Universal Design for Learning: Technology that Supports Students with Learning Disabilities in Reading and Writing

by

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Coursework Project EDSP 9012 Part 2

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CHAPTER 1: INTRODUCTION

Purpose of Study

Universal Design for Learning (UDL) is an approach to education that aims to eliminate barriers to learning for all students including those with disabilities (CAST, 2008). The purpose of this study is to describe the framework of UDL and to explore technology that supports its’ practice. The literature reviewed in this study is intended to provide an overview of technology suited for supporting Universal Design for Learning in the instructional areas of reading and writing. More specifically, this study is aimed at exploring specific technologies that when used in an inclusive setting, support the principles of UDL. Challenges faced when implementing UDL are also explored, along with ways in which challenges can be overcome. Finally, this study will examine the role of IEPs in UDL.

Problems Underlying the Study

Curriculum in most schools follows a “one-size-fits-all” approach presented through lectures and the use of textbooks. It is often inflexible in how it is presented to students, how it allows students to respond, and how students are engaged in the learning process. This print dominated approach has led to the marginalization of many students. For those with disabilities, equal opportunity is still not provided in education. Change is needed in many aspects of education, but especially in how the curriculum is delivered to children (Jackson, 2005).

New reforms in education are directed at eliminating the marginalization of children who do not excel under traditional approaches. Past approaches resulted in practices where students who struggled with the curriculum, received less of it. Educators are now beginning to question how well the curriculum and instruction allow for the participation of all students. New views
hold that problems are caused by the inert presentation of curriculum that may be insensitive to the varied ways in which individuals learn. Efforts to reform education in the US have set higher standards for students with disabilities affording them the same opportunities as their peers (Jackson, 2005). However, these opportunities have yet to be realized, partly because of a continued emphasis on print-based materials (Jackson, Harper & Jackson, 2002). Though more students with disabilities are now included in the general classroom, their placement has not guaranteed success. The drop out rate for students with disabilities is extremely high, and the impact of school failure is discouraging. Research shows that in the US, 60% of prison inmates are illiterate, and 75% of unemployed adults are illiterate. About one third of mothers on social assistance have disabilities (Rumberger & Thomas, 2000). These statistics highlight the need for new approaches in education.

Other barriers exist blocking access for students to the general curriculum. Meeting every student’s needs is a difficult challenge for teachers. Though reform initiatives are calling for greater access for students with disabilities, they also require higher and more inflexible academic performance requirements (Moody, Vaughn, Hughes & Fischer, 2000). All students must to be prepared for standards-based assessment, and teachers need to adjust the curriculum and their teaching for this to occur (Jackson et al., 2002). This leaves less time for teachers to accommodate and adapt their instruction for students with disabilities (Deschenes, Cuban, & Tyack, 2001). Meeting individual needs can be especially difficult for teachers with large class sizes. Teacher responsibilities are growing making it difficult to assess and accommodate individual needs (Schumm, Vaughn, Gordon & Rothlein, 1994).

A major premise of this study is that UDL is an approach that can guide educators in providing more meaningful curriculum access for all of their students. Though requiring change
and a great deal of initial planning, once in place UDL makes many of the individualized accommodations currently occupying a great deal of teacher time unnecessary. Though other approaches have emerged to counter traditional teaching styles, such as differentiation or individualized instruction, UDL represents a major shift towards curriculum reform in education and is most suited to meeting a greater diversity of learning needs. The research completed focuses on answering the following questions:

1. What is Universal Design for Learning?
2. What instructional strategies support Universal Design for Learning?
3. Which technologies support the principles of Universal Design for Learning?
4. How can technologies assist students with Learning Disabilities in the areas of reading and writing?

Research Methods

This project is a Literature Review. Articles and books published between the years of 1990-2008 have been referenced with the exception of one article from 1980 that is used to illustrate historical changes in education. The ProQuest 5000 database was used to locate journal articles. Publications from the Center for Applied Science Technology (CAST) and the National Center on Accessing the General Curriculum are referred to often.

Significance of Study

Classrooms today are more diverse then ever, and when curriculum is designed to meet the needs of only one type of learner, exclusion of students with different abilities, learning styles, and backgrounds is the result (CAST, 2008). Students with special needs pose challenges for teachers by making it difficult to ensure that they are meeting curricular expectations (Flores, 2008). With the current focus on inclusion, teachers of all grades need information on how
technology can be used to meet the needs of students with disabilities (Jackson, 2004). There is increasing recognition that technology has the potential to improve the progress made by individuals with learning disabilities (Lewis, 1998). But there is a lack of knowledge regarding the technologies that exist and the effectiveness of specific tools. The author hopes that this study will be significant in outlining how specific technologies can be used to meet the needs of all students, and how educators can work towards implementing UDL in their schools and classrooms.

**Key Definitions**

*Learning Disability*: Learning disabilities are defined similarly in the US and Canada. According to the Learning Disabilities Association of America (LDA, 2006), the term Learning Disability (LD) broadly describes a number of specific learning disabilities such as dyslexia or dysgraphia. People with LD are of average or above average intelligence. A gap exists between the individual’s potential and actual achievement (LDA, 2006). The Learning Disabilities Association of Canada (LDAC) uses the term LD to refer to a number of disorders that may effect attainment, organization, maintenance, comprehension or use of verbal or nonverbal information. Like LDA, LDAC defines students with LD as having at least average intelligence, but demonstrating impairment in one or more abilities related to perception, thinking, remembering, or learning (LDAC, 2005).

*Curriculum*: This study will assume the CAST definition of curriculum that includes four components: goals, methods, materials, and assessment. Goals include the expectations for teaching and learning. Methods refer to specific instructional methods for the teacher. Materials consist of the media and tools used for teaching, and assessment refers to the reasons and methods for measuring student progress (CAST, 2008).
Limitations and Delimitations

The articles and books referenced in this study represent trends that are occurring in the United States. Though the implications of the research is useful and meaningful to Canadian educators, as well as educators from other countries, the research found relies on US legislation such as IDEA, and the TECH act, as well as studies conducted in US schools. This does not imply that work with technology and UDL are not taking place in Canada, but there is a lack of literature published that is based on Canadian studies.

The scope of literature explored in this study has been narrowed to focus only on technology used within the subject areas of reading and writing. Technology that would support the development of math skills, and other subject area skills are not explored. The literature included is also limited to its usefulness for children with learning disabilities (LD) only. The literature covered does not address the potential benefits for students with autism, blindness, physical impairments, or serious cognitive delays. However, UDL and technology most definitely has potential benefits for these students as well.

In order to stay within the principles of UDL, this study only explores technologies used to meet student needs within a regular classroom setting. There is an immense quantity of technology on the market that is available for educators, and therefore not all of the tools in existence could be described within this study. The author has attempted to include those technologies that have been studied and supported through research.
CHAPTER 2: REVIEW OF LITERATURE

Changes in Education

Before describing Universal Design for Learning, it is important to explain some of the changes in education that have led to its development. Historically, schools dealt with learning disabilities by isolating a student for specialized instruction. In the mid-1970s, focus was placed on a student’s diagnosed level, and curriculum followed a bottom-up formula. Educators believed that there were certain prerequisite skills a student must master before accessing certain content (Jackson & Harper, 2002). Expectations of students who received alternative curriculum and instruction were lower, resulting in a slower approach to learning. As a result, students were denied access to the general curriculum (Carlberg & Kavale, 1980).

