanding or identifying numbers, such as telling time on a clock, to an inability to comprehend algorithms in mathematical equations and difficulty with directions such as those on a map. Difficulty remembering sequences of events, making change with money, and recognizing names and faces are common manifestations of a learning disability in math.

Unfortunately, little is known about how math competency is acquired (Geary, 2003). This hinders researchers' attempts to develop acceptable theories regarding the various manifestations of learning disabilities in math (Garnett, 1998). As a result, it is difficult to accurately determine the prevalence of learning disabilities in math. However, most sources report that approximately 3% to 6% of children in the general population are affected by some form of learning disability in math (Shalev, Auerbach, Manor, & Gross-Tsur, 2000). Additionally, according to figures reported by Wilson (n.d.), an estimated 15% to 26% of children with a math learning disability also exhibit symptoms of ADHD, and 17% to 64% also have a LD in reading. Despite the extreme variation in the probability of co-morbidity of LD in math with ADHD or LD in reading, educators and parents must be aware of the possibility of co-morbidity so that they can properly assess students' needs and provide appropriate supports.

The National Council of Teachers of Mathematics Standards (NCTM) has developed and continually revised standards that emphasize the importance of understanding concepts and enhancing problem-solving abilities over procedural, rule-driven knowledge. A number of school districts and states have adopted these standards; however as with any strategy or technology that is introduced into a classroom, implementation is of paramount importance, particularly when dealing with students who have learning disabilities. In an article published by the Council for Exceptional Children, Gagnon and Maccini (2001) provide examples of effective strategies for algebraic instruction for students with learning disabilities. (These standards are reviewed in more detail in the Overview segment of this document.)

LD in math affects every student differently, and strategies and technologies should focus on the amelioration of each individual's unique problem areas. Common problems include:

- Difficulty organizing information on paper, which could be demonstrated by trouble lining up columns and keeping one problem separate from another;
- An inability to recognize numbers;
- Difficulty counting or recalling simple math facts without relying on strategies such as counting on fingers;
- Trouble with visual spatial skills such as shape and pattern recognition
- Difficulty connecting abstract concepts with concrete representations, or graphing;
- Difficulty handling money when making change or calculating a tip;
- Trouble understanding and keeping track of time, or remembering sequences of events and
- Difficulty understanding word problems.

Accommodations for Learning Disabilities in Math

Educators should be aware that the degree of complication from each of these functional limitations vary from one individual to another, and students may require differing supports for seemingly similar problem areas. The following accommodations and technologies are only a sample of available solutions for learning disabilities in math; they are intended to provide the reader with a general understanding of ways to overcome the functional limitations noted above.

Strategies for Organization of Information

Students with learning disabilities in math often make "simple" mistakes when trying to perform mathematical calculations, such as transposing numbers within or between problems. Uncomplicated adaptations such as graph paper and varying colors of pens or pencils can help students to overcome these limitations (Learning Disabilities Association of America, 2005). Graph paper enables students to exactly line up columns for arithmetic problems, thereby reducing the possibility that students will confuse the tens rows with the hundreds rows, or one problem with another. Colored pencils, pens, and highlighters can also be a helpful modification as they enable the student to define each problem with a different color, further easing the burden of differentiating them by their place on the paper alone. In addition to these low-tech options, some companies offer computer-based electronic worksheets to aid students who have difficulties organizing math problems on paper.

Onion Mountain Technology has bundled a wide assortment of low-tech tools for students with math learning disabilities into a collection known as the LoTTIE kit for math (Low Tech Tools for Inclusive Education). This kit contains assorted color highlighter tapes, various pencil grips, 5 different types of calculators, software for printing graph paper, math table fact sheets, various rulers, stamps and a stamp pad, markerboard sets, a timer, and other miscellaneous manipulatives. The kit, which is designed for students in grades K-12, helps instructors and parents assess which devices best meet the needs of students (Onion Mountain Technology, Inc., 2003).

Products to Improve Organization

IntelliTools offers MathPad software, which is designed for students in grades K-4 who have difficulty solving math problems on paper. This program helps students navigate through problems while offering verbal feedback, customizable font size and color contrast, as well as enabling an instructor to input problems. MathPad is available in a basic version, which covers addition, subtraction, multiplication and long division; as well as a more advanced version (MathPad Plus) for grades 3-8, that works with fractions and decimals. Both systems can be used with a mouse, IntelliKeys, or a switch (IntelliTools, 1997). An additional enhancement that enables voice input for MathPad is available through Metroplex Voice Computing. Using Dragon NaturallySpeaking software, this program allows students to perform calculations and check answers with the four basic functions. More advanced calculations can be performed with Math Talk Scientific Notebook, which also uses Dragon NaturallySpeaking voice recognition software. Both programs allow instructors to input homework, which can be completed using the program and later saved or printed to turn in (Mathtalk.com, 2003). Appropriate for students who benefit from the additional reinforcement of speaking and seeing their work, these programs are also helpful to students with writing difficulties and visual impairments.

Strategies to Improve Number Recognition

Students with learning disabilities in math may see numbers and symbols as drawings as opposed to meaningful numbers, or they may have memorized numbers in a sequence for counting but cannot recognize that a collection of objects is equivalent to a specific number (Wright, 1996). Number recognition, understanding number values, and the ability to count abstract objects in order to assign a numerical value are essential skills necessary for using math in daily life. In order to realize these skills, there are a number of smaller tasks which must be mastered. Students must learn English number words, the associated Arabic numbers, and the sequence of both. Additionally, they must know the ways in which numbers can be combined to form larger and smaller numbers, both in the sense that 2 + 2 = 4, as well as a 2 and a 2 make 22. Geary (1999) states that the most difficult part of counting may lie in the ability to understand the base-10 system. He believes that this concept is difficult for students with and without a LD in math. There are an unlimited number of games that a parent or instructor can play with children to help them to identify numbers. For example, an instructor can: refer to a printed number line when speaking a number; have children find the numbers one through 100 in a newspaper, cut them out, and glue them to paper in order; simply praise children for speaking numbers that they see while on a walk outside.

TouchMath is a method of teaching math that is intended to bridge manipulation and memorization. TouchMath uses number recognition and counting strategies to create simplified methods of addition and subtraction for students in grades K-3. The TouchMath kit teaches math using auditory reinforcement, flash cards, and timed tests, and is widely used in special education classes in the U.S. (TouchMath.com, 2005).

Products to Improve Number Recognition

On Cloud Nine® Math: A Visualizing/Verbalizing Math Program is a software program designed for students of all ages. The program helps students improve their mathematical reasoning and problem-solving (Bell, 2003). The program strives to develop concept and numeral imagery by applying imagery to the computation and conceptualization processes. For example, to create a link between what students see when they look at a number and the reality of that number's value, the program will show a number, and then prompt the student to choose the amount of items that make up that number. The On Cloud Nine ® Math kit includes manipulatives, worksheets, assessment sheets, fact sheets, and word problems, all of which are geared towards understanding, visualizing, and verbalizing the language behind math (Lindamood-Bell Learning Processes, 2004). Sunburst's Tenth Plant- Number Meanings and Counting is designed for students in grades pre-K-1. The software helps students understand the meaning of numbers, estimations, and more-than and less-than concepts. Students identify the numerals that apply to quantities of objects from fun, real-world scenarios, such as the number of characters in a parade; compare the number of objects in two groups; and estimate both quantities and lengths (Sunburst, 2004e).

Strategies to Address Counting and Recall of Math Facts

The ability to count is essential for performing math functions. Some students who have a learning disability in math have difficulty moving to forms of counting that are more advanced than handheld manipulatives or finger counting. Additional practice, combined with instruction, has the potential to help students memorize basic facts and learn new strategies for this important skill. Additionally, games may be particularly effective if they are able to hold the student's attention (Garnett, 1998). A sample of games is included later in this section.

Learning disabilities in math also frequently manifest themselves as difficulty memorizing basic math facts, such as multiplication tables or addition and subtraction facts. Often students simply require more practice, although they may also require adapted learning strategies. For example, math fact charts that students can carry in their pockets can help them in their effort to memorize information. Seeing all of the numbers next to each other provides a frame of reference for recall, and an instructor may black out facts as the student masters each computation. Flashcards can help students to improve retention of basic arithmetic facts, and increase their ability to quickly solve problems (Kenyon, 2000). Presenting memorization tasks in a game-like setting encourages learning through engagement (Lock, 1996). Electronic flashcard games can improve recall of math facts. To enhance the effectiveness of learning any math facts, instructors should work with students to perform calculations using the commutative and associative properties of math; whereby numbers can trade places for addition and multiplication problems, or order of operations may be switched, while still producing the same answer. Instructors must take care to keep in mind the learning strategies currently being utilized by each student. According to Wright (1996), repetitive reinforcement of

the strategies already being used by each student will result in the student improving their ability to perform that task. This strategy is intended to remove the student from simple memorization of facts, and bring them to a place of understanding how each numerical relationship produces a given answer.

Products to Address Counting and Recall of Math Facts

Many software programs that help students with counting focus on real-life applications of counting using time and money skills. For example, Sunburst's Memory Fun has students in grades K-3 cleaning up an attic, while it provides them with games to help them build: counting skills with tallying and finding the related numeral; memory and money skills with matching games; and time-telling skills with digital and analog clocks (Sunburst, 2004c). GAMCO's Math Concepts One… Two… Three… offers 7 games within the series. The games are geared towards students in grades K-3. The software includes over 100 activities, ranging from counting to basic graphing skills (GAMCO Educational Software, 2003b). Auditory help features, teacher management tools, and animated activities keep students engaged while providing instructors with enough control to tailor the games to each student's needs. Intellitools Number Concepts 1 and 2 help students with early math concepts such as greater-than and less-than as well as addition and subtraction.

LeapFrog® produces four game-type devices that aid students in memorization of math facts with drill and practice routines. Electronic Flash Magic ® Flash Cards is a handheld game that is available for addition and subtraction (numbers 0 through 12) as well as multiplication and division (0 through 12). Designed for children ages 4 and over, students are given a problem to solve and encouraged to shout out an answer. They then shake the unit to make the correct answer appear on the screen. This product offers an untimed learning mode and a quiz mode that gives students 60 seconds to solve a number of equations (LeapFrog®, 2004b). Leapfrog's Mind Mania Math is a portable arcade-style game designed for students ages 7 and up. This electronic device teaches addition, subtraction, multiplication, division, fractions, and decimals and offers three levels of difficulty for each game. The unit features a clock and alarm, and has a carabineer clip that students can use to attach the device to their backpack or jacket (LeapFrog®, 2004d). Turbo Twist Math Handheld, Twist and Shout Addition, and Twist and Shout Multiplication are designed to accommodate a wide range of age groups. These handheld toys offer grade-specific game modes that cover basic arithmetic, fractions, percentages, and decimals. Children twist dials and slam buttons to generate correct answers and are rewarded with engaging animations, music and sound effects. The Mind Mania Math product automatically adjusts to various levels of difficulty (LeapFrog®, 2004e), and is upgradeable to more advanced grade levels with separate cartridges. Twist and Shout products offer practice and quiz modes (LeapFrog®, 2005). Learning Advantage's MathStar is a handheld device designed for students in grades 1 and over. It offers 8 levels of difficulty for each area of basic arithmetic as well as decimals, percentages, and fractions. Students try to answer questions quickly in order to get their time and initials in the high-scores display. This device provides visual and

audio feedback and enables an instructor to preprogram problems (Learning Advantage, 2002).

Students may also have trouble understanding the concepts and properties behind the procedures that they are performing. For example, a student may know that 3 x 5 = 15, but not understand that 5 x 3 = 15. They have memorized the first fact, but because they do not understand the commutative property of multiplication, they cannot see that reversing the numbers produces the same solution. Math Workshop Deluxe by Riverdeep Interactive Learning Limited is designed for students in grades 3-6, and offers 8 activities regarding spatial relationships, computations, and rational numbers. It enables teachers to customize activities for students, including creating their own problem sets and parameters, and also allows for tracking of student progress (Riverdeep Interactive Learning Limited, 2004a).

Strategies to Improve Shape and Pattern Recognition

Mathematics involves cumulative knowledge and as such, requires that students have a firm grasp of beginning concepts before they are able to comprehend more complex equations and problems. Shape identification and pattern recognition are integral to further understanding of mathematics and are amongst the first concepts learned by students as they enter into the study of mathematics. Shape recognition provides the foundation for geometry, while pattern recognition develops an understanding of how many parts make up a larger whole and an understanding of relationships in the natural and man made world. Products geared towards shape recognition are generally designed for younger students in grades preK-1, while products for pattern recognition can be found for students in grades preK-8.

Products to Improve Shape and Pattern Recognition

A number of computer programs are available to aid children in the understanding of shapes and patterns. Attainment Company has designed software called Attribute Tiles to help younger children learning to identify sizes, shapes, and colors. Voice output combined with on-screen text aids students who have different learning styles, and variable settings enable an instructor to choose the difficulty level appropriate for each student (Attainment Co., 2004a). Introduction to Patterns, by Sunburst is designed for students in grades preK-1. The program introduces children to patterns found in nature and art, and challenges their skills in geometry, numbers, measurement, and spatial relationships (Sunburst, 2004b). Marblesofts Early Learning Series introduces shapes, colors, number sequencing, and patterns in a multi-media format.

For many years, schools used Macintosh-based computers. As a result, many software products have been developed only for Macintosh platforms. For example, Don Johnston Inc's Blocks in Motion is designed to be used on Macintosh computers by students in grades K-8. The program challenges students' problem-solving and critical thinking skills. Students build and animate shapes to learn how to create patterns and larger objects from smaller geometric shapes (Don Johnston Inc., 2004a). Tessellation

Exploration by Tom Snyder is designed for students in grades 4-8, and enables students to manipulate geometric shapes to see the results of slides, turns, flips, rotations, reflections, and glides. The program includes classroom lessons, an assessment quiz, and a tutorial to guide students to understanding transformations, angles, and shapes (Tom Snyder, 2004b).

Strategies for Connecting Abstract Concepts with Concrete Representations

Beyond basic pattern recognition, many students who have learning disabilities in math have trouble visualizing abstract notions and understanding numerical representations and mathematical relationships. They may be unable to connect verbal concepts with concrete representations. Manipulatives are physical representations of numbers that are intended to enhance the learning experience by providing a hands-on view of otherwise abstract concepts. They are useful tools for students in any grade, although the ways in which they are used depend on the difficulty of the curriculum. For children who are just learning about arithmetic, base 10 blocks can be used to improve understanding of addition, subtraction and multiplication. Consisting of single units, rods (1 rod =10 units), and flats (1 flat = 10 rods = 100 units), these objects demonstrate to students how single units make up larger groups, and offer a hands on experience to aid in the understanding of addition and subtraction principles (Learning Resources, 2000). Cuisenaire rods are wooden or plastic rods that use different colors to represent the various lengths of rods. These differing pieces can be put together and taken apart to show students concrete examples of fractions; for example, three green rods are the same length as a blue rod, so one green rod is one third of a blue rod (ETA/Cuisenaire, 2005). ETA Cuisenaire offers a measurement tool kit called MeasureWorks that includes a wide variety of manipulatives to teach students in grades 1-5 about time, length, volume and capacity, weight, temperature, area and perimeter, and angles (ETA/Cuisenaire, 2005). MathLine is essentially a simplified abacus, relating beads on a rod to numbers. Available in models designed for grades preK-8, this manipulative provides structure with beads that cannot be removed from the rod; and flexibility with its applications for over 25 math concepts (Mathline.com, 2002). Manipulatives are available in a wide variety of forms other than base 10 blocks and Cuisenaire rods, and can include algebra tiles, dice, coins, tangrams, and thermometers to name a few (Salend & Hofstetter, 1996). Kits are a convenient way to obtain multiple manipulatives as well as guides with suggestions on how to use them within the classroom.

Products to Connecting Abstract Concepts with Concrete Representations

Software and web-based programs can also provide practice with manipulatives. However, two-dimensional pictures and graphs are often the source of confusion that manipulatives are intended to overcome, and therefore the removal of the physical hands-on experience may prove difficult for children with a LD in math (Garnett, 1998). Regardless of the delivery system, whether hands-on or computer-based, perhaps the most important aspect of using any manipulatives is to reinforce the connection between the concrete examples and imagery that can be drawn upon at a later time for use in problem-solving (Bell, 2003).

Math That Counts is a website offering 10 different visual manipulatives, as well as hundreds of other applets that can be accessed from any PC (McFarland, 2005). These applets offer intriguing games and puzzles for students with a wide range of skill levels. However, these programs do not save data, nor do they provide a great deal of feedback. IntelliMathics 3 provides a platform on which children can experiment with computer based-manipulatives to solve math problems. The program offers pre-designed activities that can be used out of the box or customized with changeable graphics and instructions. Instructors and students can also create new activities using templates provided with the program. IntelliMathics 3 also tracks students' performance and offers summary and detailed printable reports (Synapse Adaptive, n.d.a). Instructors should evaluate their student's needs as well as their own, such as progress tracking ability, feedback provided to students, and ability of the program to engage the students. With these needs in mind, instructors can select programs appropriate for their students (Crawford & Brown, 2003).

The National Library of Virtual Manipulatives for Interactive Mathematics (NLVM) at Utah State University has been awarded a National Science Foundation grant to develop a collection of virtual manipulatives that can be used to supplement classroom instruction. The programs are categorized by both grade level and topic area with applications including number and operations, algebra, geometry, measurement, and data analysis and probability. This resource is available online free of charge, and is now also available on CD with advanced features such as the ability to customize, save, and print work. The product is available for a broad range of applications with pricing for single user licenses through multiple school licenses (NLVM, 2005).

Strategies to Teach Graphing

Graphing is an important component of mathematics, teaching students the relationships between numbers on a plane and enabling them to illustrate functions that would otherwise just be a written formula. In order to learn the various skills required to understand graphing, students require practice.

Products to Teach Graphing

In addition to graphing calculators, there are a number of software programs designed to aid students with this skill. Tom Snyder offers two programs specific to graphing skills: The Graph Club 2.0 and Graph Master. The Graph Club is designed for students in grades K-4, and helps students to understand, create, and use various types of graphs. This program offers over 100 activities involving math, science, social studies, and languages. A built-in tutorial, on-screen notebook, and printable assessment tools guide students as they graph up to 12 categories (Tom Snyder, 2004c). Graph Master is designed for those in grades 4-8, who are prepared for advanced graphing skills. Students complete 20 activities using a set of nine graphs and 10 readymade data sets, while an online glossary assists them with unknown terms. Mean, median, mode, and range are analyzed, and students can also import data and compare graphs (Tom Snyder, 2005). Green Globs and Graphing Equations by Sunburst is designed for students in

grades 9-12 and teaches the relationship between equations and their related graphs. Level of difficulty progresses with the student and includes beginning algebra through trigonometric and discontinuous functions. The program also includes two practice games, Green Globs and Trackers (Sunburst, 2004a).

For older students who struggle to understand higher level math, two products are available to assist in understanding how to plot and understand graphing. The Geometers Sketchpad can be used by both teachers and students to plot graphs. It was designed to allow students to explore the relationships between points on a graph. This program is useful for students in geometries, algebra, trigonometry, precalculus, and calculus (Key Curriculum Press, 2005). A free evaluation edition can be downloaded from www.keypress.com/sketchpad/. The evaluation edition is valid for 60 days. A similar program, called Graphmatica, is also available. This software is primarily designed for high school algebra through college calculus. An evaluation version of Graphmatica is available from k-Soft (k-Soft, 2005).

Graphing calculators are widely used in classrooms today. This makes them attractive for students with disabilities given that there is no stigma attached to their use. Texas Instruments has a line of graphing calculators for different grade levels. The TI-73 Explorer is designed for middle school math and science; the TI-84 Silver Edition is designed for high school and college level work; and the TI-89 Titanium Advanced is designed for college level math, science, and engineering. These calculators can store and operate using a number of different programs. Many of the applications are pre-loaded onto the calculator and some are available for download. The calculators connect to a computer via the USB port for easy transfer of information (Texas Instruments, 2006).

Strategies for Understanding Currency

Many students with learning disabilities in math have difficulty understanding currency. This trouble may stem from difficulty identifying coins, understanding the numerical value of dollars and cents, or an inability to add, subtract, or estimate. This inability prevents a student from being able to determine whether he or she has enough money to make a particular purchase. Difficulty understanding decimal placement and percentages also inhibit many students with learning disabilities in math from effectively handling money in real world situations**.** Manipulatives such as plastic coins or fake paper currency can help students to become familiar with monetary denominations. In cases where the student is able to make the connection between play money and real money, a coin counting calculator, such as the Coin-u-lator by PCI can help them to understand the relationship between dollars and cents. Software products are also available and often use real-life examples of situations involving money to challenge students to determine an amount that should be paid out or received as change. Additionally, software programs are available for adults to aid them with activities such as balancing a checkbook. Debit cards and credit cards are becoming more common currency options for daily purchase. While these options solve an immediate problem of paying for items

without handling money, the user must be able to keep purchase and balance information so that spending limits are not exceeded.

Products for Understanding Currency

LeapFrog's Cash Register and Shopping Cart are designed to build counting and money skills in preschool-aged children. The shopping cart is suitable for children ages 2 and up, and is filled with products to teach counting, quantities, and more-than and less-than concepts. The toy cash register teaches numbers and counting along with coin identification and money values. Used in combination, these toys provide an educational experience while allowing the children to play (LeapFrog®, 2004c). The Coin-u-lator is a handheld coin counting calculator designed by PCI Educational for students ages 5 and up. This calculator teaches coin identification, money values, and addition and subtraction of money amounts. A matching game challenges students to choose the correct increments to arrive at a given value, and a voice encourages students when they input the correct answer. Worksheets and activity cards are also available separately for use with and without the Coin-u-lator (PCI, n.d.).

A number of software products have been developed to aid students with understanding currency, such as GAMCO's Money Challenge, which is designed for students in grades K-5. Up to two students count quantities of money, decide if they have enough money to make a specific purchase, calculate change, and are rewarded with a tic-tac-toe game for correct answers. This software enables instructors to change levels of difficulty and monitor students' progress (GAMCO Educational Software, 2003c). Attainment Co offers a number of other software games to teach students how to handle money, including Budget Town and Budget City, Adapting Math Curriculum: Money Skills, Basic Coins, Dollars and Cents, and Toward Independence (Attainment Co., 2004e).

Adults who have learning disabilities in math may also require assistance when handling money, particularly when computations, such as those in a checkbook, are necessary. The Talking Checkbook 3.0 is computer-based software that offers auditory feedback through an internal speech engine, or through programs such as Window Eyes or JAWS. The Talking Checkbook also offers enhanced auditory feedback via extensions for each voiced item that ensure the material is read back in a logical format. The program, which can print checks, has replaced the confusing terms "debit" and "credit" with the more common terms "withdrawal" and "deposit." Files can be transferred to Microsoft Office applications such as Word and Excel, and the program can be used for multiple accounts (Premier Assistive Technology, n.d.b).

Strategies for Telling Time

Time is measured using a base 12 system, rather than the standard base 10. Because of this difference, students must learn an entirely different system when calculating the time (Effland, Lerner, Perkins, Turkon, n.d.). For example, adding one hour to twelve o'clock will bring us to one o'clock. However, twelve plus one equals thirteen, not one. Students may require a great deal of practice and explanation before they are able to grasp the

concept. Practice with digital and analog clocks and software-based activities can help students to develop time telling skills.

Products for Telling Time

Attainment Co. offers a low-tech TimeWheel, which is a laminated card stock clock with analog and digital displays. The hour and minute hands moved independently to teach students how to tell time (Attainment Co., 2004d). Discover Time by GAMCO is designed for students in grades K-5. This two-player software teaches students about time via the hands on an analogue clock face and the numerals on a digital clock. Students can write out a given time in words or translate written time onto a clock by moving the clock hands, or typing numbers into the digital clock. This software also allows a teacher to track a student's progress and alter the level of difficulty (GAMCO Educational Software, 2003a). Attainment Co. also offers TimeScales, which is software that is broadly designed to accommodate students in grades 1-12. It provides a variety of clock faces, including digital and analog, and offers voice output as well. Variable preference settings enable instructors to choose the level of difficulty, see scoring results, and save students' work. This program is compatible with touch screen, single switch and Intellikeys input devices (Attainment Co, 2004c). Also by Attainment Co., is Match Time, which is software designed for students in grades 3-6. Match Time helps them to better understand time concepts. Four levels of difficulty offer various challenges, while a tracking component enables an instructor to see the student's progress (Attainment, 2004b). Other time telling programs include Trudy's Time and Place House by Edmark (Riverdeep Interactive Learning Limited, 2004c), and Tom Snyder's Timeliner (Tom Snyder, 2004d).

Strategies for Understanding Word Problems

Children with learning disabilities in math often have difficulty understanding what a word problem is asking, and need assistance to recognize what type of equation will solve the problem. In an attempt to answer, students may simply add up all numbers in a word problem, without understanding what operation to use. Jitendra (2002) discusses one strategy used to help children understand the calculations required by an addition or subtraction word problem, which involves the use of graphic representations in three distinct problem schemata categories: changes, groupings, and comparisons. The instructor first provides examples using all known variables and graphic representations of the changes, groups, or comparisons in each problem. Once a student has gained an understanding of problem schemata identification and representation, they can move onto solving word problems. In solving word problems, students must identify the necessary operation and sequence of steps to be performed, and then carry out the identified procedures. Recent studies have shown this method to be successful for addition and subtraction word problems, and have thereby demonstrated that students with learning disabilities can be effective problem solvers. Jitendra and DiPipi (2002) found that a schema-based strategy can also be successful for multiplication and division word problems; however, due to the small scale of the study, additional research is necessary to validate these results.

Products for Understanding Word Problems

Optimum Resource Middleware offers a few programs for math word problems, including the StickyBear series for younger children. It offers programs covering careers, sports, and travel for students in grades 3-9, and it offers hundreds of math problems that relate to everyday scenarios. The programs include a built-in calculator for students and lesson plans to help teachers integrate the program into their curriculum (Optimum Resource, Inc., n.d.). Word Problem Square Off by GAMCO offers three levels of difficulty, and is designed for students in grades 3-8. One or two players earn points by solving word problems ranging in difficulty from single-step problems involving whole numbers to multiple-step problems involving decimals. Students redeem points to purchase letters and solve a mystery phrase. Progress monitoring and customization are standard with all three levels of this program (GAMCO Educational Software, 2003e).

Also by GAMCO, Paws and Pyramids is designed for students in grades 5-8. Word problems in 20 levels of difficulty teach students about perimeter, volume, and area concepts as they solve a larger mystery. Designed for one or two players, this software also offers performance tracking and customization (GAMCO Educational Software, 2003d). Following on the mystery theme, Tom Snyder's Math Mysteries has students in grades 4-7 answer word problems to solve a larger mystery theme. Word problem skills, such as understanding the problem, collecting information, determining the solution and double checking work are challenged by both single and multi-step problems. Guided practice, hints, feedback and assessment reports combined with audio narration and text captioning aid students with various abilities as they solve the mystery (Tom Snyder, 2004a).

Other Products for People with Learning Disabilities in Math

Enhanced Calculators

Through the years, calculators have become more common within classrooms nationwide. However, students with learning disabilities in math may require adaptations to standard calculators to further reinforce the information being gathered from these devices. For example, auditory output can be a helpful tool for students who have difficulty with visual processing, as is common with learning disability in math (Keller, 2005). Auditory output, large text buttons and large display screens are available on many calculators; however, adjustability and the overall range of features are significantly enhanced by using software based on-screen calculators. Check the operating system on the computer for on-screen calculators; Windows OS provides standard and scientific options. For other options with additional features, R.J. Cooper and Associates produces the Talk and Scan Calculator for use with a standard PC or Macintosh. This on-screen calculator is resizable and offers auditory output for students of all ages. Unlike standard calculators that simply provide an answer to a problem, this program asks students to attempt to input the correct answer. An auto-correct feature helps to alleviate frustration by enabling students or instructors to set the calculator to

provide the correct answer after a predetermined number of incorrect answers have been given (R.J. Cooper, 2004).

Scientific calculators are a common site in classrooms. Texas Instruments scientific calculators are popular among students and teachers. They can help students to master higher level math such as algebra, trigonometry, and statistics. They can also aid in general math. Students can store equations and other information in the calculator's memory. These calculators offer students downloadable games, tutorials, and homework help is available on the Texas Instruments web site (Texas Instruments, 2006).

Don Johnston, Inc. produces Big Calc, an on-screen talking calculator that offers a wide range of options for students of all ages. Features include adjustable font size, background color, and speech settings. This product is compatible with switches and Intellikeys (Enablemart, 2004). CalcuScribe (2005) is a laptop-like word processor that is appropriate for students practicing basic arithmetic through scientific and trigonometric functions. It offers two forms of math processing capabilities; the first is a standard four-function calculator, and the second is a unique calculator program that automatically computes and saves results. Aside from the auto-computing function, this program enables a student to: enter data including math problems and text; solve the problems; see errors on-screen; and correct their original work without reentering data. A few of CalcuScribe's unique features include: capabilities for wirelessly transmitting information to other CalcluScribe units; auto-save; swiveling and adjustable large-screen with a zoom function; and sticky keys and auto-repeat adjustment.

Software Series

Riverdeep Interactive Learning Limited offers a number of math series programs including the Mighty Math Series, Smart Steps, SportsMath, StudyWorks, and Destination Math (Riverdeep Interactive Learning Limited, 2005c). All series cover a range of age groups and skill levels and offer tracking features as well as customization to student's needs. For example, Destination Math is a series of software programs covering content ranging from pre-primary mathematics for students in kindergarten and first grade, through algebra concepts designed for students in grades 9-12. Aligned to national and state standards, assessments determine each student's needs prior to challenging them with seven levels of difficulty. Information provided on the Computing Technology for Math Excellence (CT4ME, 2005) website states that the programs have been tested and proven to increase scores and student achievement.

Online Content

Larson Learning Inc. has established LarsonMath.com, which offers customizable teaching and testing content that can be related to textbook instruction and state standards. Features include tracking and assessment tools for instructors, audio output for struggling readers, online resources, and 24-hour technical support. Two programs are available: The intermediate program offers content for students in grades 3-6. The pre-algebra program offers content for students in grades 6 and up (Larson Learning, Inc.,

2005). There are also many websites that are available to help students to master math. For a list of other helpful math websites, visit the Magnolia Mustangs Math Websites for Students (Magnolia Mustangs, n.d.).

Technologies for Instructors

Tool Factory recently introduced the Dyscalculia Screener to help educators discern which 6- to 14-year-old students may have a learning disability in math versus those who are simply demonstrating poor math skills. Administered in approximately 30 minutes, the program runs students through 4 subtest areas, including enumerating, understanding number size, understanding numerals, and understanding simple arithmetic. In order to minimize test anxiety, the program does not provide feedback regarding right and wrong answers. However the program provides prompts to students, encouraging them to continue as they complete each section. For the instructor, the program produces individual diagnostic reports and student profiles. These documents can be used to tailor curriculum to each student's needs (Tool Factory, n.d.).

Marvelsoft produces Marvel Math, which is software that enables instructors to create math e-tests based on their own hard copy exams, textbook information, or by selecting criteria included with the program. Visual and auditory feedback can be customized to provide support to students at the instructor's discretion (Marvelsoft, 2004). Assessmath by Learning in Motion is designed for students in grades K-8 and provides instructors with the means to create electronic tests with problems that are tailored to curriculum goals and students' needs. Instructors select grade level, mathematical content, level of difficulty, item format, use of context, and time allotment. The program contains more than 150 problems per grade level and allows for problems to be added and modified. The software also offers assessments of single tests or multiple test results (Learning In Motion, Inc., 2004). The Best of Math Exemplars by Exemplars is software designed for grades K-8 that offers lessons and activities along with tests and assessments for a variety of skill levels. Teachers' guides aid the instructor in determining the most appropriate activities and options for their students. The Best of Secondary Math Exemplars offers the same features and functions but on a level appropriate for students in grades 7-12 (Exemplars, 2004).

Emerging Technology

Incorporating technology for learning into today's classrooms is a critical component of success for many children. For others, it is an effective method to engage and interest students in learning. Technology developers are moving toward the development of technology that is designed for all students. This move provides the opportunity for greater integration of technology into the learning environment. Teachers are much more likely to develop lesson plans with technology platforms when all students will benefit. Of course, assistive technology will continue to offer increased access to these lessons for many students with more significant disabilities (National Association of State Boards of Education [NASBE], 2001).

Electronic devices are extremely popular with today's young people. They use computers, carry cell phones, and use electronic gadgets at early ages. Taking this population's fascination with technology as a foundation, many developmental learning toys are available in the mainstream market for very young children and at many levels of development. Examples of successful learning toys that have been introduced into the commercial marketplace include the LeapFrog products and Vtech's V-Smile system. They also offer electronic learning for children as young as 6 months old. These systems allow children to easily transition to the handheld devices that are popular in the market today. PDAs and digital phones are commonly used to communicate via text messaging and voice communications. Many young people have no trouble learning the abbreviated messaging system commonly used on these devices even when they have difficulty mastering standard English. It is said that the difference is motivation and engagement. As these tools become increasingly popular, one must learn to use the associated "language" in order to effectively communicate with peers.

PDAs and MP3 players have many potential uses in today's classroom. PDAs are becoming streamlined and as a result support only a few core applications (i.e. calendar, address book, e-mail). Why are these devices being slimmed down at a time when demand for dynamic portable computing is growing (Lurie, 2003)? Simply stated, current platforms draw too much battery power to support a great deal of functionality. It is expected that improved battery power and computing power will be packed into much smaller spaces bringing more versatile systems in the next few years (Bauer, S., Personal Communication, February 23, 2006). The advent of e-books for PDA platforms is coming, but is still too expensive for school systems to implement (Sulli, 2004). MP3 Players can offer e-books in the form of digital audio. This is an attractive option for people who have difficulty reading as well as those who are short on time. TextAloud, a text-to-speech engine, allows users to create MP3 files from text that they can listen to on the go (NextUp Technologies, 2006). The major issue with these technologies is the fear that they will be distractions in the classroom. This could inhibit the use of these useful technologies for students with learning disabilities.

Electronic gadgets are not the only tools being used by young people today. A report published by the Kaiser Family Foundation (Rideout, Vandewater, & Wartella, 2003) indicated that 48% of children who range in age from 0 to 6 years have used a computer. The report also stated that when these children reach the ages of 4-6, 7 out of 10 of them have used a computer. Many very young users, who play games on the internet, are able to recognize their favorite websites by the icons that represent them. At this point, many education professionals are playing catch up to become as adept at technology then the children they teach (T^2RERC, in press).