In the United States, changes in thinking developed in the 1980s when concern over education increased. A series of reform initiatives began aimed at improving the performance of students, so that when they reached adulthood, they could better lead the nation within a more global economy (Eisner, 2001). These initiatives centered on approaches that were aimed at all students, including those with disabilities. However, focus was still primarily placed on specialized curriculum and instruction until the 1997 amendments to the Individuals with Disabilities Act which mandated that: “all students with disabilities must have access to the general curriculum and participate in state and district wide assessment systems intended to measure effective progress” (IDEA, 1997). This law prohibited exclusion from the general curriculum. It also addressed the outdated practice of reducing expectations of children with disabilities. IDEA 1997 changed the role of assistive technology for special education. Prior to this, assistive technology was a provision related only to supplementary aids. Assistive technology was limited to supporting students with severe disabilities. IDEA 1997 used the
definition of assistive technology as defined by the Technology-Related Assistance for Individuals with Disabilities Act of 1988 (Tech Act) (Dell, Newton, & Petroff, 2008). The most recent IDEA (2004) uses the same language as IDEA 1997, but extends the practice of providing students access to the general curriculum within the regular classroom whenever possible (Jimenez, Graf & Rose, 2007). The goal of both IDEA 1997 and IDEA 2004 was to remove barriers limiting access to the curriculum so that all students may participate and progress through the general curriculum as much as possible (Jackson, 2005).

Though the main focus of education was once the mastery of knowledge, it has now shifted towards the mastery of learning (CAST, 2008). Traditional curriculum poses a number of barriers to students, particularly printed text. If a student has a weak developed ability to decode, attend, or comprehend, printed text is not an accessible way for them to learn (Hall, Strangman & Meyer, 2003). Teachers now have access to new media such as digital text, images, audio, video, and multimedia allowing flexibility in programming for a wider range of student strengths and needs. Special education is now viewed more as a support system for students with disabilities, in contrast to a resource for addressing disability specific needs. The former approach to fixing the student has shifted to fixing the curriculum and the school to meet the needs of all students. More students with disabilities are now included in regular classroom settings (Jackson & Harper, 2002). However, simply allowing students with disabilities access to the general curriculum does not ensure meaningful participation or success (Wehmeyer, 2006). The classroom of today likely includes students whose first language is not English; students who don’t read at grade level; students with behavioral issues; students from diverse cultural backgrounds; and students considered gifted. There are also students with special needs including learning disabilities, visual impairments, and motor disabilities to name only a few.
Greater diversity poses challenges for teachers when attempting to deliver the curriculum in a way that will work for everyone (Rose & Meyer, 2002). Teachers need to learn to design programs that actively support students with and without disabilities (Jimenez et al., 2007). Universal Design for Learning has developed in response to the diversity of needs within schools and classrooms. It is described in the next section as an alternative approach to instruction that aims to support all students.

**What is Universal Design for Learning?**

Universal design is a concept that supports inclusion and providing access for people with disabilities into all areas of life. The concept originally came to exist in relation to architecture, later becoming part of hardware and software design, and is now a key principle for instruction (Dell et al., 2008). The idea of Universal Design in architecture came into existence when U.S federal legislation mandated that buildings be accessible to individuals with disabilities. Architects started to design structures that were accessible for all. For example, curb cuts allowed access to the walkway for a person in a wheelchair, while also making access easier for those with walkers, strollers, or bicycles. (Lieberman, Lytle, & Clarcq, 2008).

In 1984, The Center for Applied Special Technology (CAST) was established with the goal of developing technologies that would provide a greater range of opportunities for individuals with disabilities (Rose & Meyer, 2002). At this time through Universal Design students with disabilities had gained access to the general classroom, but this did not ensure their access to the general curriculum. CAST advanced Universal Design by applying the concept to curriculum development and instruction (Edyburn, 2005). The term UDL was developed throughout the 1990s and was first coined when CAST created the National Center of Accessing
the General Curriculum (NCAC) in 1999. NCAC was a 5-year program aimed at improving curriculum access for students with disabilities. Funding for NCAC ended in 2004, but the progress of NCAC has continued through CAST (Spooner, Baker, Harris, Ahlgrim-Delzell & Browder, 2007). UDL has made a greater profile for itself since the reauthorization of IDEIA (2004), which supports the development of technology with universally designed features. IDEIA (2004) also supports incorporating universal design concepts into educational standards, assessments, curriculum, and instructional methods (Jimenez et al., 2007).

UDL goes beyond simple physical access by focusing on creating flexible instructional materials and teaching strategies that allow educators to meet a greater variety of needs. UDL is an approach to teaching that aims to overcome the “one-size-fits-all curricula” that creates barriers for many (CAST, 2008). Barriers are especially faced by students with learning disabilities, and often the curriculum is not designed to meet their learning needs. Teachers use a UDL approach by designing the curriculum and their instruction to meet a diversity of learner needs, as opposed to making adjustments for individual students (Pisha & Coyne, 2001). The curriculum is designed from the beginning to meet the needs of all students before instruction begins (Jimenez et al., 2007). According to one special education teacher:

The concept of UDL is the intersection where all our initiatives – integrated units, multi-sensory teaching, multiple intelligences, differentiated instruction, use of computers in schools, performance-based assessment, and others- come together (Donna Palley, as cited in Rose & Meyer, 2002, p. 7).

UDL is an approach that aims to eliminate barriers to learning and its design extends to instruction, curriculum, and assessment (Meyer & Rose 2000).

Teachers follow three principles when planning and teaching within the framework of UDL. These three principles share the common goal of providing students with a variety of options (Rose & Meyer, 2002). Though good educators have found ways to differentiate the
curriculum for years, UDL when used with technology can make it easier to customize the curriculum for diverse learners (CAST, 2008). The purpose of this next section is to describe instructional strategies that can be used to support UDL by appealing to the wide range of needs of students. CAST (2008) outlines nine guidelines for instruction within the three principles of UDL. In their book *Teaching Every Student in the Digital Age: Universal Design for Learning*, Rose and Meyer (2002), outline 12 teaching methods that support the three brain networks of recognition, strategic, and affective learning. Many of the strategies outlined by these two sources are referenced throughout the next section. The instructional strategies are presented within the three principles of UDL.

**Provide Multiple Means of Representation**

It is important that information is presented in a variety of ways so that it is recognizable to all students (CAST, 2008). Rose and Meyer (2002) explain that this strategy appeals to the brains’ recognition networks. Students vary in how they recognize information. Some grasp visual or auditory information better than printed text. There is not one means of representation that will work for all students, so providing options is critical (CAST, 2008).

With printed text, examples are limited. However digital media and tools present information in the form of text, image, sound, and video. Students can interact with and manipulate digital media allowing them to learn about patterns. Using digital media allows teachers to collect many examples that can be presented to students (Rose & Meyer, 2002). When the visual and auditory display of information is adjustable through enlarged text, color and addition of speech or sound, perceptual clarity is increased for many (CAST, 2008).

Using visual examples in the form of graphic organizers can also help students recognize and organize concepts. The use of color, size, and shape helps to emphasize relationships.
Visual learners can be reached by using pictures and videos. Visual examples of information can assist with memory retention by allowing students to picture information in their minds (Flores, 2008).

An example of providing multiple means of representation within a lesson would include explaining a new concept verbally while displaying the concept using digitized text. The concept might also be explored through a hands on activity or demonstration (Jackson & Harper, 2002). Hands-on activities are often associated with science but can provide opportunity in other subject areas as well. For example the use of manipulatives in math can increase understanding of procedures and concepts (Flores 2008). Critical features of the concept could also be highlighted by using animation or graphic elements that emphasize the most important parts. Highlighting critical features of a lesson makes the process of identifying relationships and patterns easier for students. In addition, teachers would ask students to reflect on their own experiences related to the concept being taught in order to call upon background knowledge. The importance of accessing background knowledge is supported by brain research which shows that new ideas learned need to be connected with previous learning (Rose & Meyer, 2002).

Provide Multiple Means of Expression

Students vary in the way that they express what they know. Some may be able to demonstrate what they have learned through writing, while others can better express themselves orally. There is no one means of expression that benefits all students, so once again, providing options is necessary (CAST, 2008). Individual students have different ways of learning skills so teaching approaches need to differ in order to support strategic learning. Strategic learning is the second of three brain networks as described by Rose & Meyer (2002). Strategic learning refers to the way in which individuals follow their own pathways for learning. Because individuals
follow different paths to learn skills and concepts, it is necessary to allow them to express what they have learned in different ways (Rose & Meyer, 2002).

When completing an assignment students can be provided with a “project menu” allowing them to choose their own format. The student may be allowed to write an essay, give an oral report, or complete an audio recording or multimedia presentation (Flores, 2008). Programs such as HyperStudio and PowerPoint provide tools for using multiple media and for organizing presentations. The software guides the student to incorporate images and printed work in a professional manner. These forms of digital media support the student’s ability to demonstrate their knowledge and skills (Rose & Meyer, 2002).

Options for composing what they know should also be provided including but not limited to: the use of spellcheckers, word prediction software, speech to text software, calculators, and concept mapping tools. These tools provide students with the capacity to demonstrate what they know by matching their abilities with what the task demands (CAST, 2008).

Ongoing feedback should be provided while students are learning new skills. Many students are not responsive to corrective feedback at the end of a project or activity. When feedback is ongoing or “formative” it allows students to monitor their own progress (CAST, 2008). Feedback can be given verbally, visually, in writing, or physically during a hands on activity (Lieberman et al., 2008). Feedback can take the form of guided questions, self-reflection, and representations of progress such as before and after photos or charts that show progress (CAST, 2008). Ideally learners should learn to self-monitor their own progress to ensure that feedback is ongoing. Software tools such as text-to-speech combined with a word processor can provide feedback. The student can hear how their writing sounds when it is read aloud prompting them to make corrections as they work (Rose & Meyer, 2002). A digital rewind
and playback can also allow students to compose orally and check their work by listening (CAST, 2003).

When students are learning a skill, they often need scaffolds to support them as they practice and strive towards independence. These scaffolds are important for all students, and critical for students with disabilities (CAST, 2008). Students need to over-learn the steps in a process until it is automatic (Rose & Meyer, 2002). Supported practice allows students to split up the parts of a skill and learn the individual components (Hall et al., 2003).

Examples of scaffolds for instruction include using different models to demonstrate the same skill. Teachers and Educational Assistants can support the student throughout the practice phase of performance by providing feedback and individualized instruction. The use of checklists is another scaffold that can be used when planning a project and sequencing steps to completion. Teachers can model think-alouds of the process involved in a particular skill in order to support the student (CAST, 2008). Some scaffolds are part of digital reading and writing software such as spell checkers which support writing mechanics so that students can focus on expressing their ideas (Rose & Meyer, 2002). Examples of flexible media that can support a student include video demonstrations, digital recordings, and sample sets of the skill to be learned, such as examples of paragraph writing. Each of these skill models can be stored on computers and then referred to as needed by the individual learner (CAST, 2003). Scaffolds should be gradually released as students become more independent (CAST, 2008).

**Provide Multiple Means of Engagement**

UDL stresses the importance of engaging learners in instructional tasks in order to support affective learning (Hall et al., 2003). The affective network refers to “the fuel that students bring to the classroom, connecting them to the “why” of learning” (Rose & Meyer,
Affect involves developing a deep interest in a topic and students must be engaged and motivated for this to occur (Rose & Meyer, 2002). Engagement is also a critical component of classroom management. Teachers need to offer choices of tools, and vary the difficulty of material and level of supports given in order to maintain student attention (Hall et al., 2003). Students vary in the ways in which they will be engaged and motivated to learn. Some are engaged by novelty, while others prefer routine. Therefore multiple options for engagement are necessary (CAST, 2008).

When students are given choices of content their enthusiasm increases. Digital media provides flexibility so that teachers can appeal to individual interests. For example, by searching the Internet students can learn about a topic that interests them such as hockey or outer space. QuickTime provides 3D tours on certain topics, and Write, Camera, Action! lets users become a movie producer while developing writing and language skills. Virtual simulation programs can be found online that explore scientific principles that students may not understand through textbooks or lectures. The World Wide Web and multimedia tools can re-engage learners who are not responding to traditional methods (Rose & Meyer, 2002).

Students vary in the types of challenges that motivate them to do their best work. Teachers need to adjust the level of difficulty of material and challenges given. Some students prefer reachable and predictable outcomes, while other are engaged by high-risk challenging tasks. Teachers can reach all learners by providing alternatives in the use of tools and scaffolds. Software programs often provide adjustable levels of challenge. For example, Write:OutLoud is a talking word processor that allows the student to control the program features as they need them. Features such as auditory typing, proofreading feedback, highlighting, and automatic spell checking can be switched on and off. The flexibility of this program can support writers at all
different ability levels (CAST, 2001). By giving choices for difficulty level, teachers are providing an opportunity for students to set realistic goals for themselves, helping them develop skills for independent learning (Rose & Meyer, 2002).

Students may also be supported through opportunities for collaboration and group work. Some students are more motivated when working collaboratively with others and peers can provide one-on-one support (CAST, 2008).

Students are engaged by different environments or learning contexts. Factors such as the structure of a task or noise in the classroom engage students differently. Some individuals prefer independent assignments, and other benefit from small or large-group activities. Individuals may prefer exploring ideas through their own approaches, while others need structure and direction. Teacher-designed WebQuests can meet individual preferences for learning. Teachers can pre-select sites for students to find information, or remove signposts for students who are able to locate information independently (Rose & Meyer, 2002).