The Educational Development Center has researched on defined "Power Users" of Information and Communications technology. These children are defined as:

> "tech savvy youth with an affinity for computers, the Internet, and gadgets that allow them to 'stay connected,' whose technical acumen is unmatched by that of any prior generation. These are individuals, generally born after

> 1982, brought up in households with personal computers, Internet access, wireless phones, video recorders and other technical devices. They are true 'natives' to information and communications technology – for they have never experienced life before the advent of these things – unlike the rest of us, who, at best, are immigrants" (pg. 4).

The survey conducted by the EDC, in cooperation with Certiport, found that Power Users influence how and what they teach in the classroom. These are the children that will shape the future of technology in the classroom. They not only help teachers to become familiar with technology but also help other students to learn (Certiport, n.d.).

Computers are a common sight in today's classroom – there is one computer for every 5.7 students in the United States (Net Family News, 2005b). Whether they are desktops, laptops, or tablet computers, they are infiltrating the school systems with funds from programs such as NCLB's Enhancing Education through Technology grants and the E-Rate program. As mentioned earlier in this chapter, computers are an excellent way for students with and without a LD to access the curriculum. Today's students' use thumb drives (a.k.a. memory sticks, flash drives, jump drives and USB drives), Secure Digital, and compact flash instead of notebooks and the internet instead of the encyclopedia.

Throw-Away Computers

The price of technology has decreased dramatically; however, many people with low socio-economic status are still denied the use of these technologies. Many educators and assistive technology practitioners have stated that a "throw-away computer," or a computer that has been designed to meet basic access needs in a low-cost device, would greatly impact the use of computers in the classroom (T^2RERC, in press). Efforts are already underway to construct just such a system. The Massachusetts Institute of Technology (MIT) Media Center designed a $100 laptop that will be distributed through a new, non-profit association called One Laptop per Child (OLPC) (OLPC, n.d.). This laptop will be manufactured by a Taiwanese company called Quantra Computer, Inc. Red Hat, an open source software developer will supply software for the system and AMD will provide the processors (Kanellos, 2006). The initial version of the $100 Laptop will be distributed to developing countries around the world. A commercial system will be made available sometime in the future. According to OLPC, the laptops are designed to be rugged and energy-efficient. A new access system known as Mesh networking will supply internet access. They will feature a Linux-based system, which is a free UNIX-based operating system. The computers will not feature traditional drives (only 500 MB of local storage), but instead will utilize flash memory drives. The usability of these systems in American schools may be challenged by the fact that they will not feature the operating systems that Americans are accustomed to. Other companies, such as Microsoft (cell phone application) and AMD (Personal Internet Communicator) are developing low-cost systems, but each faces challenges in terms of success in the marketplace (Kanellos, 2006).

Open Source Software

As a cost-control measure, the $100 laptop uses open source software (i.e. Linux) as opposed to proprietary systems (i.e. MS Windows). Open source software provides access to the source code of a software title that can be manipulated and improved by many users, thereby allowing the program to evolve rapidly (Open Source Initiative, 2006). The Open Source Initiative (2006) states that in order to qualify as open source, the software "must be distributed under a license that guarantees the right to read, redistribute, modify, and use the software freely" (para. 31). Open source software is becoming more popular, especially in developing countries where proprietary software systems are proving too expensive. Open source software may become more attractive to schools who wish to cut expenses. It also offers an opportunity for students to explore and work with software source codes on a "real world" level. Red Hat, one of the companies involved in the $100 laptop program is a world leader in open source solutions (Red Hat, 2006).

Freeware

Freeware is software that is freely distributed on the internet. There are many freeware programs that are attractive to schools based on their utility as well as their cost. For example, a freeware program that is becoming popular as an alternative text entry interface is Dasher (available at http://www.inference.phy.cam.ac.uk/dasher/). Dasher allows the user to select letters via a pointing interface as opposed to a standard keyboard. It is recommended for use with the following situations:

- Joystick, touchscreen, trackball, or mouse;
- Hands-free computer use (i.e., by head-mouse or by eyetracker);
- A palmtop computer; and
- A wearable computer (Inference Group, 2006).

Another freeware program known as Open Office (http://www.openoffice.org/) offers a free office suite that could challenge Microsoft for dominance in the marketplace (Valenza, 2005). Many other freeware programs are available. Here are a few sites where freeware is available:

- http://kidsfreeware.com/
- http://www.freewarefiles.com/
- http://www.kidsdomain.com/down/pc/_agefreeware-index.html

A major concern about using freeware in school systems is security. In many cases, IT professionals lock systems so that children do not download viruses on to school computers. Moving into the future, schools must balance security risks with the benefits of using freeware.

Subscription-Based Programs

Software providers are beginning to use the internet as a distribution tool. Instead of packaging software and distributing it via the postal service, providers are beginning to

offer subscriptions to online software. For example, Browsealoud, a speech enabling tool for websites developed by Texthelp, offers free software to customers of information service providers who pay an annual subscription fee.

Many large software companies are slowly moving to subscription-based software, including Microsoft, Oracle, and Computer Associates (Foley, 2004b). There are concerns that this new delivery model will not sit well with large customers who prefer to pay yearly for software nor with school districts that restrict Internet access and program and file downloading. However, many large software providers are finding that their customers are pushing for subscription-based programs so that they can access software on an as-needed basis (Hoffman, 2002). The question of how effectively this model of delivery will work for schools is unanswered. Universities are beginning to appreciate the flexibility of subscription-based licensing in that initial acquisition costs are low and vendors respond to customers' needs because they want to continue to serve them. Many feel that subscription-based services will be the norm for software provision in the next six years. Already a quarter of all software sales take place via subscription services (Foley, 2004a). The move to subscription-based services is beginning in the K-12 environment. The Learning Company (TLC) software has already become a mainstay in schools, through Discovery School and the Learning Company School. They plan to migrate all of the CD-Rom-based software they offer to web-based subscription service known as *unitedstreaming* (Net Family Newsletter, 2005a). This evolving trend will be interesting to watch in the coming years.

Online Tutoring and Homework Help

There are many resources available on the Internet to help children with their homework. In fact, a survey conducted by the Associated Press (AP) and America Online (AOL) found that 82% of parents and 81% of teachers rated online resources for homework help as either good or very good (eSchool News, 2006b). Online tutoring services such as SmartHelp from Apangea Learning (http://www.apangealearning.com/02b_apangea_smarthelp.htm) use a research-based system to ensure positive results from its math tutoring system. The system tests children to measure initial knowledge, develops targeted plans (called learning pathways) to improve skills, and offers online lessons and human tutoring to ensure that children are progressing. Perhaps the most attractive feature on SmartHelp is that the learning pathways are sent to teachers for review and revision, ensuring that the goals of the program are the same as the goals of the school (eSchool News, 2006a). Students are provided instruction via computer-based lessons that are interactive and use audio, text, and graphics to review math concepts and assist the students in solving problems using a 7-step method. This process includes the following steps (Apangea Learning, 2005):

1. Explore the problem;
2. Define the goal;
3. Identify the variables;
4. Build an equation;
5. Solve the equation;

6. Answer the question; and
7. Explain the answer.

One school that used the software, Holy Family Learning Center, stated that their students' test scores have dramatically improved (28% on Pennsylvania System of School Assessment Exam) since the implementation of this system (eSchool News, 2006a). SmartHelp services are provided on a subscription basis.

There are other methods of getting online help, though they are less thorough than online tutoring services. For example, webmath.com walks children through math problems on an on-demand basis. They also provide an "ask the expert" link that allows students to submit a problem for assistance. There is no cost to use the webmath.com site. Students submit a problem via the website and are then notified by e-mail when the answer and explanation are in. Sparknotes.com offers online study guides. Some are free to access online and some are available for a small fee. Discoveryschool.com's BJ PinchPeck (http://school.discovery.com/homeworkhelp/bjpinchbeck/) offers some excellent links to other online homework help sites.

Conclusion

Schools are catching up with the computer age. Tech-savvy students will most likely play a lead role in bringing some of these emerging technologies into schools. Initiatives such as NIMAS will help ensure that all children have access to curricular materials however they need them. For additional information on NIMAS, see the section on legislation and funding. Groups such as WikiMedia Foundation's Wikibook program (http://en.wikibooks.org/wiki/Main_Page) allows educators and students to develop and use Wikitexts to supplement textbooks in the classroom (Valenza, 2006). The Internet, podcasts and open courseware will stimulate thinking in independent learners.

A major concern for schools as they move into the digital age will be the security of their systems. Schools will need time to meet the challenge of securing their systems. Teachers must also learn to use and integrate technology solutions in the classroom. Teacher training, such as that mandated by NCLB, will become increasingly important as teachers attempt to engage children who have grown up with technology in all aspects of their life. Universal design for learning will become the norm in American schools as the options for curricular access and engagement are increased through technology.

References

8 Bit Software. (2000). *V3 mail*. Retrieved October 6, 2005, from http://www.v3mail.com/

Ablelink. (2005). *Webtrek*. Retrieved October 6, 2005, from http://www.ablelinktech.com/_desktop/productview.asp?ID=5

AlphaSmart, Inc. (2004). *AlphaSmart products.* Retrieved October 25, 2004, from http://www2.alphasmart.com/products/index.html

Amundson, S., & Weil, M. (1996). Prewriting and handwriting skills. In J.Case-Smith, A.S. Allen, & P.N. Pratt (Eds.)., *Occupational therapy for children* (pp. 524-541). St .Louis, MO: Mosby.

Apangea Learning, Inc. (2005). *Who says you can't do more with less? Reach more students more efficiently and cost-effectively with Apangea SmartHelp*. Retrieved February 23, 2006, from http://www.apangealearning.com/02b_apangea_smarthelp.htm

Assistive Technology Training Online Project (2005). *Technology for special populations: Reading Aids.* Retrieved January 3, 2006, from http://atto.buffalo.edu/registered/ATBasics/Populations/LowTech/reading.php

Attainment Co. (2004a). *Attribute tiles.* Retrieved December 8, 2004, from http://www.attainmentcompany.com/AB1031005/showdetl.cfm?&DID=11&Product_ID=1258&CATID=5

Attainment Co. (2004b). *Match time*. Retrieved December 27, 2004, from http://www.attainmentcompany.com/AB1031005/showdetl.cfm?&User_ID=172154&St=8372&St2=-37297506&St3=-61491213&DS_ID=2&Product_ID=70&DID=11

Attainment Co. (2004c). *Timescales*. Retrieved December 17, 2004, from http://www.attainmentcompany.com/AB1031005/showdetl.cfm?&DID=11&Product_ID=69&CATID=5

Attainment Co. (2004d). *TimeWheel.* Retrieved December 8, 2004, from http://www.attainmentcompany.com/AB1031005/showdetl.cfm?&DID=11&Product_ID=1169&CATID=5

Attainment Co. (2004e). *Toward Independence*. Retrieved December 27, 2004, from http://www.attainmentcompany.com/AB1031005/showdetl.cfm?&DID=11&Product_ID=1477&CATID=41

Beacon Ridge. (2004). *Product Catalog*. Retrieved January 3, 2006, from http://www.beacon-ridge.com/

Bell, N. (2003). *Imagery the sensory-cognitive connection for math.* Retrieved September 8, 2005, from http://www.ldonline.org/article.php?max=20&id=413&loc=70

Bisagno, J.M., & Haven, R.M (2002). Customizing technology solution for college students with learning disabilities. *The International Dyslexia Association Quarterly Newsletter, Perspectives*, 21-26. Retrieved October 3, 2004, from http://www.ldonline.org/ld_indepth/technology/customizing_technology.html

Blackboard Learning System. (2004). *Advancing teaching and learning with technology*. Retrieved October 7, 2005, from http://www.blackboard.com/docs/AS/Bb_Learning_System_Brochure.pdf

Blackboard, Inc. (2005a). *Blackboard and WebCT announce agreement to merge*. Retrieved January 5, 2006, from http://investor.blackboard.com/phoenix.zhtml?c=177018&p=irol-newsArticle&ID=767025&highlight=

Blackboard, Inc (2005b). Class.com and Blackboard partner to enhance Class.com's delivery of courses worldwide. Retrieved April 13, 2006, from http://investor.blackboard.com/phoenix.zhtml?c=177018&p=irol-newsArticle&ID=510525&highlight=

Blackboard, Inc. (2005c). *Zogby report finds surge in online learning*. Retrieved January 5, 2006, from http://www.blackboard.com/company/press/release.aspx?id=762348

BrainPOP. (2005). *BrainPOP ® fact sheet.* Retrieved October 6, 2005, from http://www.brainpop.com/support/documents/brainpop_factsheet.pdf

BrightEye Technologies. (n.d.). *Scan and listen technology at affordable prices.* Retrieved January 3, 2006, from http://www.brighteye.com/products.htm

Calcuscribe (n.d.). *QWERTY Calcuscribe*. Retrieved November 2, 2004, from http://www.calcuscribe.com/missing.html

CalcuScribe. (2005). *Calcuscribe*. Retrieved January 20, 2005, from http://www.calcuscribe.com/htmls/faqs.html

Center for Applied Technology (CAST). (2004). *Chapter 2: Developing reading recognition.* Retrieved December 22, 2005, from http://www.cast.org/publications/books/ltr/chapter2.html

Center for Applied Technology (CAST). (2005a). *Universal design for learning: Frequently asked questions.* Retrieved September 28, 2005, from http://www.cast.org/research/faq/index.html

Center for Applied Technology (CAST). (2005b). *What is universal design for learning?* Retrieved September 30, 2005, from http://www.cast.org/research/udl/index.html

Certiport. (n.d.). *Research Abstract: Power Users.* Retrieved February 22, 2006, from http://powerusers.edc.org/research.htm

CESA 6 Media Center. (2004). *CMC online Catalog: Browse by category*. Retrieved December 27, 2004, from http://www.cesa6.k12.wi.us/CMC/interactive_catalog/cmcbrowse.asp

Chafee Amendment (1996). Copyright Law Amendment, 1996: PL 104-197. Retrieved June 13, 2006, from http://loc.gov/nls/reference/factsheets/copyright.html

Class.com (2004). About us. Retrieved April 13, 2006, from http://www.class.com/

Cognitive Concepts, Inc. (2005). *Earobics Literacy Launch ®: We know it works.* Retrieved December 22, 2005, from http://www.earobics.com/teachers/ell/research.cfm

Coolmath.com, Inc. (2005). *Cool math for students.com*. Retrieved October 10, 2005, from http://www.coolmath4students.com/

Computerade. (2004). *Picture sentence match.* Retrieved January 3, 2006, from http://www.computerade.com/PSM/index.html

Crawford, C. & Brown, E. (2003). Integrating internet-based mathematical manipulatives within a learning environment. *The Journal of Computers in Mathematics and Science Teaching.* v. 22 no. 2 p. 169-80.

Crick Software, Inc. (2003). *Our products: Clicker*. Retrieved January 10, 2005, from http://www.cricksoft.com/us/products/clicker/default.asp

CT4ME. (2005*). Software titles: Destination math*. Retrieved October 3, 2005, from http://www.ct4me.net/software_def.htm

DAISY Consortim. (2006). *About the DAISY consortium.* Retrieved January 4, 2006, from http://www.daisy.org/about_us/default.asp

Dalton, D. W., & Hannafin, M. J. (1987). The effects of word processing on written composition. *Journal of Educational Research, 80*(6), 338-342.

Department of Education. (2004). *The five essential components of reading.* Retrieved December 19, 2005, from http://www.classbrain.com/artread/publish/article_60.shtml

Dimensions Therapy Center. (n.d.). *Software review: LocuTour™ multimedia line of software.* Retrieved January 5, 2006, from http://www.dimensionsspeech.com/articles-locutour.shtml

Disarno, N.J., Schowalter, M., & Grassa, P. (2002). Classroom amplification to enhance student performance. *Teaching Exceptional Children, 34*(6)20-26.

Don Johnston, Inc. (2003). *Simon SIO: Sounds it out: Individual phonics instruction.* Retrieved October 19, 2005, from http://www.donjohnston.com/pdf/djlearning/sioresearch.pdf

Don Johnston, Inc. (2004a). *Blocks in motion.* Retrieved November 30, 2004, from http://www.donjohnston.com/catalog/readcover/readcoverfrm.htm

Don Johnston, Inc. (2004b). *Co: Writer Solo: Writing and graphic organizer moves students through writing process*. Retrieved December 9, 2004, from http://www.donjohnston.com/catalog/cow4000d.htm

Don Johnston, Inc. (2004c). *Draft: Builder Solo: Writing and graphic organizer moves students through writing process*. Retrieved December 9, 2004, from http://www.donjohnston.com/catalog/draftbuilderd.htm

Don Johnston, Inc. (2004d). *Write: Outloud Solo: Talking word processor motivates students to compose, revise and edit independently*. Retrieved December 9, 2004, from http://www.donjohnston.com/catalog/writoutd.htm

Don Johnston, Inc. (2005) *Draft:Builder®: Build planning, organizing, and draft-writing strategies.* Retrieved June 3, 2005 from http://www.donjohnston.com/catalog/draftbuilderd.htm

Don Johnston, Inc. (2006). *Two libraries devoted to supporting struggling readers of all abilities.* Retrieved January 3, 2006, from http://www.donjohnston.com/catalog/stflibraries.htm

Edyburn, D. (2000). Assistive technology and students with mild disabilities. *Focus on Exceptional Children, 32*(9), 1-24.

Effland, R., Lerner, S., Perkins, S., Turkon, D. (n.d.). *Exploration of Language: Temporal Reality in Language*. Retrieved June 14, 2005, from http://www.mc.maricopa.edu/~reffland/anthropology/language/index.html

Elley, W. B. (1989). Vocabulary acquisition from listening to stories. *Reading Research Quarterly, 24*(2), 174-87.

Ellis, Edwin S. (1998). *Framing main ideas and essential details to promote comprehension*. Retrieved January 25, 2005, from http://www.ldonline.org/pdf/ellis_framing.pdf

Enablemart. (2004). *Big calc.* Retrieved December 13, 2004, from http://www.enablemart.com/productdetail.aspx?store=10&pid=751&dept=24

ePALS Classroom Community (2006). Welcome to ePALS. Retrieved April 17, 2006 from http://www.epals.com/community/

eSchool News. (2006a). *Supplemental instruction: SmartHelp motivates struggling students to succeed.* Retrieved February 23, 2006, from http://www.eschoolnews.com/news/PFshowstory.cfm?ArticleID=6080

eSchool News. (2006b). *Survey: Parents need help online.* Retrieved February 23, 2006, from http://www/eschoolnews.com/news/PFshowstory.cfm?ArticleID=6110

ETA/Cuisenaire. (2005). *Math: Cuisenaire Rods.* Retrieved January 19, 2005, from http://www.etacuisenaire.com/catalog/department?deptId=CUISENAIRERODS

Exemplars. (2004). *The best of math exemplars.* Retrieved December 17, 2004, from https://www.exemplars.com/store/catalog/product_info.php?products_id=47

Fisher-Price® (2004). *Doodle Pro™*. Retrieved December 28, 2004, from http://www.fisher-price.com/us/products/thumbnail.asp?type=assistant&catID=magna&keywords=&age=&gender=NULL&price=NULL|NULL&catname=Doodle+Pro%99&lMinage=3&lMaxage=7.00&page=1&from=ToysByType&mail=

Fluharty, G. (1993). Use of an electronic dictionary to compensate for surface dysgraphia. *The Journal of Cognitive Rehabilitation, 11*(1), pp. 28-30

Foley, J. (2004a). *Power shift: Users gain flexibility and influence with new software pricing models*. Retrieved February 22, 2006, from http://images.autodesk.com/adsk/files/4395497_Autodesk_InformationWeek.pdf

Foley, J. (2004b). *Subscription-style software licenses continue upward trend.* Retrieved February 22, 2006, from http://informationweek.com/story/showArticle.jhtml?articleID=46802713

Forbes.com. (2005a). *Website review: Firefox.* Retrieved October 6, 2005, from http://www.mozilla.org/products/firefox/

Forbes.com. (2005b). *Website review: Internet explorer*. Retrieved October 6, 2005, from http://www.forbes.com/bow/b2c/review.jhtml?id=7708

Forbes.com. (2005c) *Website review: Opera*. Retrieved October 6, 2005, from http://www.forbes.com/bow/b2c/review.jhtml?id=7705

Franklin Electronic, Inc. (2003). *Hand-held devices: Learning*. Retrieved November 7, 2004, from http://www.franklin.com/estore/handhelds/

Franklin Electronic Publishers. (2005). *Spell Correctors*. Retrieved June 3, 2005 from http://www.franklin.com/estore/category.aspx?group_id=2&nettrackerid=mmc20&cat_id=20&page_type=handhelds

Frazel, M. (2002). *Web resources for educators: Graphic organizers.* Retrieved January 3, 2006, from http://www.midgefrazel.net/go.html

Freedom Scientific Learning Systems Group. (2006). *Wynn Scan and Read literacy software: Features and benefits*. Retrieved January 9, 2006, from http://www.freedomscientific.com/LSG/products/wynn_features.asp

Gagnon, J.C., & Maccini, P. (2001). *Preparing students with disabilities for algebra*. Retrieved October 3, 2005, from http://journals.cec.sped.org/EC/Archive_Articles/VOL.34NO.1SEPTOCT2001_TEC_gagnon.pdf

GAMCO Educational Software. (2003a). *Discover time*. Retrieved November 30, 2004, from http://www.gamco.com/math-6.htm

GAMCO Educational Software. (2003b). Math concepts one… two… three. Retrieved November 30, 2004, from http://www.gamco.com/math-8-9.htm

GAMCO Educational Software. (2003c). *Money challenge.* Retrieved November 30, 2004, from http://www.gamco.com/math-6.htm

GAMCO Educational Software. (2003d). *Paws and pyramids.* Retrieved December 2, 2004, from http://www.gamco.com/math-13b.htm

GAMCO Educational Software. (2003e). *Word problem square off.* Retrieved December 2, 2004, from http://www.gamco.com/math-13.htm

Garnett, K. (1998). *Math skills*. Retrieved September 12, 2005, from http://www.ldonline.org/article.php?max=20&id=974&loc=70

Geary, D. (1999). *Mathematical disabilities: What we know and don't know*. Retrieved September 14, 2005, from http://www.ldonline.org/article.php?max=20&id=538&loc=41

Geary, D. (2003). *Learning disabilities in arithmetic: Problem-solving differences and cognitive deficits.* Retrieved September 14, 2005, from http://www.missouri.edu/~psycorie/LDHandBk03.pdf

Gersten, R. & Baker, S. (1999). Reading comprehension instruction for students with learning disabilities: Executive summary. Retrieved December 19, 2005, from http://www.ld.org/research/ncld_reading_com.cfm

Graham, S. (1990). The role of production factors in learning disabled students' compositions. *Journal of Educational Psychology, 82*(4), *781-791.*

Graham, S., Berninger, V., Abbott, R., Abbott, S., & Whitaker, D. (1997). The role of mechanics in composing of elementary school students: A new methodological approach. *Journal of Educational Psychology, 89*(1), 170-182

Graham, S., Harris, K.R., & Larson, L. (2001). Prevention and intervention of writing difficulties for students with learning disabilities. *Learning Disabilities Research & Practice, 16*(2), 74-84.

Grey Stone Digital, Inc.(2004). *The BIG keys company*. Retrieved November 2, 2004, from http://www.bigkeys.com/html/bigkeys_1level.html

Grumline, R. & Brigham-Alden, P. (2006). Teaching science to students with learning disabilities. *Science Teacher, 73*(3), p 26-31.

Handley-More, D., Deitz, J., Billingsley, F. F., & Coggins, T. E. (2003). Facilitating written work using computer word processing and word prediction. *American Journal of Occupational Therapy, 57*(2): 139-51.

Handwriting Without Tears®. (2003). *The HWT program: Books and materials*. Retrieved December 27, 2004, from http://www.hwtears.com/

Hoffman, T. (2002). *Users leery about subscription-based software pricing.* Retrieved February 22, 2006, from http://www.computerworld.com/softwaretopics/software/story/0,10801,72215,00.html

Iansyst Ltd. (2005). *Reading pen II.* Retrieved January 3, 2006, from http://www.dyslexic.com/products.php?pid=34

Iansyst, Ltd. (2006). *Dyslexia.com: For the classroom: Dictionaries and spell checkers.* Retrieved January 9, 2006, from http://www.dyslexic.com/products.php?catid=32&subid=15

IBM®.(n.d.). *ViaVoice*. Retrieved November 2, 2004, from http://www-306.ibm.com/software/voice/viavoice/

iDictate, Inc. (2000). iDictate.com: A transcription service using live typists. Retrieved October 6, 2005, from http://www.idictate.com/

Inclusive TLC.(2004). From A to Z. Retrieved January 3, 2006, from http://www.inclusivetlc.com/catalogue/acatalog/From_A_to_Z.html

Inference Group.(2006). *What is Dasher?* Retrieved February 21, 2006, from http://www.inference.phy.cam.ac.uk/dasher/

Inspiration Software, Inc. (2004). *How do you inspire your students?* Retrieved December 20, 2004, from http://www.inspiration.com/productinfo/index.cfm

Inspiration Software, Inc. (2005) *Inspiraton*. Retrieved June 3, 2005, from http://www.inspiration.com/productinfo/inspiration/index.cfm

Intellitools. (n.d.). *Intellitools®: Products.* Retrieved October 25, 2004, from http://www.intellitools.com/

IntelliTools. (1997). *MathPad.* Retrieved December 13, 2004, from: http://www.intellitools.com

International Dyslexia Association. (2000). *Dysgraphia*. Retrieved January 11, 2006, from http://www.interdys.org/servlet/compose?section_id=5&page_id=49

International Dyslexia Association. (2005). *How common are language based learning disabilities?* Retrieved October 19, 2005, from http://www.interdys.org/servlet/compose?section_id=5&page_id=95

Jacobi, C. (1986). Word processing for special needs students: Is there really a gain? *Educational Technology, 26*(4), 36-39.

Jitendra, A. (2002). *Teaching students math problem-solving through graphic representations*. Retrieved September 12, 2005, from http://www.dldcec.org/pdf/teaching_how-tos/journal_articles/Article_5.pdf

Jitendra, A. & DiPipi, C. (2002). *An exploratory study of schema-based word-problem-solving instruction for middle school students with learning disabilities: An emphasis on conceptual and procedural understanding*. Retrieved September 13, 2005, from http://www.ldonline.org/ld_indepth/teaching_techniques/exploratory_study.html

Jones, T.H., & Paolucci, R. (1997). Putting education technology in perspective: The question of learning effectiveness. In J. Willis, J. Price, S. McNeil, B. Robin, & D. Willis (eds.). *Technology and teacher education annual*, pp. 881-884. Charlottesville, VA: Association for the Advancement of Computing in Education.

Kanellos, M. (2006). *PCs for the poor: Which design will win?* Retrieved February 5, 2006 from http://news.com/pcs+for+the+poor+which+design+will+win/2100-1003_3-6040019.html

Keller, E. (2005). *Dyscalculia (or dyscalculia).* Retrieved January 18, 2005, from http://www.as.wvu.edu/~scidis/dyscalcula.html

Kenyon, R. (2000). Accommodating *math students with learning disabilities.* Retrieved December 29, 2004, from http://www.gse.harvard.edu/~ncsall/fob/2000/kenyon.html

Key Curriculum Press. (2005). *The Geometer's Skecthpad®: Product information.* Retrieved January 13, 2006, from http://www.keypress.com/sketchpad/getting_started/product_info.php

Kidder, K.R. (2004). *"Reading disability" or "learning disability": The debate, models of dyslexia, and a review of research-validated reading programs.* Retrieved October 19, 2005, from http://www.ldonline.org/ld_indepth/reading/reading_approaches.html

k-Soft. (2005). Graphmatica. Retrieved January 13, 2006, from http://www8.pair.com/ksoft/

Kurzweil Educational Systems. (2005). *Kurzweil 3000 for windows: Features and benefits.* Retrieved December 22, 2005, from http://www.kurzweiledu.com/products_k3000win_features.asp

Larson Learning, Inc. (2005). *Larsonmath.com.* Retrieved October 3, 2005, from http://www.larsonmath.com/

LeapFrog® .(2004a). *All leapfrog products*. Retrieved December 20, 2004, from http://www.leapfrog.com/do/browseproducts

LeapFrog®. (2004b). *Electronic flash magic ® flashcards.* Retrieved November 24, 2004, from http://www.leapfrog.com/do/findproduct?ageGroupKey=grade&key=eflash_addsub

LeapFrog®. (2004c). *LeapFrog® shopping cart.* Retrieved December 1, 2004, from http://www.leapfrog.com/do/findproduct;jsessionid=51059F0848EAED54C9B3A077D6AB02DC.papp2_1?ageGroupKey=preschool&key=learnshoppingcart

LeapFrog®. (2004d). *Mind mania math.* Retrieved November 29, 2004, from http://www.leapfrog.com/do/findproduct?ageGroupKey=grade&key=maniamath

LeapFrog®. (2004e). *Turbo twist math handheld.* Retrieved November 29, 2004, from http://www.leapfrog.com/do/findproduct?ageGroupKey=grade&key=ttmath

LeapFrog ®. (2005). *Twist and shout addition.* Retrieved October 3, 2005, from http://www.leapfrog.com/do/findproduct?ageGroupKey=grade&key=twistadditio n

Learning Advantage. (2002). *Math star.* Retrieved November 30, 2004, from http://www.learningadvantage.com/mathstar.html

Learning Disabilities Association of America. (2005). *Dyscalculia*. Retrieved January 18, 2005, from http://www.ldanatl.org/aboutld/parents/ld_basics/dyscalculia.asp

Learning Disabilities (LD) Online. (2004). *LD online tech guide*. Retrieved February 27, 2006, from http://www.ldonline.org/ld_indepth/technology/product_list/writing.html

Learning Fundamentals. (2004). *It's a …Safari.* Retrieved December 22, 2005, from http://www.learningfundamentals.com/products/product.php?id=8

Learning Fundamentals. (2005). *Learning fundamentals: Speech.* Retrieved January 3, 2006, from http://www.learningfundamentals.com/products/

Learning In Motion, Inc. (2004). *Assessmath.* Retrieved December 17, 2004, from http://www.learn.motion.com/products/assess/index.html

Learning Point Associates. (2002). *Virtual schools and e-learning in K-12 environments*. Retrieved September 30, 2005, from http://www.ncrel.org/policy/pubs/html/pivo111/apr2002c.htm

Learning Resources. (2000). *Hands-on soft base ten flats.* Retrieved January 19, 2005, from http://www.learningresources.com/Category.pasp?txtCatalog=Toys&txtCategory =Blocks+Math&startrow=21

Levinson Medical Center for Learning Disabilities. (2004). *The Dyslexic Syndrome*. Retrieved January 21, 2005 from http://www.dyslexiaonline.com/uk/info_syndrome.php

Lewis, R. B., Graves, A. W., Ashton, T. M., & Kieley, C. L (1998). Word processing tools for students with learning disabilities: A comparison of strategies to increase text entry speed. *Learning Disabilities Research & Practice, 13(2), 95-108.*

Lexia Learning Systems. (2005). *Reading: Lexia strategies for older students.* Retrieved December 22, 2005, from http://www.lexialearning.com/products/reading/sos.cfm

Li, H., & Hamel, C.M. (2003). Writing issues in college students with learning disabilities: A synthesis of the literature from 1990 to 2000. *Learning Disabilities Quarterly, 26* (1), 29-46.

Lindamood-Bell Learning Processes. (2004). *Programs/materials: Mathematical computation and reasoning.* Retrieved January 20, 2005, from http://www.lblp.com/programs/ocnmath.shtml.

Lock, R. (1996). *Adapting mathematics instruction in the general education classroom for students with mathematics disabilities.* Retrieved September 29, 2005, from http://www.ldonline.org/ld_indepth/math_skills/adapt_cld.html

Listen Technologies Corporation. (n.d.). *Education solutions.* Retrieved October 5, 2005, from http://www.listentech.com/solutions/nav_education.php?PHPSESSID=c4fd8a77055b3068075f2fef9801f1b6

Lurie, J. (2003). *Picking a PDA platform: Sun and Microsoft are at it again*. Retrieved February 23, 2006, from http://builder.com.com/5100-6374-1049886.html

MacArthur, C. A. (1988). The impact of computers on the writing process. *Exceptional Children, 54*(6), p. 536-542.

MacArthur, C. A., Graham, S., Schwartz, S. S., & Schafer, W. D. (1995). Evaluation of a writing instruction model that integrated a process approach, strategy instruction, and word processing. *Learning Disability Quarterly, 18(4), pp. 278-291*

MacArthur, C.A. (1998a). *From Illegible to Understandable: How Word Prediction and Speech Synthesis Can Help.* Retrieved January 6, 2006, from http://www.ldonline.org/ld_indepth/technology/word_prediction.html

MacArthur, C. A. (1998b) Word processing with speech synthesis and word prediction: Effects on the dialogue journal writing of students with learning disabilities. *Learning Disability Quarterly, 21*(2), pp.151-166.

MacArthur, C. A. (1999). Overcoming barriers to writing: Computer support for basic writing skills. *Reading & Writing Quarterly: Overcoming Learning Difficulties Vol 15(2),* pp. 169-192.

Magnolia Mustangs. (n.d.). *Math websites for students.* Retrieved January 13, 2006, from http://tiger.towson.edu/~mlackn1/mathwebsitestudent.htm

March, T. (1998). *Why WebQuests? An introduction.* Retrieved October 14, 2005, from http://www.ozline.com/webquests/intro.html

Marvelsoft. (2004). *Marvel math.* Retrieved December 16, 2004, from http://www.braillebookstore.com/marvel-math.htm

MathLine.com. (2002). *MathLine concept-building system.* Retrieved November 28, 2005, from http://www.howbrite.com/

Mathtalk.com. (2003). *Product information and comparison.* Retrieved November 28, 2005, from http://www.mathtalk.com/products.htm

McFarland, D. (2005). *Math that counts.* Retrieved January 20, 2005, from http://maththatcounts.com/

McHale, K., & Cermak, S.A. (1992). Fine motor activities in elementary school: Preliminary findings and provisional implications for children with fine motor problems. *American Journal of Occupational Therapy, 46*, pp. 898-903.