Teachers should vary the predictability of activities. Schedules, visible timers and cues can be provided for students who benefit from structure. However, unexpected activities within highly structured routines need to be provided to appeal to certain learners. Sensory stimulation should also be varied from quiet activities, to more interactive ones (CAST, 2008). Certain electronic programs include background noise to distract or surprise the user. This type of sensory stimulation can engage and motivate students. Sensory stimulation should have the option of being turned off for students who are more likely to be distracted than motivated by noise. Noise buffers such as headphones can also be used to reduce unwanted sensory stimulation (Rose & Meyer, 2002).
Experts agree that students do not have one type of intelligence or way of learning. UDL calls on educators to use knowledge of brain networks to make teaching methods flexible and meaningful for all students (Rose & Meyer, 2002). Digital material can provide the needed flexibility to support the different learning networks (CAST, 2003). The UDL principles and instructional strategies described in this section can ensure that all students have access to the curriculum.

**Technology and UDL**

The Individuals with Disabilities Education Improvement Act of 2004 defined Assistive technology as “any item, piece of equipment, or product system, whether acquired commercially or off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities” (IDEA, 2004). Assistive technology encompasses a range of tools from “low” to “high” tech devices. It includes both technologies for people with specific disabilities as well as for the general public. Assistive technology has two main purposes. It can support a student’s strengths in order to offset a disability. It can also provide an alternative way of performing a task in order to compensate for a disability (Lewis, 1998).

The difference between assistive technology and UDL is that assistive technology aims to support individual access to the curriculum. In contrast, UDL focuses on designing curriculum that is accessible for all (Rose & Meyer, 2002). However, the implementation of UDL depends on the use of technology, or digital materials (Hall et al., 2003). Technology plays an important role in UDL beginning with the planning stage. Access to computers, the Internet, and other technology greatly increases teachers’ ability to diversify instruction (Harris, Kaff, Anderson & Knackendoffel, 2007). Digital materials are flexible in a way that speech, text, and
images used alone are not. They can be modified in many ways, and this flexibility makes it possible to customize methods of teaching to individuals (Hall et al., 2003).

The next section will provide a more detailed overview of reading and writing technology that supports UDL, as well as what research studies have found regarding the success of such technologies in addressing the needs of students with learning disabilities. The technology reviewed is supportive of at least one of the principles or brain networks of UDL as outlined previously. The technologies included are also in line with many of the instructional strategies recommended by CAST. In addition, the tools and programs described are supportive of the principles of UDL because they can be used within the regular classroom to teach and allow practice of skills regardless of individual developmental level. This technology can be used with all learners and in this way does not isolate students with learning disabilities, but provides access for all.

**Reading Technology**

The ability to read requires a complex set of skills. Students need to identify many levels of patterns to decode, as well as understand different reading forms. Due to the many skills needed to read, students can face a number of barriers ranging from recognizing letters, letter-sound relationships, words, sentences, and larger groups of words. Each of these reading skills depends on quick automatic processing, and difficulties may arise at any part of the process. Recognition through decoding words and sentences is only one of the purposes of reading. Students must also be able to construct meaning and interpret what they have read to be successful (Rose & Meyer, 2002).
Computer Based Reading Instruction and Text Enhancements

The earliest reading instruction program designed within the principals of Universal Design was Wiggleworks (Male, 2003; Rose & Meyer, 2002). Created by the Center for Applied Special Technology (CAST), Wiggleworks is an electronic book that teaches reading skills to students regardless of their stage of development (Gussin, 1996). The student is provided with many options, including having text read aloud to them, changing the size of text, graphics, the speed in which a story is read, and the ability to record their own voice while reading the story (Male, 2003). It also includes a Write mode where the student uses a word processor, supported by tools including paint, and concept words from the book (Gussin, 1996). The flexibility of Wiggleworks makes it usable for all children, and represents the first example of universally designed curriculum (Rose & Meyer, 2002). Wiggleworks offers a richer and more flexible program that can help a child learn to read and write, regardless of developmental stage or disability (Gussin, 1996).

The Living Books series offers an entire piece of literature on a CD-ROM. The books are multimedia including illustrations and digitized sound. The student is able to interact with the text and the visuals. The interactive nature of talking books acts as a motivator for readers, especially struggling readers, which is supportive of the principle of providing multiple means of engagement. Features may also allow the student to choose an unknown word and hear it read aloud. While using one of the living Books series, the reader is able to select either “read to me” or “let me play”. In the “let me play” mode, the reader can interact with the text and graphics. The reader can choose to have one word aloud, or the whole text. Characters on the screen can be chosen to speak and move (Lewis, 1998).
CAST and Scholastic worked collaboratively to create a program called Thinking Reader. This software consists of electronic books that support readers at all skill levels. Thinking Reader is available for grade 5-8 and allows students to read and interpret different books as they improve comprehension and fluency. The program includes 5 levels, level 1 providing the most support and level 5 the least. The student presses a play button and the text is read to them while it is highlighted. Important words are underlined, and the student can access a printed and spoken definition (Edyburn, 2005). CAST research on Thinking Reader in the classrooms found that on average, students who read computer-supported novels achieved higher scores on standardized reading comprehension tests than students who read the print version of novels. Thinking Reader supports UDL by providing strategic supports for students. It also provides opportunities for self-reflection and self-assessment that assists students in monitoring their own progress (Rose & Meyer, 2002).

Fast ForWord is a software program that was developed in response to difficulties with auditory temporal processing. This program aims to remediate receptive and auditory processing. Fast ForWord draws the student’s attention to “phonetic elements” that make up phonemes. Students are taught how to hear small speech sounds which helps them to later create rhyming words, separate words into syllables, and identify sound-letter relationships (Male, 2003). Studies of children using Fast ForWord found that most made significant improvements in speech and language comprehension (Earl, 1998). As the student progresses in their ability to recognize sounds, the Fast ForWord program adjusts to the child’s level (Dell et al., 2008). The flexibility of this program supports strategic learning by providing challenges that are well matched to a student’s skill level.
IntelliTools offers a wide range of software tools including programs for language arts and math. The IntelliTools reading program is used with early readers to develop phonemic awareness. A study of 55 students in grade one who were at risk for reading failure found that all achieved gains in phonemic awareness, decoding words, and word writing over a period of 16 weeks (Howell, Erickson, Stanger & Wheaton, 2000). IntelliTools also teaches other components of reading through a structured program that combines digital books with auditory support and comprehension activities. Programs designed by IntelliTools are aimed at meeting a diversity of needs within the classroom (Male, 2003).