Microsoft Corporation. (2005). *Internet Explorer.* Retrieved October 6, 2005, from http://www.microsoft.com/windows/ie/default.mspx

Mindmaker, Inc. (2003). *TextAssist: Introduction.* Retrieved January 4, 2006, from http://www.textassist.com/

MindPlay. (2004). *MindPlay: Ace reporter.* Retrieved December 28, 2004, from http://www.mindplay.com/opp/AceRep.html

MindPlay. (2005). *My reading coach: Help Teach Children and Adults to Read With a Personal Coach.* Retrieved December 22, 2005, from http://www.myreadingcoach.com/

Mossberg, W.S. (2004). *Security, cool features Of Firefox web browser beat Microsoft's Internet Explorer.* Retrieved October 5, 2005, from http://ptech.wsj.com/archive/ptech-20041230.html

Mozilla. (2005). *Firefox – Rediscover the web.* Retrieved October 6, 2005, from http://www.mozilla.org/products/firefox/

National Association of State Boards of Education. (2001). *Any time, any place, any path, any place: Taking the lead on e-learning policy.* Retrieved October 6, 2005, from http://www.nasbe.org/e_Learning.html

National Center for Education Statistics (NCES) (2002). Internet access in U.S. public schools and classrooms: 1994-2001. U.S. Department of Education: Office of Educational Research and Improvement. Retrieved June 13, 2006, from http://www.netdaycompass.org/outside_frame.cfm?thispath=instance_id=1701^category_id=5&thislink=http://nces.ed.gov/pubs2002/2002018.pdf&instance_id=4154

National Center for Learning Disabilities. (2004). *Fact sheets: Dysgraphia*. Retrieved January 7, 2005, from http://www.ncld.org/LDInfoZone/InfoZone_FactSheet_Dysgraphia.cfm

National Institute for Literacy. (2004). *The partnership for reading: Glossary*. Retrieved January 21, 2005, from http://www.nifl.gov/partnershipforreading/glossary/glossary.html

National School Boards Association. (2001). *The First R: A new look at reading software*. Retrieved December 22, 2005, from http://www.electronic-school.com/2001/01/0101poweruser.html

Net Family News. (2005a). *Meaty web stuff for educators.* Retrieved February 22, 2006, from http://www.netfamilynews.org/s1991105.html

Net Family News. (2005b). *Tech in schools.* Retrieved February 22, 2006, from http://www.netfamilynews.org/s1991001.html

NextUp Communications. (2005). *Text aloud*. Retrieved October 6, 2005, from http://www.textaloud.com/

NextUp Technologies. (2006). *Converting text to MP3 with TextAloud.* Retrieved February 23, 2006, from http://www.nextup.com/TextAloud/text-to-mp3.html

NICHY (2004). Connections to …learning disability. Retrieved June 13, 2006, from http://www.nichcy.org/resources/LD1.asp

NLVM. (2005). *Virtual library.* Retrieved October 3, 2005, from http://nlvm.usu.edu/en/nav/index.html

One Laptop per Child (OLPC). (n.d.) *Quanta Computer Inc. to manufacture $100 laptop.* Retrieved February 21, 2006, from http://laptop.org/2005-1213-olpc.html

Onion Mountain Technology, Inc. (2003). *LoTTIE kit for math.* Retrieved January 18, 2005, from http://www.onionmountaintech.com/kit.php?id=15

Open Source Initiative. (2006). *Open source: Frequently asked questions.* Retrieved February 21, 2006, from http://www.opensource.org/advocacy/faq.php

Opera. (n.d.) *Opera for Windows: Key features in Opera 8.* Retrieved October 5, 2005, from http://www.opera.com/products/desktop/

Optimum Resource, Inc. (n.d.). *Middleware- math word problems- careers*. Retrieved December 16, 2004, from http://www.stickybear.com/mw/mwp/mwpcareers.html.

OT Ideas, Inc. (n.d.). *Tools and learning products to assist teachers and occupational therapists: Handwriting.* Retrieved October 25, 2004, from http://www.otideas.com/Items/handwriting.htm

Outhred, L. (1987). To write or not to write: Does using a word processor assist reluctant writers? *Australia and New Zealand Journal of Developmental Disabilities, 13,* 211-217.

Pasadena Independent School District (2005). *Technology and Dyslexia*. Retrieved January 4, 2006 from http://www.pasadenaisd.org/Curr_Instr/Dyslexia/Technology.htm

PCI. (n.d.). *The Coin-u-lator*. Retrieved December 1, 2004, from http://www.pcicatalog.com/products/webstore/detail.asp?Category=ALL&SubCategory=ALL&StockNumber=PCI700W.

Peterson-Karlan, G.R. & Parette, P. (2005). Millennial students with mild disabilities and emerging assistive technology trends. *Journal of Special Education Technology, 20*(4), p 27-38

Pilgrim, M. (2002). *What is RSS?* Retrieved October 6, 2005, from http://www.xml.com/pub/a/2002/12/18/dive-into-xml.html

Premier Assistive Technology. (n.d.a). *Complete reading system®: A total reading system for the blind user.* Retrieved January 3, 2006, from http://www.premier-programming.com/CRS/Completereadingsystem.htm

Premier Assistive Technology. (n.d.b). *Talking checkbook 3.0*. Retrieved October 4, 2005, from http://www.premier-programming.com/tcb/Talking_checkbook.htm

ProofreadNOW.com, Inc. (2002). *Why your word processing software doesn't find spelling and grammar errors very well…and never will.* Retrieved January 11, 2006, from http://www.proofreadnow.com/Grammar_whitepaper.pdf

Queens University. (2005). *Learning disabilities and technology.* Retrieved January 3, 2006, from http://educ.queensu.ca/~ecs/techuses/ld-and-technology.html

QuickPAD Technology Corporation. (2002). *Shop products.* Retrieved November 2, 2004, from http://www.quickpad.com/Showcase.asp

Quinlan, T. (2004). Speech recognition technology and students with writing difficulties: Improving fluency. *Journal of Educational Psychology, 96(2),* 337-346

Read Naturally. (2004). *Why read naturally?* Retrieved December 22, 2005, from http://www.readnaturally.com/why/default.htm

Reading Rockets®. (2005). *Target the problem: Word decoding and phonics*. Retrieved October 19, 2005, from http://www.readingrockets.org/helping/target/phonics

ReadPlease. (2005). *Welcome to ReadPlease.* Retrieved December 22, 2005, from http://www.readplease.com/

Red Hat. (2006). *Red Hat rated #1 in value*. Retrieved February 21, 2006, from http://www.redhat.com/

Research Zone. (1999). *What is a web browser?* Retrieved October 5, 2005, from http://www.classzone.com/research/pages/basics/res09.htm

Rideout, V.J., Vandewater, E.A., and Wartella, E.A. (2003). *Zero to six: Electronic media in the lived of infants, toddlers, and preschoolers*. A Kaiser Family Foundation Report. Retrieved February 10, 2006, from http://www.kff.org/entmedia/3378.cfm

Riverdeep Interactive Learning. Ltd. (2004a). *Math workshop deluxe.* Retrieved November 30, 2004, from http://www.riverdeep.net/products/other/math_workshop_deluxe.jhtml

Riverdeep Interactive Learning, Ltd. (2004b). *Reading / language arts: Storybook Weaver® Deluxe 2004.* Retrieved November 7, 2004, from http://www.riverdeep.net/products/storybook_weaver/storybook_weaver_deluxe.jhtml

Riverdeep Interactive Learning, Ltd. (2004c). *Trudy's time and place house.* Retrieved December 27, 2004, from http://www.riverdeep.net/products/early_learning/trudys_taph.jhtml

Riverdeep Interactive Learning, Ltd. (2005a). *Bailey's book house*. Retrieved January 3, 2006, from http://rivapprod2.riverdeep.net/portal/page?_pageid=353,141934,353_141935&_dad=portal&_schema=PORTAL

Riverdeep Interactive Learning, Ltd. (2005b). *Featured product: Destination reading.* Retrieved December 22,2005, from http://rivapprod2.riverdeep.net/portal/page?_pageid=353,110734&_dad=portal&_schema=PORTAL

Riverdeep Interactive Learning Limited. (2005c). *Math products.* Retrieved October 3, 2005, from http://rivapprod2.riverdeep.net/portal/page?_pageid=353,110730&_dad=portal&_schema=PORTAL

R.J. Cooper and Associates. (2004). *Talk and scan calculator*. Retrieved December 1, 2004, from http://www.rjcooper.com/talk-n-scan-calculator/index.html

R.J. Cooper and Associates. (2005). *I Can E-mail.* Retrieved October 6, 2005, from http://rjcooper.com/icanemail/

Rovai, A.P. & Barnum, K.T. (2003). Online course effectiveness: An analysis of student interactions and perceptions of learning. *Journal of Distance Education, 18* (1), 57-73.

Salend, S.J. & Hofstetter, E. (1996). *Adapting a problem-solving approach to teaching mathematics to students with mild disabilities.* Retrieved January 19, 2005, from http://www.highbeam.com

Saugus.net. (2004). *Glossary of computer terms.* Retrieved October 25, 2004, from http://www.saugus.net/Computer/Terms/

Scansoft, Inc. (2004). *Dragon NaturallySpeaking 8.* Retrieved November 2, 2004, from http://www.scansoft.com/naturallyspeaking/

Scholastic, Inc. (2006). *Scholastic online for teachers.* Retrieved January 3, 2006, from http://teacher.scholastic.com/products/wiggleworks/index.htm

Scott, J. (2001). Listening Skills. *Dyslexia Online Magazine*. Retrieved January 21, 2005, from http://www.dyslexia-parent.com/mag37.html

Senate Bill 5664 (2005). 59th Legislature, 2005 regular session.

Shalev, R.S., Auerbach, J., Manor, O., & Gross-Tsur, V. (2000). *Developmental dyscalculia Prevalence and prognosis.* Retrieved September 27, 2005, from http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=11138905&dopt=Abstract

Slater Software, Inc. (n.d.). *Picture it.* Retrieved January 11, 2005, from http://www.slatersoftware.com/pit.html

Slater Software, Inc. (2004). *PixWriter™*. Retrieved December 22, 2005, from http://www.slatersoftware.com/

Smart Kids Software, Inc. (2004). *Kidworks Deluxe.* Retrieved December 20, 2004, from http://www.smartkidssoftware.com/nddav13b.htm

Sulli, J.D. (2004). *The future of PDA eBooks.* Retrieved February 23, 2006, from http://www.writers-publish.com/pda-ebooks.html

Sunburst. (2004a). *Green globs and graphing equations*. Retrieved November 24, 2004, from http://store.sunburst.com/Resources/GreenGlobs_04.pdf

Sunburst. (2004b). *Introduction to patterns*. Retrieved December 3, 2004, from http://store.sunburst.com/ProductInfo.aspx?itemid=176729

Sunburst. (2004c). *Memory fun.* Retrieved December 2, 2004, from http://store.sunburst.com/ProductInfo.aspx?itemid=176656#complete.

Sunburst. (2004d). *Reading and language: Reading process.* Retrieved December 22, 2005, from http://store.sunburst.com/Category.aspx?MODE=RESULTS&CATID=5332

Sunburst. (2004e). *Tenth planet: number meanings and counting.* Retrieved December 23, 2004, from http://store.sunburst.com/ProductInfo.aspx?itemid=176590

SuperKids Educational Software Review. (2004). *Reading Software -- The Big Picture.* Retrieved from November 16, 2004 from http://superkids.com/aweb/pages/reviews/reading/

Synapse Adaptive. (n.d.a). *Access and productivity tools: IntelliMathics.* Retrieved September 29, 2005, from http://www.synapseadaptive.com/intellitools/new/Intellimathics_3.htm

Synapse Adaptive. (n.d.b). *Synapse ADA workstations.* Retrieved November 2, 2004, from http://www.synapseadaptive.com/synapse/workstat.htm

Synapse Adaptive. (n.d.c). *Voice It VTR3200 digital voice recorder*. Retrieved January 10, 2005, from http://www.synapseadaptive.com/recorders/recorders.htm

Taylor Associates Communication, Inc. (2004) *Reading Plus: Instruction.* Retrieved December 22, 2005, from http://www.ta-comm.com/instruction/index.html

Technology Transfer Rehabilitation Engineering Research Center. (in press). *Education Technology: Primary market research.* Buffalo, NY: Center for Assistive Technology, University at Buffalo

Telex. (n.d.). *Telex EZdaisy digital talking book information*. Retrieved January 4, 2006, from http://www.telex.com/talkingbook/files.nsf/Pages/Telex+EZ+Daisy+Digital+Talking+Book+Player/$file/Telex_ezDaisy_DTB_Information.d.oc

Texas Instruments (2006). *Products.* Retrieved January 13, 2006, from http://education.ti.com/educationportal/sites/US/productHome/us_product.html

Texthelp Systems, Ltd. (2003a). *Products.* Retrieved January 11, 2005, from http://www.texthelp.com/products.asp?q1=products

TextHelp Systems, Ltd. (2003b). *Read & Write 7.1E Gold Pronunciation.* Retrieved October 19, 2005, from http://www.texthelp.com/rwg.asp?q1=products&q2=rwg

Texthelp Systems, Ltd. (2004). *Browsealoud: Look, click, listen.* Retrieved October 6, 2005, from http://www.browsealoud.com/

Texthelp Systems, Ltd. (2005). *Browsealoud white paper.* Retrieved October 6, 2005, from http://www.browsealoud.com/browsealoud.pdf

Tom Snyder. (2004a). *Math mysteries.* Retrieved December 28, 2004, from http://www.tomsnyder.com/products/product.asp?SKU=MATMAT&Subject=Math.

Tom Snyder. (2004b). *Tessellation exploration.* Retrieved December 28, 2004, from http://www.tomsnyder.com/products/product.asp?SKU=TESEXP&Subject=Math

Tom Snyder. (2004c). *The graph club 2.0.* Retrieved December 28, 2004, from http://www.tomsnyder.com/products/product.asp?SKU=GRPV20&Subject=Math

Tom Snyder. (2004d). *Timeliner.* Retrieved December 27, 2004, from http://www.tomsnyder.com/products/product.asp?SKU=TIMV50&Subject=Math

Tom Snyder. (2005). *Graph master*. Retrieved October 3, 2005, from http://www.tomsnyder.com/products/product.asp?SKU=GRAMAS&Subject=Math

Tool Factory. (n.d.). *Products: Dyscalculia screener*. Retrieved October 3, 2005, from http://www.toolfactory.com/products/page?id=2083

TouchMath.com. (2005). *TouchMath. The alphabet of mathematics.* Retrieved November 28, 2005, from https://www.touchmath.com/index.php?CAT_UID=5

Touch Screens, Inc. (n.d.). *Computer access at the touch of a finger.* Retrieved November 2, 2004, from http://www.touchwindow.com/

T2D, Inc. (2003). *Troll Touch Touchscreens.* Retrieved November 2, 2004, from http://www.trolltouch.com/products.html

United States Department of Education (2001). The condition of education. Retrieved June 13, 2006, from http://nces.ed.gov/pubs2001/2001072.pdf

University of Reading. (2003). *Dyslexia Info*. Retrieved May 27, 2005 from http://www.rdg.ac.uk/studyskills/dyslexia/dyslexia%20info.htm

Valenza, J.K. (2005). *The top 10 technology trends affecting education in 2005.* Retrieved February 23, 2006, from http://www.philly.com/mld/philly/living/columnists/joyce_kasman_valenza/13573401.htm

Valenza, J.K. (2006). *Imagine textbooks in a new form.* Retrieved February 21, 2006 from http://www.philly.com/mld/philly/living/columnists/joyce_kasman_valenza/13905892.htm

Web Based Education Commission. (2000). *The power of the internet for learning: Moving from promise to practice*. Retrieved January 5, 2006, from http://www.ed.gov/offices/AC/WBEC/FinalReport/WBECReport.pdf

WebCT. (n.d.) *WebCT digital content: Key features in WebCT e-packs*. Retrieved January 5, 2006, from http://www.webct.com/content/viewpage?name=content_key_features

Web Math. (n.d.). *Webmath.com: Solve your math problem.* Retrieved October 6, 2005, from http://www.webmath.com/.

WGBH Education Foundation. (2002). *Basics of reading.* Retrieved October 19, 2005, from http://www.pbs.org/wgbh/misunderstoodminds/readingbasics.html

Widgit Software, Inc. (n.d.) *Writing with Symbols 2000*. Retrieved January 11, 2005, from http://www.widgit.com/products/wws2000/WWS20001.htm

Wikipedia. (2006). E-learning. Retrieved June 22, 2006, from http://en.wikipedia.org/wiki/E-learning

Wilson, A. J. (n.d.). *Dyscalculia primer and resource guide.* Retrieved September 27, 2005, from http://www.oecd.org/document/8/0,2340,en_2649_14935397_34495560_1_1_1_1,00.html

Wilson, M. (n.d.). *Classroom sound-field amplification: An audiologist's suggestions*. Retrieved October 5, 2005, from http://www.hearmore.com/classsuggestions.htm.

Wright, C. (1996). *Learning disabilities in mathematics.* Retrieved January 26, 2005, from http://www.ldonline.org/ld_indepth/math_skills/math-1.html

YouthLearn. (2003). *Teaching techniques: Keeping students focused*. Retrieved December 22, 2005, from http://www.youthlearn.org/learning/teaching/focused.asp

Chapter 4: Legislation, Funding, and Education Technology

The impact of legislation and funding on assistive technology development and delivery cannot be underestimated. Public policy can foster innovations and enhance the opportunity for successful technology transfer. This legislation is important because it lays the groundwork for development of new and innovative applications of technology. It is important to note that this policy does not directly address the transfer of technologies for people with disabilities. However, it does create an environment where the transfer of innovation from universities, federal labs, and small business can foster the development of all technology, including technology that is universally designed and assistive technology. Policy can also create a need for assistive or universally designed technology on a local or national level (Bauer, 2005). The legislation section of the Industry Profile on Education Technology is designed to provide an overview of relevant policy that impacts the transfer of technology and the availability and provision of assistive technologies.

Legislation and Funding for Innovation and Transfer

The legislation discussed in this section can also be referred to as supply side legislation. It facilitates the development and movement of innovations from government labs, universities, and small companies (Bauer, 2005). This legislation is unique because it creates opportunities to move technologies into the mainstream marketplace that may have otherwise stagnated at the development site. Key supply side legislation is listed in Table 1.

Table 4.1: Legislation for Innovation and Transfer

Act Title	Alternative Title
Technology Innovation Act of 1980 (P.L. 96-480)	Stevenson – Wydler Act
Patent and Trademark Act of 1980 (P.L. 96-517)	Bayh-Dole Act
Small Business Innovations Development Act (P.L. 97-219)	None
The Small Business Technology Transfer Act of 1992 (P.L. 102- 564, Title II)	None

Technology Innovation Act of 1980

Technology transfer is a process by which technologies developed for use in one application area (i.e. military applications) are used in a different application areas (i.e. assistive technologies, wireless communication, etc.) (Lane, 2005). A great deal of innovative technology applications are developed by and for the federal government by the network of federal laboratories. As a result, getting technology out of the federal laboratories is instrumental in much of the innovation that takes place in the United States and beyond. In recognition of the need to move federally developed technology into the private sector, the Technology Innovation Act of 1980 (also called the Stevenson-Wydler Act) (P.L. 96-480) was passed. This law laid the groundwork for technology transfer into and out of the Federal Laboratories. The Stevenson-Wydler Act also established Offices of Research and Technology Application (ORTA) at major federal laboratories to

facilitate the transfer of Federal Lab Technology. Subsequent legislation such as the Federal Technology Transfer Act of 1986 (P.L. 99-502) not only created mechanisms to enforce federal technology transfer, but it also created minimum royalty fees for technologies licensed by federal inventors and created the Cooperative Research and Development Agreement (CRADA) under which a private sector company and federal lab co-develop technology (intellectual property) with each party having specific rights to use this technology (Bauer, 2005). There are many variations on the basic concepts of technology licensing and CRADA, including a "cost-in" CRADA or "Work for Others" CRADA; a "Cost-Shared" CRADA; and "Contract Work". For additional information on CRADA, please visit the T^{2}RERC website.

Patent and Trademark Act of 1980

Universities also play an important role in the development of technology and innovation. The Patent and Trademark Act of 1980 (Bayh-Dole Act) (P.L. 96-517) gave federally funded US universities ownership of any intellectual property (IP) generated by their faculty and staff. As a result of the Bayh-Dohl Act, university technology transfer offices (TTO) were established to screen university created IP, establish the market value of IP, patent valuable IP, locate private sector partners, and negotiate license agreements (or the equivalent) with these partners. Royalties from license agreements accrue back to the university. A small portion of these royalties is returned to the inventor who created the innovation.

Small Business Innovations Development Act of 1982

Small Business is a major source of technology innovation in the United States. However, many small businesses lack the resources to operate research and development (R & D) programs that would allow them to compete with large business. According to a summary report completed by the Contract Services Administration (Garmen, 2005), a 1982 Senate Small Business Committee report validated that small business was indeed a major source of innovation, but lacked the federal support to serve as a major force in technology development. The report stated,

> "*…only 3.5 to 4 percent of the Federal R&D dollar is spent with small firms. This underutilization of small businesses in Federal R&D programs is especially regrettable when considering the highly successful track record of small firms in generating jobs, tax revenues and other economic and social benefits. Based on the studies and on a series of congressional hearings, the Committee concluded that one way to revitalize the U.S. economy is to develop a means by which Federal agencies can better tap the innovative potential of small businesses."*

In recognition of this fact, the Small Business Innovations Development Act of 1982 (PL 97-219), which was reauthorized until September 30, 2008 by the Small Business Reauthorization Act of 2000 (P.L. 106-554), required that all large federal agencies (defined as any agency providing extramural research funding that exceeds 100 million

dollars per year) must commit a few percent of their extramural funding as grants to small US businesses (less than 500 employees) by way of Small Business Innovation Research (SBIR) grants. The agencies that participate in the SBIR program include (Zyn Systems, 2005):

- Department of Agriculture
- Department of Commerce
- Department of Defense
- Department of Education
- Department of Energy
- Department of Health and Human Services
- Department of Homeland Security
- Department of Transportation
- Environmental Protection Agency
- National Aeronautics and Space Administration
- National Science Foundation

The purpose of the SBIR program is to stimulate private sector technology development that might help the sponsoring federal agencies achieve their missions. The SBIR program creates shared IP, allowing the federal agency and the small business that created the innovation to share IP rights. In many cases, the small business manufactures products based upon this intellectual property for the private sector while the government retains a non-exclusive right to the technology for governmental use. The principle investigator for an SBIR grant must be employed by a small business (SBA, 2001). Within guidelines established by the SBIR Act, participating agencies are free to set rules for administration and funding levels for their SBIR programs. Most programs have both Phase I and Phase II grants, and an unfunded Phase III grant. The Phase I grants are typically funded for up to six months and $100,000. Phase I grants are used to complete work on a technical proof of concept. The Phase II grants are typically funded for up to two years and $750,000 per year. The exact amount awarded will vary between funding agencies. Phase II grants are used to refine the prototype and demonstrate commercial viability. A small business concern must first apply for and receive a Phase I grant prior to applying for a Phase II grant. Phase III SBIR grants do not provide government funds but focus on the successful commercialization of the innovations developed within the SBIR program. SBIR grants are awarded on a competitive basis.

Small Business Technology Transfer Act of 1992

The Small Business Technology Transfer Act of 1992 (Public Law 102- 564, Title II), reauthorized until September 30, 2009, by the Small Business Technology Transfer Program Reauthorization Act of 2001 (P.L. 107-50) established a mechanism that is very similar to the SBIR program except that the principle investigator for an Small Business Technology Transfer (STTR) grant may be either university-based or an employee of the small business. The grant must include a private sector partner in the form of a small business. Agencies that participate in the STTR program include:

- Department of Defense
- Department of Energy
- Department of Health and Human Services
- National Aeronautics and Space Administration
- National Science Foundation
- Department of Homeland Security

In order for Universities and small business to participate in this program, they must meet specific eligibility requirements (SBA, 2001). The small business must:

- American-owned and independently operated
- For-profit
- Company size limited to 500 employees

The nonprofit research institution must also meet certain eligibility criteria, these include:

- Located in the US
- Meet one of three definitions
    - Nonprofit college or university
    - Domestic nonprofit research organization
    - Federally funded R&D center

There is no size limitation on the university partner for an STTR grant. Like the SBIR program, the STTR program follows the 3 Phase implementation systems. STTR grants are awarded on a competitive basis.

Legislation and Funding for Technology Provision and Delivery

Technology described in this section can also be described as demand-side legislation. This legislation pushes application and delivery of technology in the commercial marketplace (Bauer, 2005). Understanding this legislation is essential to ensuring the delivery and funding mechanisms that will drive sales and application. Key demand-side legislation is listed in table 2.

Table 4.2: Legislation for Technology Provision and Delivery

Act Title	Alternative Title
Individuals with Disabilities Education Improvement Act of 2004 (P.L. 108-446)	IDEA 2004
No Child Left Behind Act of 2001 (PL 107-110)	NCLB
Section 504 of the Rehabilitation Act as Amended (P.L. 93-112)	Section 504
Section 508 of the Rehabilitation Act as Amended (P.L. 105-220)	Section 508
Americans with Disabilities Act (P.L. 101-336)	ADA

The Individuals with Disabilities Education Improvement Act of 2004

Please note that although the IDEA 2004 (P.L. 108-446) has become law, the final regulations, which correspond to the changes made to the previous IDEA legislation have not been published as of this writing.

The Individuals with Disabilities Education Improvement Act of 2004 (IDEA 2004) (P.L. 108-446) was designed to promote the participation of children with disabilities in the nation's schools. IDEA 2004 has been closely aligned with the Elementary and Secondary Education Act of 1965 that was reauthorized as the No Child Left Behind Act. This was done in order to ensure that "special education can become a service for [children with disabilities] rather than a place where such children are sent" (§ 601(c)). This reauthorization of IDEA recognized the need for assistive technologies and for universal design. The definition for universal design was taken from the Assistive Technology Act of 1998 (20 U.S.C. 3002):

> "The term 'universal design' means a concept or philosophy for designing and delivering products and services that are usable by people with the widest possible range of functional capabilities, which include products and services that are directly usable (without requiring assistive technologies) and products and services that are made usable with assistive technologies" (20 U.S.C. §602).

Universal design in the context of education is beneficial because it provides the opportunity to consistently reinforce learning by presenting information in multiple formats. This approach to learning ensures that students are presented with information in ways that they can understand. In many cases, universal design for learning can make the classroom a more interesting place for all students as it encourages teachers to move beyond the traditional lecture-and-take-notes formula into a broader multimedia approach. Many children who have problems sustaining attention excel in these environments.

According to IDEA 2004, students with a specific learning disability (SLD) are those who have a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in the imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations. It includes conditions such as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. When a student is found to have a LD, the school district is required to provide special education services to support the student in receiving an appropriate education. Each student must have an Individualized Education Program (IEP) that is tailored to fit his or her education needs (Turnbull & Turnbull, 2000). The IEP is developed with input from team members that can include special and general educators, school psychologists, related service providers, educational consultants, administrators and parents. A team approach helps to address the unique needs of each student.

The IEP is a written document that includes the student's present level of performance, annual goals and objectives, services and supports to be provided, program modifications, testing accommodations and how the student's progress will be evaluated. Initial service dates are recorded as well as the anticipated frequency, location and duration of the recommended services. These services are most often provided to students with a LD within the general education classroom (U.S. Department of Education, 2002). Recognizing the impact that technology, including assistive technology, can make to maximize accessibility for children with disabilities, technology supports must be considered when developing an IEP (IDEA, 2004). AT can be considered at any time by any member of the IEP team. However, during the development of the IEP, the IEP team must consider whether the child needs assistive technology devices and services to support his or her academic or functional progress. The team must consider what is required for a student to fully or partially participate and determine the necessary supports. Because there are common technology items designed for other uses that can be considered AT, "AT is any item that is *needed* (modified from *required* by IDEA 2004) by a student to improve his or her functional capabilities and that is written in the IEP." There are four places in the IEP where AT may appear (Bowser and Reed (2004, p. 1)):

1. In the measurable annual goals;
2. In the related services necessary to support the child;
3. In the supplementary aids and services for the child or for supports for school personnel; and
4. In testing accommodations.

It is recommended that the school district provide guidelines to the IEP team for documenting AT needs in the IEP. A clear description of its use should include information on observable and measurable outcomes. AT services as well as devices should be documented in the IEP (QIAT, 2004).

School districts are required to provide accommodations to students with disabilities when they need it to ensure their access to a "free and appropriate public education" (FAPE). Assistive technology that is called for in the student's IEP, must be provided by the school system. This can mean access to special instruction, the general curriculum or extracurricular activities (Bowser & Reed, 2004). It is important to note that any device that is purchased by a school system for the benefit of a student with a disability remains the property of the school and not that of the student. Funding through IDEA has not always been delivered as promised by the legislation. Golinker (2000) states that many schools fail to provide assistive technology and services on the basis of cost. It is important that the student with a disability, or an advocate who works in their interests, to ensure that AT is considered in the development of each Individualized Education Program (IEP) and that the technology is acquired by the school system as mandated by the legislation.

Once students graduate from the service system in the K-12 environment, they must learn how to seek their own accommodations through either a post-secondary institution or

through their employers. This is a significant challenge for many who would prefer to keep their disability to themselves as opposed to disclosing it in a new environment. Transition Services are critical to the success of students with learning disabilities as they move from the school environment to the either continued education or work.

As illustrated below, IDEA 2004 has changed its definition of transition services:

> (34) TRANSITION SERVICES - The term 'transition services' means a coordinated set of activities for a child with a disability that--
>
> (A) is designed to be a results-oriented process, that is focused on improving the academic and functional achievement of the child with a disability to facilitate the child's movement from school to post-school activities, including post-secondary education, vocational education, integrated employment (including supported employment), continuing and adult education, adult services, independent living, or community participation (20 U.S.C § 602).

Schools are required to have an IEP addressing the transition needs of the child in place by the age of 16. IDEA 2004 moved the age requirement for transition planning from 14-16 years of age. When obtaining technology for students in transition, it is advisable to create a cost-sharing mechanism between the school and the adult vocational rehabilitation agency to ensure that the technology can move with the student into post-school environments.

National Instructional Materials Accessibility Standard (NIMAS)

IDEA 2004 will implement the National Instructional Materials Accessibility Standard (NIMAS) upon its publication in the Federal Register (U.S. Department of Education, 2005) (Please note: the NIMAS standards have not been published at the time of this writing). NIMAS is a voluntary standard designed to create standardized source files that allow schools from pre-K-12 to easily create alternative formats for qualified students with disabilities (Center for Applied Special Technology (CAST), 2005). Children with reading disabilities are clearly defined as an audience for the accessible materials, as are children who are blind, have visual disabilities, and who are unable to read or use standard printed materials because of physical limitations. NIMAS will urge publishers to "create NIMAS-conformant XML files, a package file (detailing all components) and PDF documents containing the layout of the print work to the National Instructional Materials Access Center (NIMAC)." The American Printing House for the Blind is responsible for the oversight of NIMAC (Bujak, 2005). NIMAC will then distribute these files to authorized entities that will be responsible to disseminate the information to children who require them.

The NIMAS standard will allow for the creation of individualized accommodations in providing print alternatives to students with disabilities. Once a national file format for print materials is created, various accessible versions will be easy to produce. The Office of Special Education Programs (2004) and CAST, the agency charged with the creation

of the NIMAS standards, has listed many potential benefits of a single accessibility standard for education materials as proposed in by the National File Format Technical Panel, including that:

- A national file format will significantly reduce the cost and expense associated with the creation of multiple file formats for publishers.
- Authorized entities under the Chaffee Amendment will be able to easily create alternative delivery formats for accessible materials using the national file format. They will also be able to share marked up versions of these documents to create a repository of accessible materials.
- Students with print disabilities will be able to easily access alternative file formats without the significant wait times usually associated with this process. Schools will be relieved of the investment of time and resources required to create accessible materials on a local level.
- Commercial product development will be simplified by allowing companies to focus on developing products compatible with one format as opposed to the formats proposed by each state.

It is important to note that NIMAS will not solve the issue of curriculum accessibility. However, given the print-based nature of the delivery of curriculum in American schools, it is a very positive step toward delivery of a universally designed curriculum.

No Child Left Behind

The No Child Left Behind Act of 2001 (NCLB) (P.L. 107-110) was originally authorized as the Elementary and Secondary Education Act of 1965. NCLB has made sweeping changes children's education of children in the United States. High-stakes testing, school accountability, and early intervention for struggling readers have all been promoted with the passage of this legislation. The four main principles of NCLB are:

- Holding schools accountable for learning;
- Increasing flexibility for schools in reaching goals;
- Providing more options for parents to choose outside of schools that fail to meet Adequate Yearly Progress (AYP) for 2 consecutive years; and
- Using research to promote effective teaching strategies to enhance student learning (U.S. Department of Education, 2004).

Despite the lofty goals outlined by the NCLB, the law yields mixed reports from schools across the nation. Many states are experiencing an increase in the number of children who pass the high-stakes test that the law put into place. Still, others wonder whether the price of the increases is too high. Students with disabilities are not exempted from the high stakes assessment requirement of NCLB. According to a joint report from the National State Directors of Special Education (NADSE) and the National Education Administration (NEA) (2004) NCLB's assessment requirements for students with disabilities include:

- In the 2006-2006 school year NCLB mandates call for participation in annual assessments in reading/language arts and mathematics in grades 3-8, and one time in grades 9-12.
- In the 2007-2008 school year NCLB mandates call for participation in science assessments in the "grade level in which they are enrolled (once in grades 3-5, 6-9 and 10-12) (p 6)."

Appropriate accommodations or alternate assessments (in cases where the student is unable to participate, even with accommodations) are allowed on an as-needed basis. Accommodations are determined by both a state's list of permitted accommodations and the accommodations that are written into the IEP of the students taking the standardized tests. Any accommodation used by a student on a high-stakes assessment should be the same as those used during the student's regular instructional program. Non-standard accommodations (i.e. adapted equipment or adapted format), may result in scores that do not count toward AYP.

The concept of high-stakes testing for students with disabilities and other struggling learners is not without controversy. In fact, while the needs of many struggling students are highlighted as schools endeavor to achieve AYP, the "teach-to-the-test" mentality makes it difficult for teachers to focus on struggling learners, including those with disabilities (Center for Education Policy, 2005). These students, referred to as "Gap Kids," are being lost in the shuffle as the push for the high achievement standards for the majority of students are encouraged. Consider the following excerpt from the Center for Education Policy (2005) report:

> Many survey respondents and forum participants noted that NCLB does not make adequate provision for "gap kids"—those who have mild mental retardation or other disabilities that seriously affect their learning but are not severely cognitively disabled. Under NCLB, these students must take tests geared to standards for their grade level rather than their learning level—an approach that many of our respondents feel is at odds with the individualized education plans and learning goals of the Individuals with Disabilities Education Act. Moreover, educators note, many students with disabilities have been placed in special education precisely because they cannot achieve at the same levels as other children and are in need of extra services (p viii).

Many of the expert interviews conducted by the T^{2}RERC in preparation for the Demand Pull Project on Technology Transfer mentioned that NCLB would raise awareness of the issues for so-called "gap kids" and for many who struggle to learn who have not been identified as having a learning disability. While this may broaden the market for technology application in the schools, the funding for technology is only assured for students with a diagnosed disability who get technology applications written into their IEPs. Still many of the larger assistive technology companies are encouraged because the money available for general application technologies is much higher than that available

for traditional "assistive technologies" that may be recommended for a child in his/her IEP.