The computer can be used as an effective teaching tool for reading. The computer based reading instruction described above is supportive of UDL because it provides multiple options for strategic learning by combing text with auditory and visual support. The ability of these technologies to offer repetition and individualized instruction makes them useful for teaching certain skills. Okolo, Bahr, and Rieth (1993) found that computer based instruction can improve skills in areas of word recognition and decoding. Higgins and Boone (1993) agree, but found that reading software is not as effective for improving comprehension. Similarly, when Leong (1995) studied programs with enhanced options including text with speech; text with speech and word definitions; text with reading prompts; and text with speech that simplified passages, no improvements in passage compression were found. Though it is likely that reading enhancements as well as re-designing electronic texts to improve comprehension is worthwhile, not all programs have been successful (MacArthur, Ferretti, Okolo & Cavalier, 2001). Computer based reading instruction represents a useful way in which teachers can provide multiple options for their students in order to support strategic learning.
Speech Synthesis (Text to Speech)

Word recognition plays a vital role in reading comprehension (Perfetti, Marron & Foltz, 1996). When students struggle with decoding, they understand less of what they read, and receive less practice in reading because they read more slowly and less often (MacArthur et. al, 2001). Speech synthesis programs translate text on the computer screen into speech. Students can select words, sentences, or entire sections to be read aloud. These programs can help reduce frustration for students who struggle with decoding (Lundberg 1995). Speech synthesis also supports the principle of multiple means of representation by combining text with auditory support. However, the quality of speech synthesizers does vary. The speech created may be easy to understand, but is not as smooth as human speech. It often lacks intonation and other human characteristics. But as technology develops, improvements are being made. Some newer speech synthesizers offer users the ability to select voices of different ages, gender, or accents. Speech synthesis is becoming more available (Zhao, 2007). The most current Windows edition offers speech synthesis (Male, 2003).

Studies of text enhanced with speech synthesis have found differing results (MacArthur et al., 2001). Most studies of speech synthesis have focused on the technology’s success in improving word recognition. In one study, students with word recognition difficulty used speech synthesis while reading stories on the computer. The study showed that students improved their ability to decode and recognize words (Higgins & Raskind, 2000). Other studies suggest that speech is a valuable component of reading software. According to Wise and Olson (1998), speech to text doubles the speed in development of decoding skills. The use of speech synthesis is also found to increase student motivation to read (Montali & Lawandowski, 1996). Montali and Lewandowski (1996) found that when students in grades eight and nine read text on the
screen as it was highlighted and read aloud, they comprehended the text significantly better (MacArthur et al, 2001). However when Leong (1992) studied the effect of combining auditory and visual presentation of text with middle school students, no significant improvements in comprehension were found. This lack of progress may be a result of studying below average readers as opposed to readers with learning disabilities (MacArthur et al, 2001). Speech synthesis programs allow teachers to support students who are struggling with decoding without isolating them from their peers. Because students have the option of selecting auditory support only as they need it, speech synthesis is extremely flexible and can be used by all students.

**Scan/Read Systems**

Scan/read programs combine the computer, scanner, optical character recognition software, and speech synthesis to read aloud text. At the same time, the text is displayed and enhanced on the monitor. Pages of text are scanned and converted to an electronic file. The scan/read program then speaks the words on screen while highlighting text (Dell et al., 2008). A popular scan/read program is the Kurzweil 3000. Features of the program are designed to meet the needs of students with reading comprehension difficulties. Students can change the visual display, set the reading speed to match their preference, and have access to a talking dictionary and thesaurus. The student can click on an unknown word and the program will display the definition and read it aloud. The success of scan/read programs on the reading performance of postsecondary students was studied by Hecker, Burns, Katz, Elking and Elkind (2002). Results showed that twenty students using the Kurzweil 3000 attended more to their reading, were less distracted, and were able to read for a longer amounts of time. Another study by Anderson-Inman and Horney (1997) found that although these programs are powerful, success depends on students receiving instruction in how to use program features effectively (Dell et al., 2008). Like
speech synthesis, scan/read programs are supportive of UDL by providing options in how information is presented. Scan/read programs support the brains’ recognition networks by providing an alternative way for individuals to recognize information.

**Technology and Writing**

Writing includes a number of complex processes including systems of planning, evaluation, linguistics, and transcription. Students with disabilities struggle with all of these aspects of writing. They tend to do little planning, and revision (MacArthur et al., 2001). Difficulties with writing can reduce a student’s academic achievement throughout their school years (Hetzroni & Shrieber, 2004). Computers can be used in different ways to support writing difficulties. Such programs are described below.

**Word Processing**

Word processors have a variety of features that may assist students with the writing process (MacArthur et al., 2001). Word processing programs enable students to enter text, change it easily, and store it to be used later. An important advantage of allowing students to use word processing, is how easily text can be altered. Spelling and grammar errors can be corrected more quickly, and typing avoids the problems that are caused by poor handwriting (Lewis, 1998). Word processing programs can compensate for some student’s difficulties with spelling or the writing process (Forgave, 2002). Research on students with writing disabilities who used spell-check showed that students corrected 37% of their errors, as opposed to only 9% without the aid of spell-check. Spell check does have limitations, such as when students spell correctly but are confused by homonyms. Or in some cases spell check may not identify words that are severely misspelled, and therefore not suggest correct spelling (MacArthur et. al, 2001).
When working with partners, word processors allow students to view the screen together, enabling them to work collaboratively to compose or revise a piece of work without handwriting separate parts. However if a student is a weak typist, typing may slow them down (MacArthur et al., 2001).

Studies comparing word processing with handwriting shows that word processing improved writing quality, especially for students with poor writing skills (Lewis, 1998). Specific research on word processing for students with learning disabilities is limited however. But there is research demonstrating that word processing does lead to improvement in writing quality when it is combined with instruction. Word processing also leads to an increase in the amount of text written (MacArthur & Schwartz, 1990). A study comparing two groups of elementary students with and without use of a word processor showed students demonstrated improved writing ability related to meaning, content, form, and mechanics (Owston & Wideman, 1997). Similarly, a study by Hetzroni & Shrieber (2004) found that when using a word processor, three junior high school students made fewer spelling errors and produced writing that was more organized. Word processors represent another option that teachers can make available to their students in order to support individual needs within an inclusive setting. Word processing programs can also be used to support the principle of providing multiple means of expression, by allowing students to choose the option of typing over handwriting.

**Word Prediction**

Word prediction software allows the student to type the beginning letters of a word, and then the program predicts the word to be spelled by offering a list of possibilities. If the word appears on the list, the student can choose it rather than having to type it. This assists in avoiding spelling problems. Word prediction often combines speech synthesis, which reads the
text and predicted words. Word prediction programs can benefit students with severe spelling difficulties (MacArthur et al., 2001). These programs are consistent with the approach of UDL because they allow students to practice writing with supports, which appeals to strategic learning (Rose & Meyer, 2002). Read & Write 5.0 by textHELP (1999) works with any Windows application and is one example of word prediction software that augments spelling and syntax. The word prediction tool can be made active or inactive by the student (Quenneville, 2001).

MacArthur completed three studies of word prediction programs used by students with LD and severe spelling problems (1998). In the first study of 9 and 10 year old students, the program had a significant effect on the readability and spelling of their journal entries. However in a second study of word prediction software using a more sophisticated dictionary and prediction systems, no improvements in spelling or readability were found. In his third study (1999) MacArthur used the same students but in a quieter setting with a dictionary more tailored to the writing task. The students then showed improved readability and spelling (MacArthur et al., 2001). If the dictionary selected is not matched properly to a writing task, students can be overwhelmed by too many choices. Beginning writers do better when a small dictionary is selected with a focused set of words. When writing a research paper on a specific topic, students perform better with a larger dictionary and topic related vocabulary (Dell et al., 2008).