The Reading First (Title I) programs promoted by NCLB primary push the remediation of poor reading skills (NCLB, 2001) as opposed to compensation strategies (including technology interventions) that may impact many of these students ability to succeed in the classroom. This program is causing a great deal of controversy as many claim that the Title I programs promote only a select few reading programs (Manzo, 2005). Others state that it has allowed the federal government to determine the reading curriculum that is in place in schools across the country, despite legal mandates that prevent this from happening (Cavanaugh, 2005). Title I schools that fail to meet AYP in consecutive years face the potential removal of students whose parents want them to attend a school that is able to meet AYP (Heath, 2005).

It is widely held that the integration of instructional, learning, and assistive technologies in the classroom will have a positive impact on the ability of students with learning disabilities and other struggling learners to succeed in the classroom. NCLB includes a provision, Enhancing Education through Technology (§2401), that will:

- Promote the use of technology to enhance academic achievement;
- Promote private-public partnerships that will increase access to technology;
- Create technology infrastructures in schools to enhance access to technology;
- Train teachers and administrators to integrate technology into curricula through professional development programs;
- Ensure that teachers and administrators are kept abreast of training and research on technology integration;
- Promote technology alternatives (i.e. distance learning) from geographically isolated communities; and
- Support rigorous evaluation of programs funded by the Enhancing Education through Technology part of NCLB.

Implementation of this Part will be controlled through grants to states, which will in turn provide sub-grants to local education agencies (LEA). Technology applications in schools have the ability to impact students across all age groups. In fact, the age group with the greatest increase in the use of the internet from 2000-2002 was found among 2-5 year olds (US DOE, 2004). 78% of children between the ages of 12 and 17 go online (U.S. Department of Commerce, 2005). While access to the internet and other web-enabled technologies hold great promise, many are concerned about the necessity to limit access to undesirable sites and information. School firewalls will help to ensure the safety of students while online.

Rehabilitation Act of 1973 and its Amendments

The Rehabilitation Act of 1973 and its amendments remind us that disability is a natural part of the human experience that it in no way diminishes the rights of people to live independently, make their own choices, pursue meaningful careers, and experience full

participation in society (Legal Information Institute, 2003). The Rehabilitation Act Amendments are sweeping in terms of access to services in both independent living and vocational rehabilitation in that they established and funded both the initial Centers for Independent Living and Vocational Rehabilitation services. State vocational rehabilitation agencies are charged with assisting people with disabilities who qualify for employment services in their communities. As a part of these vocational rehabilitation services, assistive technology may be purchased if necessary to enable the person to obtain or maintain paid employment. All expenditures made by state vocational rehabilitation agencies are based on customer need and employment goal.

Section 504

Section 504 of the Rehabilitation Act Amendments (Section 504) (29 U.S.C. § 794) ensures that children with disabilities have equal access to education. Any school or agency that received federal funding must abide by the non-discrimination policies laid out in Section 504. The key non-discrimination portion of Section 504 states:

> "No otherwise qualified individual with a disability in the United States, as defined in section 706(8) of this title, shall, solely by reason of her or his handicap, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance or under any program or activity conducted by any Executive agency or by the United States Postal Service.... 29 U.S.C. § 794(a) (1973)."

Section 504 provides an assurance that children with disabilities will have access to modifications and accommodations to provide access to a free and appropriate public education (FAPE). Children who receive services under Section 504 generally have a 504 plan. A plan that describes a program of instructional services to assist qualified students with special needs who are in a regular education setting (Cleveland Heights Teachers Union, n..d.). It is important to remember that Section 504 is part of a civil rights law, as such; it prevents discrimination against people with disabilities. Some students who are not receiving services under IDEA, will be eligible for services under 504. According to Wrightslaw (2005):

> "If a child has a disability that does not adversely affect educational performance, then the child will not be eligible for special education services under IDEA but will usually be entitled to protections under Section 504 (para. 6)."

Unfortunately, Section 504 provides no financial support to schools for implementation, and as a result it has largely been unenforced by the Office of Civil Rights (Rosenfeld, 2005). Schools that are out of compliance may:

(1) initiate administrative proceedings to terminate Department of Education financial assistance to the recipient;

(2) refer the case to the Department of Justice for judicial proceedings (U.S. Department of Education, n.d.).

Section 504 is not limited in its application to students in K-12. Instead, it applies to any program or activity receiving Federal financial assistance (Government Services Administration [GSA], 2002a). Therefore, post-secondary institutions and employers who receive federal financial assistance are also responsible for non-discrimination under Section 504. It is important to remember that Section 504 does not require post-secondary institutions to alter their admissions standards for people with disabilities.

Section 508

Section 508 (29 U.S.C. ‘ 794d) requires that federal agencies provide equal access to information to all people with disabilities whether they are employees of the federal government or members of the public at large (Government Services Administration, 2002b). While applicable to all electronic and information technology used by the federal government, the scope of this legislation does not apply to entities outside of the federal sector. However, many private and research entities are working to improve access to digital information (Access Board, 2000). In addition, the federal government is promoting the advantage of the agencies it works with to make their electronic and information technology accessible. For example, vendors of these technologies are highly motivated to sell to the federal government; ensuring accessibility of their products puts them at a distinct competitive advantage (Government Services Association, 2002). This law benefits people with learning disabilities as it ensures access to information through non-traditional formats such as text-to-speech.

Americans with Disabilities Act (ADA) of 1990

The landmark civil rights legislation of 1990, the American’s with Disabilities Act (ADA) (P.L. 101-336) is designed to provide equal access to employment to all people with disabilities. The law prohibits discrimination on the basis of disability and mandates reasonable accommodation by employers for people with disabilities. For many people with learning disabilities this means that they will be provided with the accommodations necessary to complete essential job functions if they choose to disclose their disability. Reasonable accommodation calls for an employer to adapt, upon employee disclosure of disability, a position or tasks associated with a position that would allow a person with a disability to experience equal employment opportunities. Reasonable accommodations generally fall into one of three categories: accommodation to the job application process, accommodation to allow the person with a disability to perform the essential functions of a job; and accommodation to facilities to ensure equal access to all areas of the work environment (Office of Personnel Management, 2001). It is important to note that the ADA does not require the employer to alter the essential functions of the position, nor does it mandate accommodations that would present an undue hardship to the employer. If employees with hidden disabilities choose not to disclose the disability to the employer, they are not covered by the ADA until said disclosure is made.

Canadian Legislation

The United States has a very centralized approach to services for people with disabilities as most of the legislation is handed down from the federal level. Legislation that requires services for people with disabilities in Canada is much more provincially based. For example, while Ontario schools use IEPs, they are not considered legal documents. They are merely a tool for communication with parents. In fact, services to kids with disabilities are not necessarily based on a label that would qualify them as requiring special education. The provision of AT evaluation, services, and devices are provided to children who require them, regardless of the label they carry (K. Schaffer, personal communication, September 14, 2005). The Canadian Council on Social Development conducted a survey to determine the perceived effectiveness of the special education system in Canada. Surprisingly, only 19% of the respondents felt that children with disabilities were having their special education needs met (Kierstead & Hanvey, 2001). However, because the Special education requirements vary from province to province, it is difficult to say what works Canadian schools and what does not. Specific provincial legislation regarding education and human rights can be obtained at the Learning Disabilities of Canada website.

References

Access Board. (2000). *Board issues standards for electronic and information technology*. Retrieved January 29, 2004, from http://www.access-board.gov/news/508-final.htm.

Americans with Disabilities Act of 1990 (ADA), P.L. 101-336. Title 42, U.S.C. 12101 et seq.

Assistive Technology Act of 1998. 29 U.S.C. 3001 et seq.

Bauer, S.M. (2005). The public policy project. Technology Transfer Rehabilitation Engineering Research Center Update, 7(1) p 13-14.

Bowser, G. & Reed, P. (2004). *A School Administrator's Desktop Guide to Assistive Technology*. Arlington, VA: CEC-TAM.

Bujak, J. (2005). Never scan a textbook again: NIMAS recap. Retrieved September 15, 2005, from http://www.donjohnston.com/newsletters/literacylink.htm#T1

Cavanaugh, S. (2005). Group seeks federal probe of Reading First. *Education Week, 24*(44), p 3,20.

Center for Applied Special Technology (CAST) (2005). Policy and practice: National Instructional Materials Accessibility Standard (NIMAS). Retrieved September 12, 2005, from http://www.cast.org/policy/index.html.

Center for Education Policy (2005). From the capital to the classroom: Year 3 of No Child Left Behind Act. Washington, D.C.: Center for Education Policy.

Cleveland Heights Teachers Union(n..d.) 504 Plan frequency asked questions. Retrieved September 12, 2005, from http://www.chtu.org/504.html#what

Federal Technology Transfer Act of 1986. P.L. 99-502.

Garman, C.D. (2005). SBIR – A look back to 1982. Contract Services Association of America. Retrieved August 1, 2005, from http://www.csa-dc.org/documents/SmallBusinessInnovationResearchProgram-anhistoricalover.pdf

Golinker, L. (2000). Funding assistive technology devices and services in the Individuals with Disabilities Education Act (IDEA) of 1997. Retrieved February 9, 2004 from http://www.ucp.org/ucp_channeldoc.cfm/1/12/74/74-74/732

Government Services Administration (2002a). Section 504 of the Rehabilitation Act Retrieved September 12, 2005, from http://www.section508.gov/index.cfm?FuseAction=Content&ID=15

Government Services Administration (2002b). *What does 508 mean to you?* Retrieved January 29, 2004, from http://www.section508.gov/index.cfm?FuseAction=Content&ID=4

Heath, S. (2005). Parents guide to NCLB. Retrieved September 15, 2005, from http://www.wrightslaw.com/nclb/art.htm

Individuals with Disabilities Education Improvement Act Amendments of 2004, P.L. 108-446, 20 U.S. C. § 1400 et seq.

Kierstead, A.G. & Hanvey, L. (2001) Special Education in Canada. Perception, 25(2). Retrieved September 12, 2005, from http://www.ccsd.ca/perception/252/specialed.htm

Lane, J.P. (2005). Technology Transfer: Overview Module. Retrieved August 2, 2005, from http://cosmos.buffalo.edu/t2rerc/pubs/training/overview/index.htm

Manso, K.K. (2005). Complaint filed against reading initiative: Success for all officials request investigation of federal program. *Education Week*, *24*(41) p 3.

National Association of State Directors of Special Education & National Education Association (2004). IDEA & NCLB: The intersection of access and outcomes. Washington. D.C.: National Education Administration.

National Center on Learning Disabilities (2005b). IDEA 2004: Changes to the Identification & Eligibility Procedures for Specific Learning Disability (SLD): Frequently Asked Questions. Retrieved September 30, 2005, from http://www.ncld.org/advocacy/IDEA04_FAQ.cfm

No Child Left Behind Act of 2001 (P.L. 107-110) 20 USC 6301 § 301

Office of Personnel Management (2001). *Federal employment of people with disabilities: Reasonable accommodation*. Retrieved January 29, 2004, from http://www.opm.gov/disability/hrpro_6-01-B.asp

Office of Special Education Programs, US Department of Education (2004). National instructional materials accessibility standard report, Version 1.0. Retrieved August 8, 2005, from http://www.cast.org/policy/index.html

Patent and Trademark Act of 1980. P.L. 96-517.

Quality Indicators for AT Services (2004). *Quality Indicators for Assistive Technology Services, 2005* . Retrieved August 8, 2005, from http://sweb.uky.edu/~jszaba0/qiatqualityind.html

Rosenfeld, S.J. (2005). Section 504 and IDEA: Basic similarities and differences. Retrieved September 12, 2005, from http://www.ldonline.org/ld_indepth/legal_legislative/edlaw504.html

Section 504 of the Rehabilitation Act of 1973, as amended, 29 U.S.C. § 794.

Section 508 of the Rehabilitation Act of 1973, as amended, 29 U.S.C. § 794d

Small Business Administration (SBA) (2001). Handbook for SBIR proposal presentation. Retrieved August 2, 2005, from http://www.sba.gov/gopher/Innovation-And-Research/SBIR-Pro-Prep/

Small Business Innovations Development Act of 1982. P.L. 97-219

Small Business Reauthorization Act of 2000. P.L. 106-554

Small Business Technology Transfer Act of 1992. P.L. 102-564

Small Business Technology Transfer Program Reauthorization Act of 2001. P.L. 107-50.

Technology Innovation Act of 1980. P.L. 96-480.

Turnbull, H. R., & Turnbull, A. P. (2000). Free appropriate public education: The law and children with disabilities. Denver: Love Publishing.

U.S. Department of Commerce (2005). Visions 2020.2: Student views on transforming education and training through advanced technologies. Retrieved August 24, 2005, from http://www.netday.org/speakup_forstudents.htm.

U.S. Department of Education. (2002). *Twenty-fourth annual report to congress on the implementation of the Individuals with Disabilities Education Act.* Washington, DC: U.S. Government Printing Office.

U.S. Department of Education (2004). Toward a new golden age in American education: How the internet, the law and today's students are revolutionizing expectations. National Education Technology Plan. Washington, D.C.: US Department of Education.

U.S. Department of Education (n.d.). Protecting students with disabilities, Retrieved September 12, 2005, from http://www.ed.gov/about/offices/list/ocr/504faq.html

U.S. Department of Education (2005). Federal Register: 34 CFR Parts 300, 301, and 304 Assistance to States for the Education of Children With Disabilities; Preschool Grants for Children With Disabilities; and Service Obligations Under Special Education—Personnel Development To Improve Services and Results for Children With Disabilities; Proposed Rule. Part II. June 21, 2005.

Wrightslaw (2005). Who is eligible for protections under Section 504…but not under IDEA? Retrieved September 12, 2005, from http://www.wrightslaw.com/info/sec504.who.protect.htm

Zyn Systems (2005). SBIR federal agency programs. Retrieved August 2, 2005, from http://www.zyn.com/sbir/#agsites

Appendix:

Manufacturers Index
Organizations and Associations
Conferences and Trade Shows

Educational Technology Manufacturer's Index

8 bit Software
sales@v3mail.com
http://www.v3mail.com/

AbleLink Technologies
719.592.0347
http://www.ablelinktech.com/

Advanced Micro Devices, Inc.
408.749.3060
http://www.amd.com/us-en/

AlphaSmart by IPD, Inc.
888.274.0680
http://www.alphasmart.com/

App4Mac, Inc.
415.314.1624
http://www.app4mac.com/kidsbrowser.html

Apple Computer, Inc.
408.996.1010
http://www.apple.com/

Artic Technologies
248.588.7370
http://www.artictech.com

Attainment Co.
800.327.4269
http://www.attainmentcompany.com

Audio Gear
800.959.4252
http://www.audiogear.com

Blackboard, Inc.
800.424.9299 x. 4
http://www.blackboard.com/us/index.aspx

BrainPOP.com LLC
212.689.9923
http://www.brainpop.com/

Bright Eye Technologies
877.233.7323
http://www.brighteye.com

Broderbund (ClueFinders)
415.659.2000
http://www.broderbund.com

Calcuscribe
415.923.1024
http://www.calcuscribe.com

CAST
781.245.2212
http://www.cast.org

Centrum Sound
408.736.6500
http://www.centrumsound.com/sf.html

Class.com, Inc.
888.482.5598
http://www.class.com/

Cognitive Concepts, Inc.
888.328.8199
http://www.earobics.com/

Computerade Products
info@computerade.com
http://www.computerade.com

Computing Technology for Math Excellence
419.756.5980
http://www.ct4me.net

Coolmath.com
coolmathkaren@aol.com
http://www.coolmath.com/

Crick Software Inc.
866.33.CRICK
http://www.cricksoft.com/us/

Devicode Technology
914.667.2730
http://www.devicode.com/index.htm

Discovery Education - *unitedstreaming*
800.323.9084
http://www5.unitedstreaming.com/index.cfm

Don Johnston, Inc.
800.999.4660
http://www.donjohnston.com

Don Johnston Software, Inc.
800.999.4660
http://www.donjohnston.com

e-Pals.com Classroom Exchange
613.562.9847
http://www.epals.com/

Enablemart
888.640.1999
http://www.enablemart.com

ETA Cuisenaire
800.445.5985
http://www.etacuisenaire.com

Exemplars
800.450.4050
http://www.exemplars.com

Fast for Word
888.665.9707
http://www.scientificlearning.com

Franklin Electronic Publishers
800.266.5626
http://www.franklin.com

Freedom Scientific, Inc. - Learning Systems Group
888.223.3344
http://www.freedomscientific.com

Freeverse, Inc.
212.929.3549
http://www.freeverse.com/bumpercar2/

GAMCO Educational Software
888.726.8100
http://www.gamco.com

Gander Publishing (On Cloud Nine Math)
800.554.1819
http://www.ganderpublishing.com

Google Blogger
650.253.0000
http://www.blogger.com/start

Grey Stone Digital
800.249.5397
http://www.bigkeys.com/

H45 Technologies
800.373.8181
http://www.h45.com

Handwriting Without Tears
301.263.2700
http://www.hwtears.com/

HearIt, LLC.
800.298.7184
http://www.hear-it.org

IBM Inc.
800.IBM.4YOU
http://www.ibm.com

iDictate, Inc.
1.877.DICTATE x 1
http://www.idictate.com/

Inclusive TLC
800.462.0930
http://www.inclusivetlc.com

Ingenuity Works, Inc.
800.665.0667
http://www.ingenuityworks.com

Innovative Learning Concepts, Inc. (Touch Math)
800.888.9191
http://www.touchmath.com/