There is no one form of expression that is best suited for all students (CAST, 2008). Word prediction software represents one option that can be provided in order to support multiple means of expression. One of the advantages of word prediction is that it can be switched on or off by the student, representing a flexible scaffold that is supportive of providing multiple means of engagement.
**Speech Synthesis (Speech to Text)**

Speech technology is recommended by CAST as an option for providing students with an alternative means of expressing their knowledge (CAST, 2008). Speech - to text technology helps students avoid problems with writing and typing skills by dictating their written work. This enables students with disabilities to produce text faster than with handwriting or typing (Graham, 1999). Students are able to dictate their ideas quickly and therefore are more able to focus on the content of their writing. Studies show that using speech recognition technology has long-term benefits. A study by Higgins and Raskind (2000), found that students between the ages of 9 and 18 who used voice recognition software demonstrated improved reading comprehension and spelling (Zhao, 2007). With the aid of speech recognition students can express themselves more easily.

Speech synthesis can be used in conjunction with a word processor, so a student can listen to text as they are writing. Talking word processors allow writers to monitor the accuracy of their work by listening to the text as it is entered. Examples of talking word processors include Write:OutLoud, IntelliTalk, Kids Works 2, and The Amazing Writing Machine (Lewis, 1998). The text can be read by letter, word, sentence, or a section that the student selects. Many programs also highlight the text while it is read (Fennema-Jansen, 2001). Research by Borgh & Dickson shows that students do more revision when they use speech synthesis (MacArthur, 1999). Another study by Rosegrant showed that students using a word processor with speech synthesis wrote more, made more corrections, and produced better quality papers (MacArthur, 1999). Speech technology has great potential to benefit students with special needs (Zhao, 2007).
Inspiration

Many students struggle with the planning stage of writing. Some individuals with learning disabilities find graphic organizers helpful in brainstorming and mapping ideas (Quenneville, 2001). Inspiration is a form of organizational software that can help all students organize their ideas through webs or concept-maps on the screen. Students can brainstorm ideas into visual organizers that then become outlines to follow when writing (Lewis 1998).

Inspiration can be used to gather information before writing a research paper. As the student adds information to the organizer, the outline rearranges itself in a logical sequence (Forgrave, 2002). Studies show that organizing tools improve the quality of writing for students with learning disabilities (Graham, Harris, MacArthur & Schwartz, 1998). When students with difficulty processing information have access to graphic organizers or concept maps, they are more able to recognize relationships between ideas. Different colour, size, and shape can also help emphasize relationships and appeal to visual learners at all grade levels. Visuals can help students who struggle with memory by allowing them to visualize ideas in their mind (Flores, 2008). Concept mapping tools, such as Inspiration, are supportive of UDL because they provide options for composing and problem solving (CAST, 2008).

Multimedia Tools

Teachers are learning that multimedia tools can expand on their options for presenting information and making choices available for how their students express themselves (Rose & Meyer, 2002). For example some programs allow students in younger grades to draw pictures to tell a story before they can write. Multimedia software programs combine both text and graphics for story writing. When students have underdeveloped literacy skills, or little knowledge of a topic, visuals and other media can assist them with their writing (Daiute, 1992).
**HyperStudio**

HyperStudio is a multi-media computer program that gives students the ability to use text, pictures, and sound to present ideas and information. The program appeals to multiple learning styles by requiring students to not only include text, but to use their spatial and logical intelligence to work on layout and visual appeal. It is a flexible program that allows students to work at their own pace (Haviland & McCall, 1999). Students can use HyperStudio to create electronic portfolios. An electronic portfolio is a collection of student’s work over time, and their own evaluation of the contents (Johnson, 1994). According to Hanfland (1999) the use of electronic portfolios:

motivate students to produce quality work, and they also increase students’ self-esteem by showcasing their best work. Portfolios provide methodical flexibility, allow for various learning styles, increase students’ retention of content, increase student responsibility, and help develop their computer literacy skills (2003, p. 140).

Students create “hypercards” which are digital index cards displaying words and pictures. The hyper cards allow students to alter borders, backgrounds, text and pictures. Students can create several cards, which creates a “hyperstack” (Haviland & Mccall, 1999).

**PowerPoint**

This presentation software offers students multiple means of sharing their knowledge through graphics, video and sound. According to Dell, Newton, and Petroff (2008), PowerPoint can provide an engaging setting for prewriting, and offer an alternative to writing a paper for students with weak writing skills. The ability to combine graphics, sound, and video while writing can improve student motivation and assist in generating content. But it can also distract the student from the written text and interfere with time-spent writing (MacArthur et al., 2001).
Multimedia tools such as HyperStudio and PowerPoint are supportive of UDL in two key ways. These programs can provide a more engaging setting for prewriting, and they can offer an alternative to writing a paper so that a student with weak writing skills can demonstrate knowledge of a topic (Dell et al., 2008).

UDL aims to reduce barriers for all students, and has benefited from developments in digital technologies that make it possible to customize curriculum for students (Dell et al., 2008). When used within the principles of UDL, technology can help students by increasing their independence, productivity, and empowerment. It is important that technology is not isolating but inclusive when supporting students with disabilities (Jackson, 2004). The technology that has been described in this section can be integrated into the core curriculum to make more opportunities for all students.
CHAPTER 3: MOVING FORWARD WITH UDL

The purpose of this chapter is to discuss the research that supports the implementation of UDL, as well as challenges to its realization. This chapter will also examine how such barriers can be overcome. When considering how UDL can benefit students with learning disabilities, it is necessary to examine the role of the IEP and its use within the UDL framework.

Research to Support UDL Implementation

Much of the research to support the need for UDL comes from the Centre for Applied Special Technology (CAST). According to CAST, UDL principles are based on the most accepted finding in education research: “students are highly variable in their response to instruction” (CAST, 2008, p.8). In all research on teaching, or intervention, individual differences are very prominent (CAST, 2008). The three principles of UDL that were previously described are based on both neuroscience and cognitive science of learning. The principles were also developed based on the work of Lev Vygotsky and Benjamin Bloom, who identified almost identical principles necessary to address individual differences (CAST, 2008). Vygotsky’s research (1962) reflects the multiple means of recognition, expression, and engagement as supported in UDL (Dolan & Hall, 2001).

Research studies on the success of UDL are limited, perhaps because few schools have yet to fully implement the technology needed to support its principles. However, a study by The Rehabilitation Engineering Research Center on Technology Transfer identifying technology needs for people with learning disabilities (Strobel, Arthanat, Bauer & Flagg, 2007) provides some useful insight. This study involved interviewing twenty experts within the field of LD and AT about the trends and needs within technology for education. Though the experts were not
asked questions about UDL, the results supported a central theme of technology needs based on Universal Design for Learning. All 20 experts interviewed stressed the importance of an inclusive environment and an underlying premise of UDL was unanimous. The study concluded that according to these experts, the need for UDL classrooms and technologies is critical (Strobel et al., 2007).

Another study by Project Form at National Association of State Directors of Special Education (NASDSE) completed a survey of nine state directors of special education to determine how local education agencies are effectively implementing UDL principles. The directors were interviewed in order to assess UDL practices, successes and challenges. The participants reported that UDL benefits students, teachers, and administrators. According to interviewees, UDL leads to an increase in student learning, performance, and test scores. They also expressed an improvement in student behaviour and attitude towards learning. The study did report certain challenges with UDL, including time and money. Participants expressed the need for more funding and time for teachers to be trained in current technologies. Overall, the interviewees agreed the UDL is best practice and benefits all students (Sopko, 2008).

**Implementation Challenges**

Teachers face a number of challenges when striving to implement UDL within their classroom and school. Access to new technology is perhaps the greatest challenge. The technology available to teachers varies, and in many cases new technology may be hard to access or not available at all. Technology is expensive, and demand for computer programs and assistive devices have been increasing recently. However, availability of technology has not increased at the same level (Mull & Sitlington, 2003). In many cases technology that is
instructional (useful for all students) and assistive (necessary for an individual student with a disability) seems to be only available for students with the most obvious needs (Puckett, 2004).

Another challenge teachers face is a lack of knowledge and training regarding technology. Edyburn (2006) refers to a “consideration paradox” by pointing out that although IEP teams are legally required to consider assistive technology, team members might lack the knowledge to know what options exist. Teacher training in new technologies is also essential but pre-service programs lack the instructors with the skills to teach their students about technology (Mull & Sitlington, 2003).

Supporting the Implementation of UDL

There are a number of important components that must be in place in order to move forward with UDL. Implementation relies heavily on the actions taken by individual teachers. A very basic step towards moving forward is self-education. UDL has been developing for the last decade, but it is still a new approach that challenges teacher perspectives. Before teachers can implement UDL, they need to learn to look at their students differently. CAST can assist teachers who are willing to learn about UDL. The CAST website is a valuable source of information explaining the concepts of UDL, as well as tools and resources that are available (Hall et al., 2003).

Professionals must also have knowledge about technology. Teacher training programs should share responsibility for educating future teachers in new technologies so that they are properly prepared (Ashton, 2005). Teachers need to be provided with professional development opportunities regarding technology and UDL. Profession development that focuses on helping
Teachers create and use digital resources within the principles of universal design will increase the chance of improving results for all students (Jackson, 2004).

Administrative support and commitment is also helpful when implementing UDL. According to Jackson (2004), making technology accessible is not enough. Schools need to adopt a vision of inclusion and collaboration between teachers, special educators, and administration. Access to the curriculum requires a partnership between general and special educators. Collaboration between all staff members is critical in order for UDL to be successful and depends on the willingness of all parties to participate. Collaboration may take the form of building support teams (Jackson & Harper, 2002). Collaboration using the principles of UDL will support instructional planning, as opposed to modifying instruction later. Instructional planning that uses technology is important in order to locate material and content, and instructional options for teaching all students (Harris et al., 2007). Strangmen, Hall and Meyer (2003) recommend a four set process towards curriculum planning. In the first step goals are set in order to institute the context for instruction. In the second step, teachers analyze the current methods and materials in order to identify barriers to learners. The third step is to apply UDL to the lesson or unit being taught. This involves outlining goals, methods, assessments, and materials needed. In the final step, the UDL lesson or unit is taught relying on instructional strategies that minimize barriers. Curriculum planning should be carried out throughout the year involving course, unit, and lesson planning, while considering the individual needs of students. Regular classroom teachers and special educators can complement each other in the process by considering the goals of the unit while identifying accommodations necessary for students with learning disabilities (Jackson & Harper, 2002).
Access to technology makes UDL implementation achievable. CAST recommends that teachers try to accumulate digital materials, but acknowledges that UDL can proceed across a range of availability. CAST and other organizations have been working to make UDL and assistive technology more widely available. There are a number of ways for teachers to access and develop the skills necessary to implement technology. One source is the World Wide Web of digital material, which is sometimes free and presented in a multimedia format (Hall et al., 2003). Many types of reading material can be found on the Internet including books, articles, discussion boards, and blogs. Materials can be downloaded, saved in word processing programs, then manipulated to meet individual needs (Dell et al., 2008). The Internet also offers subscriptions to programs such as KidBiz3000 and TeenBiz3000, which are programs, designed to develop fluency, comprehension, and vocabulary. KidBiz 3000 sends students in grade 2 through 5 daily reading assignments at their reading level. TeenBiz is aimed at grades 6-12. All children read about a topic and complete related writing activities, but the passage levels are different based on a reading pretest. Although students read about the same topics, they are working at different levels (Dell et al., 2008).

Gaining access to digitized materials is one of the most important steps of UDL and digital text is increasingly more available (Rose & Meyer, 2002). Access to digitized text offers flexibility in the delivery of information. Digitized text can be altered into different formats including an audio file played on an MP3 player, or an HTML document that can be read with speech synthesis (Ender, Kinner, Penrod, Bauder & Simmons, 2007). By digitizing materials teachers can have access to resources that overcome barriers present in printed curricula. A student with a reading level below his or her peers will find reading assignments too difficult. The process of “cognitive rescaling” alters the reading difficulty of text. There are several
software tools that make this process possible including Microsoft Word’s AutoSummary, Kids Media Magic 2.0, Picture It, and Writing with Symbols 2000 (Edyburn, 2002).

Some novels can be downloaded, and websites and on-line reference materials are already in digital format. Textbook publishers are more often providing digital copies of text. Documents can also be scanned using optical character recognition (OCR) software to access a digital version (Edyburn, 2002). This gives teachers the ability to use the digital format with supportive technologies (Rose & Meyer, 2002). Another source of digitized text is Bookshare.org. This group offers subscriptions to give students’ access to copyrighted and non-copyrighted materials (Ender et al., 2007).

In one pilot study, the Kentucky Department of Education (KDE) aligned with the University of Louisville in 2004 to create an initiative to implement UDL. Grants were provided to six K-12 schools in order to develop a model of how UDL could be integrated into the curriculum. Over the course of three years, the schools purchased a range of technology, participated in training and professional development, and evaluated their own progress. Although the schools took a variety of approaches to implementing UDL, all of the schools have shown progress. A number of factors have been identified in supporting the success in these schools. Teacher training was imperative, but support from administration to facilitate progress was also needed. Equally useful was active participation of parents, staff, and administration (Ender et al., 2007).

Implementing UDL requires change, and involving parents and community in supporting change is crucial. When parents are informed, they can advocate for their children and assist in bringing about change. UDL depends on not only teachers, but also the support of administrators and politicians in order to obtain funding for technology (Hall et al., 2003).
IEPs and UDL

Though the implementation of UDL will benefit many students, an Individual Education Plan (IEP) is necessary for some individuals. When educating students with disabilities, the IEP is critical. The IEP document explains the student’s level of performance, sets goals, and outlines services. A newer approach to IEPs requires members to identify supports and aids that address a student’s disability by allowing them to make progress within the general curriculum. The IEP team must find entry points for a student, and identify a range of accommodations that allow the student to participate in the curriculum without changing standards. Modifications may be necessary when student entry points are far below standards, but the general curriculum sets the focus for planning (Jackson, 2004). Members of the IEP team can support UDL. According to Jackson (2004), IEP members can work proactively:

“Planning curriculum and instruction at the outset – with the widest possible range of students in mind – has the potential of reducing the time, costs and efforts associated with designing a high quality educational program for all students, especially those with disabilities” (p.3).