Inspiration Software Inc.
503.297.3004
http://www.inspiration.com

IntelliTools®, Inc.
800.899.6687
http://www.intellitools.com

JBliss Imaging
650.327.5477
http://www.jbliss.com

K-Soft, Inc.
ksoft@graphmatica.com
http://www8.pair.com/ksoft/

Key Curriculum Press
800.995.MATH
http://www.keypress.com

Knowledge Adventure
310.533.3400
http://www.knowledgeadventure.com

Kurzweil Educational Systems, Inc.
800.894.5374
http://www.kurzweiledu.com

Larson Learning Inc.
K-6 titles: 800.289.4490
7-12 titles: 800.462.6595
http://www.larsonlearning.com

LeapFrog Enterprises
800.883.7430
http://www.leapfrog.com

Learning Advantage
800.381.0381
http://www.learningadvantage.com

Learning in Motion, Inc.
800.560.5670
http://www.learn.motion.com

Learning Resources
800.333.8281
http://www.learningresources.com

Listen Technologies Corporation
800.330.0891
http://www.listentech.com/

Lexia Learning Systems, Inc.
800.435.3942
http://www.lexialearning.com/

LightSPEED Technologies, Inc.
800.732.8999
http://www.lightspeed-tek.com/

Lindamood-Bell Learning Processes
800.233.1819
http://www.lblp.com/

LocuTour, Inc. (Learning Fundamentals)
800.777.3166
http://www.locutour.com

Marvelsoft
800.987.1231
http://www.braillebookstore.com

Mathline
800.505.MATH
http://www.howbrite.com

Mayer-Johnson LLC
800.588.4548
http://www.mayer-johnson.com/

Fisher-Price
800.432.5437
http://www.fisher-price.com/us/default.asp

Metroplex Voice Computing, Inc.
817.261.1658
http://www.mathtalk.com

Microsoft Corporation
800. MICROSOFT (642.7676)
http://www.microsoft.com/

Milliken Publishing
1 (800)325-4136
http://www.millikenpub.com

Mindmaker Inc.
+36 20 981-9926 (Hungary)
http://www.mindmaker.com

MIND*PLAY*
520.888.1800
http://www.mindplay.com

Mozilla Corporation
650.903.0800
http://www.mozilla.com/

National Library of Virtual Manipulatives for Interactive Mathematics (NLVM)
435.797.2829
http://nlvm.usu.edu/en/nav/vlibrary.html

Netscape
650.254.1900
http://www.netscape.com/

NextUp Technologies, LLC.
sales@NextUp.com
http://www.nextup.com/

Nuance, Inc. (Scansoft)
781.565.5000
http://www.nuance.com

Onion Mountain Technologies Inc.
860.693.2683
http://www.onionmountaintech.com

Opera Software ASA
+47 24 16 40 00 (Norway)
http://www.opera.com/

Optimum Resource
843.689.8000
http://www.stickybear.com

OT Ideas Inc.
877.768.4332
http://www.otideas.com

Palm, Inc.
408.617.7000
http://www.palm.com

PCI Educational Publishing
800.594.4263
http://www.pcicatlogue.com

Phonic Ear. Inc.
800.227.0735
http://www.phonicear.com/home.htm

PolyVision Corporation
800.620.POLY
http://www.polyvision.com/

Premier Assistive Technology
815.722.5961
http://www.premier-programming.com

QuickPAD Technology Corporation
800.373.8181
http://www.quickpad.com/

Reading Success Lab
877.286.2837
http://www.readingsuccesslab.com/

ReadPlease Corporation
807.474.7702
http://www.readplease.com/

RES Software
+41 (0)31 302 52 37 (Switzerland)
http://www.res-software.ch

Riverdeep Interactive Learning
415.659.2000
http://www.riverdeep.net

RJ Cooper and Associates
800.752.6673
http://www.rjcooper.com/

Red Hat, Inc.
888.REDHAT1
http://www.redhat.com/

Rogers Center for Learning
949.951.3900
http://www.rogerscenter.com

Scholastic, Inc.
800.724.6527
http://www.scholastic.com

Scientific Learning Corporation
888.665.9707
http://www.scilearn.com/

Slater Software
877.306.6968
http://www.slatersoftware.com

SMART Technologies, Inc.
888.42.SMART
http://www.smarttech.com/

Softpedia
http://www.softpedia.com/user/feedback.shtml
http://www.softpedia.com/

Spark-Space Ltd.
011 44 870 240 3198 (United Kingdom)
http://www.spark-space.com

Steck-Vaughn Co.
512.343.8227
http://www.steckvaughn.com

Sunburst, Inc.
888.492.8817
http://store.sunburst.com

Switch in Time (ULTimate KidBooks)
978. 486.9433
http://switchintime.com

Synapse Adaptive
800.317.9611
http://www.synapseadaptive.com

Taylor Associates
800.732.3758
http://www.readingplus.com

Telex Communications, Inc.
800.828.6107
http://www.telex.com/

Texas Instruments, Inc.
800.336.5236
http://www.ti.com/

TextHelp Systems, Inc.
888.248.0652
http://www.texthelp.com/home.asp?

The Learning Company (Riverdeep)
415.659.2000
http://www.learningcompany.com

The Regents of the University of Michigan - Windows to the Universe
http://www.windows.ucar.edu/tour/link=/comments/comments.html
http://www.windows.ucar.edu/

Tom Snyder, Inc.
800.342.0236
http://www.tomsnyder.com

Tool Factory
800.220.8386
http://www.toolfactory.com

Touch Screens, Inc.
800.753.2441
http://www.touchwindow.com/

Tramline
info@tramline.com
http://www.field-guides.com/

Troll Touch/T2D Inc.
800.201.1160
http://www.trolltouch.com/

Virtual Ink Corporation
877.696.4646
http://www.mimio.com/

Webmath.com
info@webmath.com
http://www.webmath.com/

WETA Public Television (Reading Rockets)
703.998.2001
http://www.readingrockets.org/

Widgit Software Ltd. (United Kingdom)
44 (0) 1223 425 558
http://www.widgit.com/

Wizcom Technologies, Ltd.
888.777.0552
http://www.wizcomtech.com

Yahoo! Inc.
408.349.3300
http://www.yahoo.com/

Learning Disability Organizations and Associations

Alliance for Technology Access
2175 E. Francisco Blvd., Ste. L
San Rafael, CA 94901
Ph. 415-455-4575; TTY: 415-455-0491
Fax: 415-455-0654
Website: www.ATAccess.org

Association of Educational Therapists (AET)
1804 W. Burbank Blvd.
Burbank, CA 91506
Ph. 818-843-1183
Fax: 818-843-7423
Website: http://www.aetonline.org/index.php

Association on Higher Education and Disability (AHEAD)
P.O. Box 540666
Waltham, MA 02454
Ph. 781-788-0003
Fax: 781-788-0033
Website: http://www.ahead.org/index.htm

Center for Applied Special Technology (CAST)
40 Harvard Mills Square
Suite 3 | Wakefield, MA 01880-3233
Ph. 781-245-2212
Website: http://www.cast.org/

Center for Development and Learning
208 South Tyler Street
Covington, LA 70433
Ph. 985-893-7777
Fax: 985-893-5443
Website: http://www.cdl.org/

Children and Adults with Attention Deficit Disorder (CH.A.D.D.)
8181 Professional Place, Suite 201
Landover, MD 20785
Ph. 800-233-4050
Fax: 301-306-7090
Website: http://chadd.org/

Council for Exceptional Children (CEC)
1110 North Glebe Road, Suite 300,
Arlington, VA 22201
Ph. 703-620-3660; TTY: 866-915-5000
Fax: 703-264-9494
Website: http://www.cec.sped.org/

Council for Learning Disabilities
P.O. Box 4014
Leesburg, VA 20177
Ph. 571-258-1010
Fax: 571-258-1011
Website: http://www.cldinternational.org/c/@iG_9KWtLEGp26/Pages/home.html

Council for Opportunity in Education
1025 Vermont Avenue NW
Suite 900
Washington DC 20005
Ph. 202-347-7430
Fax: 202-347-0786
Website: http://www.trioprograms.org/

Education Resources Information Center (ERIC)
1920 Association Drive
Reston, VA 22091-1589
Ph. 800-328-0272
Website: http://www.eric.ed.gov/

The Education Trust
1250 H St. NW, Suite 700
Washington, DC 20005
Ph. 202-293-1217
Website: http://www2.edtrust.org/edtrust/

Even Start Association
2225 Camino del Rio South, Suite A
San Diego, CA 92108
Ph. 800-977-3731
Website: http://www.evenstart.org/

HeadsUp! Reading Project
National Head Start Association
1651 Prince St.
Alexandria, VA 22314
Ph. 703-739-0875
Fax: 703-739-0878
Website: http://www.heads-up.org/

International Dyslexia Association
Chester Building, Suite 382
8600 LaSalle Road
Baltimore, MD 21286-2044
Ph. 800-222-3123
Website: http://www.interdys.org/

International Reading Association
Headquarters Office
800 Barksdale Rd.
PO Box 8139
Newark, DE 19714-8139
Ph. 800-336-7323
Fax: 302-731-1057
Website: http://www.reading.org/association/index.html

Learning Disabilities Association of America (LDA)
4156 Library Road
Pittsburgh, PA 15234
Ph.412-341-1515
Fax: 412-344-0224
Website: http://www.ldaamerica.org/index.cfm

Learning Disabilities Worldwide
PO Box 142
Weston, MA 02493
Ph. 781-890-5399
Website: http://www.ldworldwide.org/index.html

National Association for Adults with Special Learning Needs (NASSLN)
C/o Correctional Education Association
8182 Lark Brown Rd., Suite 202
Elkridge, MD 21075
Ph. 800-496-9222
Website: http://www.naasln.org/

National Association for the Education of African American Children with Learning Disabilities
P.O. Box 09521
Columbus, Ohio 43209
Ph. 614-237-6021
Fax: 614-238-0929
Website: http://www.charityadvantage.com/aacld/HomePage.asp

National Association for the Education of Young Children (NAEYC)
1509 16th Street, NW
Washington, DC 20036-1426
Ph. 800-424-2460
Website: http://www.naeyc.org/

National Association of School Psychologists (NASP)
4340 East West Highway, Suite 402
Bethesda, MD 20814
Ph. 301-657-0270
Website: http://www.nasponline.org/index.html

National Association of State Directors of Special Education, Inc. (NASDSE)
King Station I - 1800 Diagonal Road, Suite 320
Alexandria, VA 22314
Ph. 703-519-3800
Website: http://www.nasdse.org/index.cfm

National Center on Educational Outcomes
University of Minnesota
350 Elliott Hall
75 East River Road
Minneapolis, MN 55455
Ph. 612-626-1530
Fax: 612-624-0879
Website: http://education.umn.edu/nceo/overview/overview.html

National Center for Learning Disabilities (NCLD)
381 Park Avenue South, Suite 1420
New York, NY 10016
Ph. 212-545-7510
Fax: 212-545-9665
Website: http://www.ncld.org/

National Center on Secondary Education and Transition (NCSET)
Institute on Community Integration
University of Minnesota
6 Pattee Hall, 150 Pillsbury Drive SE
Minneapolis, MN 55455
Ph. 612-624-2097
Fax: 612-624-9344
Website: http://www.ncset.org/default.asp

National Council on Disability
1331 F St. N.W., Ste. 850
Washington, DC 20004
Ph. 202-272-2004; 202-272-2074 (TTY)
Fax: 202-272-2022
Website: http://www.ncd.gov

National Head Start Association (NHSA)
1651 Prince Street
Alexandria, Virginia 22314
Ph. 703-739-0875
Fax: 703-739-0878
Website: http://www.nhsa.org/

National Information Center for Children with Disabilities (NICHCY)
P.O. Box 1492
Washington, D.C. 20013-1492
Ph. 800-695-0285
Website: http://www.nichcy.org/

National Institute for Child Health and Human Development (NICHD)
6100 Executive Boulevard
Rockville, MD 20852
Ph. 301-496-5733
Website: http://www.nichd.nih.gov/default.htm

Office of Special Education and Rehabilitative Services (OSERS)
U.S. Department of Education
400 Maryland Ave., S.W.
Washington, DC 20202-7100
Ph. 202-245-7468
Website: http://www.ed.gov/about/offices/list/osers/contacts.html

Reading Recovery Council of North America
400 West Wilson Bridge Road, Suite 250
Worthington, OH 43085
Ph. 614-310-7323
Fax: 614-310-7345
Website: http://www.readingrecovery.org/

Reading Rockets
WETA Public Television
2775 S. Quincy St.
Arlington, VA 22206
Website: http://www.readingrockets.org/index.php

Schwab Learning
1650 South Amphlett Boulevard, Suite 300
San Mateo, CA 94402
Ph. 800-230-0988
Fax: 650-655-2411
Website: http://www.schwablearning.org/

Technology, Reading, and Learning Difficulties (TRLD)
San Francisco, CA
Ph. 888-594-1249
Website: http://www.trld.com/

Zero to Three
National Center for Infants, Toddlers and Families
2000 M Street, NW, Suite 200
Washington, DC 20036
Ph. 202-638-1144
Website: http://www.zerotothree.org/ztt_aboutus.html

Learning Disability Organizations and Conferences

Assistive Technology Industry Association (ATIA)
877.OUR.ATIA (687.2842)
http://www.atia.org/
Annual ATIA Conference and Exhibition - January

Association of Educational Therapists (AET)
818.843.1183
http://www.aetonline.org/index.php
Annual AET National Conference- October
Annual AET Regional Conference- March

Association on Higher Education and Disability (AHEAD)
781.788.0003
http://www.ahead.org/index.htm
Annual AHEAD Conference- August

California State University at Northridge (CSUN) – Center on Disabilities
818.677.2684
http://www.csun.edu/cod/
International Conference on Technology and Persons with Disabilities - March

Center for Development and Learning
985.893.7777
http://www.cdl.org/
Center for Development and Learning National Reading Conference- December

Children and Adults with Attention Deficit Disorder (CH.A.D.D.)
800.233.4050
http://chadd.org/
Annual CHADD International Conference on Attention-Deficit/Hyperactivity Disorder- October

Closing the Gap
507.248.3294
http://www.closingthegap.com/
Annual Closing the Gap Conference – October

Council for Exceptional Children (CEC)
703.620.3660
http://www.cec.sped.org/
CEC Annual Convention and Expo- April

Council for Learning Disabilities
571.258.1010
http://www.cldinternational.org
Annual International Conference on Learning Disabilities- October

Council for Opportunity in Education
202.347.7430
http://www.trioprograms.org/
Annual Conference- September

The Education Trust
202.293.1217
http://www2.edtrust.org/edtrust/
Annual Education Trust National Conference- November

Even Start Association
800.977.3731
http://www.evenstart.org/
Annual National Even Start Association Conference- November

International Dyslexia Association
800.222.3123
http://www.interdys.org/
The International Dyslexia Association Annual International Conference- November

International Reading Association
800.336.7323
http://www.reading.org/association/index.html
International Reading Association Annual Convention- April

Learning Disabilities Association of America (LDA)
412.341.1515
http://www.ldaamerica.org/index.cfm
LDA Annual International Conference- February

LD On-Line (WETA)
Contact: http://www.ldonline.org/sitecontact
http://www.ldonline.org/
Comprehensive listing of LD organizations and conferences available at:
http://www.ldonline.org/ldresources

Learning Disabilities Worldwide
781.890.5399
http://www.ldworldwide.org/index.html
LDW World Congress on Learning Disabilities- October

National Association for Adults with Special Learning Needs (NASSLN)
800.496.9222
http://www.naasln.org/
NASSLN Annual International Conference- November

National Association for the Education of Young Children (NAEYC)
800.424.2460
http://www.naeyc.org/
NAEYC Annual Conference and Expo- December

National Association of School Psychologists (NASP)
301.657.0270
http://www.nasponline.org/index.html
NASP's Annual Convention- March
NASP Summer Conferences- July

National Association of State Directors of Special Education, Inc. (NASDSE)
703.519.3800
http://www.nasdse.org/index.cfm
NASDSE Annual Conference and Business Meeting- November

National Center on Secondary Education and Transition (NCSET)
612.624.2097
http://www.ncset.org/default.asp
Bi-Annual National Leadership Summit on Improving Results for Youth- June

National Education Computing Conference
Presented by International Society for Technology in Education
800.280.6218
http://web.uoregon.edu/ISTE/NECC2006/
National Education Computing Conference – Summer

National Institute for Child Health and Human Development (NICHD)
301.496.5733
http://www.nichd.nih.gov/default.htm
Annual NICHD Meeting of Postdoctoral Fellows, Visiting Fellows, Clinical Fellows, and Graduate Students- May

Nonverbal Learning Disorders Association (NLDA)
831.624.3542
http://www.nldline.com/
Annual Nonverbal Learning Disorders Association (NLDA) Symposium- March

Reading Recovery Council of North America
614.310.7323
http://www.readingrecovery.org/
National Reading Recovery & K-6 Classroom Literacy Conference- February

Special Needs Special Kids Conference and Vendor Fair
301.983.1880
http://www.specialneedsspecialkids.com/
Annual Special Needs Special Kids Conference and Vendor Fair - November

Technology, Reading, and Learning Difficulties (TRLD)
888.594.1249
http://www.trld.com/
Annual TRLD Conference on Technology, Reading and Learning Difficulties- January