For students with greater needs, alternative instruction and assessment may be necessary. Standards are still set using the general curriculum, but are adapted to match the student’s ability level. Accommodations and assessment are based on the objectives of the IEP (Jackson & Harper, 2002).

The IEP team may include an occupational therapist, speech pathologist, physical therapist, technology specialist, and teachers. These participants help to select appropriate technology based on student strengths (Kroth & Edge, 2007). Classroom teachers play a very important role in the development and implementation of the IEP. It is important that they are a part of the IEP team in order to design appropriate accommodations that can support all of their
students (Flores, 2008). IDEA 2004 mandates that assistive technology be considered as an accommodation during the development of the IEP (Dell et al., 2008). In such cases in order for assistive technology to be used effectively, parents need to be part of the assessment and intervention process. It is important that parents take part in the IEP process so that decisions made consider the cultural background of the student. In order to consider the needs of the student, professionals must work collaboratively with family members. School counselors should also partner with teachers and parents to develop the IEP (Kroth & Edge, 2007).

In addition to selecting appropriate assistive technology, the IEP team is responsible for ongoing assessment. As a student makes progress, their needs may change and the student may require different accommodations to succeed. Bryant, Bryant and Raskind (1998) recommend that the evaluation process combine examining the current demands of the student’s environment, with the student’s strengths and weaknesses in order to select appropriate technology.

Students on IEPs may require additional individualization that is not provided directly through UDL. However, the nature of UDL reduces the amount of accommodations needed because the curriculum is already programmed to cater to individual differences and learning needs. Many accommodations are built-in to the program design (Sabia, 2008). It is clear that technology can promote access to the curriculum for students with learning disabilities by enabling them to participate within the regular classroom. For this reason, technology should be included in the IEP (Dell et al., 2008).
CHAPTER 4: SUMMARY AND CONCLUSIONS

Universal design is an educational framework developed by CAST that provides opportunities for all learners to gain skills and knowledge. It is based on the three principles of multiple means of presentation, expression, and engagement. UDL reduces barriers that limit access for students with special needs. It is an educational approach offering curriculum instruction and assessment that are specially designed to reach diverse learners and therefore benefit all students (Sopko, 2008). The key to UDL is providing alternatives. No single teaching method supports all students, and multiple methods of instruction are needed to support learning. Though this study focused on the usefulness of UDL for students with LD, it is apparent that it’s principles and implementation would benefit individuals with other disabilities as well.

The success of UDL also relies greatly on access to technology. Technology provides access to exciting activities and opportunities for students. One extensive source of technology and digital materials is the World Wide Web (Hall et al., 2003). However technology alone is not sufficient. UDL also depends upon the use of evidenced-based instructional practices and curriculum reform. Simply providing a computer and software to students with learning disabilities will not increase their success in school, unless the technology is integrated into the curriculum (Dell et al., 2008). When properly integrated technology enhances learning and removes barriers caused by text (Jackson, 2004). Examples of integrating technology into lessons plans can be found at many websites including “Best Practices of Technology Integration in Michigan” (http://www.remc11.k12.mi.us/bstpract/bstpract.html) and CAST UDL lesson builder (http://castlessonbuilder.cast.org). These sources can assist educators in developing their own universally designed lesson plans.
The selection of technology available for teachers to use in their classrooms is constantly growing and developing. This study attempted to describe some of the most readily available and researched technologies. When selecting technology teachers should be aware that some of technology is assistive, and some programs are universally designed. When considering the use of software, teachers should refer to the three UDL principles to assess if the technology is supportive of UDL. More research of specific technologies would be useful in determining the success of specific software. In addition more research is necessary to determine which software programs are the most useful when used specifically within the framework of UDL.

It was this author’s intention to address how technology can be used by teachers to teach skills to a diversity of students, including those with disabilities, therefore providing all students access to the general curriculum. Though technology tools can improve curriculum access, students with disabilities must be taught how to use technology in valid ways. For this to occur, technology must be incorporated into daily instruction. Planning that identifies tools and skills needed by all students to demonstrate knowledge will create a framework for the inclusion of students with disabilities. IEP team members can examine the skills needed and evaluate the extent to which universally designed technologies will work for students with disabilities, and if additional assistive technology is required (Jackson, 2004). The IEP is responsible for aligning the general curriculum with individually designed instruction to ensure access to the curriculum (Jackson, 2005).

Though UDL makes the curriculum accessible to a wider range of students, some students will continue to need specialized technology. For example, when a student is blind, he or she will need a Braille keyboard. Or when a student cannot speak, they will benefit from an augmentative communication system that is not a part of all computer operating systems (Dell, et
Because this study only focused on technology benefiting students with learning disabilities in the areas of reading and writing, a discussion of technology for more specific disabilities has not been included.

There are several barriers that must be overcome in order to move forward with UDL and technology. One of the major problems causing the gap between the potential of UDL and its implementation in our schools is the lack of knowledge and skills of teachers. It is clear that teachers, and teachers in training, need to be better prepared to implement technology and the principles of UDL. In a time of inclusion and technology integration, commitment to professional development must be ongoing. CAST recognizes this need and is offering professional development opportunities directly through their website where videos and PowerPoint presentations can be downloaded. CAST recommends linking professional development opportunities to the local level to ensure relevance and effectiveness (Jackson, 2004). Such opportunities are not yet widely available to teachers in Canada and other countries. The need for professional development in technology and UDL is recommended through this study, but how professional development can be provided is an area that requires additional research and investigation. Attitudinal shifts on the part of educators also need to occur for UDL to be successful. Teachers require time to learn new skills and to form partnerships with other educators (Jackson et al., 2002).

The literature reviewed in the study relied greatly on the work of CAST, which is the organization responsible for the development of the principles of UDL, as well as certain UDL technologies. Research and advocacy for UDL is limited because CAST is currently its main supporter. Though CAST is a recognized and respected association, additional groups dedicated
to UDL might contribute to its widespread implementation, as well as a more balanced body of research into its effectiveness.

Teaching has always been a difficult profession, but is particularly challenging within the increasingly diverse classrooms of today. However, technological advances have provided teachers with exciting opportunities and resources in the form of digital media. UDL redesigns traditional teaching methods to take advantage of the tools and resources that continue to develop within the field of technology. In order for UDL to become a reality, flexible materials and professional development that supports the principles of a UDL approach are needed. Teachers need to redesign learning goals, teaching methods, and materials used in order to implement UDL (CAST, 2003). Partnerships between general educators, special educators, and other school personnel can raise standards and improve the results for all students by providing increased access to the curriculum (Jackson, 2004). This study was completed to add to the body of knowledge describing UDL as an approach to teaching that provides all students access to the curriculum, while at the same time meeting the needs of students with learning disabilities.
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