ABSTRACT

ASSISTIVE TECHNOLOGY FOR STUDENTS WITH LEARNING DISABILITIES IN WRITING: BELIEFS, KNOWLEDGE, AND USE

by Diane Lynette Bigelow

The purpose of this study was to investigate special education teacher beliefs, knowledge and use of assistive technology for students with learning disabilities in writing. A ten question survey was administered to a random sample of special education teachers in Ohio. Participants viewed technology as beneficial, but use and knowledge of assistive technology was limited. Reasons revealed were demands for training and resource availability and student needs. Value placed on technology, current education, and years of teaching experience did not correlate with participants feeling adequately trained to use assistive technology or have an impact on level of assistive technology integration. Possible reasons included inadequate teacher training, lack of teachers seeing student need for assistive technology, and the rate of technology change.
ASSISTIVE TECHNOLOGY FOR STUDENTS WITH LEARNING DISABILITIES IN WRITING: BELIEFS, KNOWLEDGE, AND USE

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Dedication

This work is dedicated to my husband, Dan Bigelow. His steadfast display of love, support, and belief in me under girded every step in the process. In spite of his serious medical challenges, he stayed the course beside me.

My children, Sam and Audrey, reminded me that writing this thesis was not the most important thing in my life. Thanks to them for helping me keep my priorities in order.

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Assistive Technology for Students with Learning Disabilities in Writing:
Beliefs, Knowledge, and Use

Introduction

A new era is upon the field of special education. The laws of No Child Left Behind (NCLB) and the Individuals with Disabilities Act (IDEA) require students with disabilities to be more fully included in the general education classrooms. One way to increase access to the general curriculum is through the use of assistive technology. While educators have long been aware of assistive technology, such as the wheelchair, that provide access for individuals with physical limitations, the possibilities of assistive technology for students with learning disabilities are relatively new.

The following is a discussion of literature on learning disabilities, specific written language learning disabilities, and assistive technology that have the potential to aid students with learning disabilities. The assistive technology of particular concern are those created to assist in the learning environment. Some of the vocabulary used for this type of assistive technology includes cognitive prosthetics and educational technology.

Literature Review

Relevant Definitions

In order to address the issues of learning disabilities and assistive technologies, it is necessary to understand the related terminology. The specific definitions selected for the present research are also provided.

*Learning disability defined.* Many people have heard the term learning disabilities and have some vague understanding of what it means. What they may not know is that the field of special education has been challenged to define this disability. Kavale and Forness (2000) opened their research on the evolution of the definition by stating that there have been a multitude of definitions. They cite the research of Tucker, Stevens, and Ysseldyke (1983) stating that there has not been an “unequivocal favorite” (p. 2). Regardless of the challenges to define learning disability, the presence of students with learning disabilities impact instruction.

Classrooms are filled with a diverse group of learners. Included in that diversity are students who have learning disabilities. The Federal Government defines learning disabilities as:

The term “specific learning disability” means a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or
written, which disorder may manifest itself in imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations. Such term includes such conditions as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. (Hallahan & Kauffman, p. 171)

While the federal definition of learning disability is widely accepted by states, The National Joint Committee for Learning Disabilities (NJCLD) has found the federal definition to be inadequate. The NJCLD presented the following definition:

Learning disabilities is a general term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities. These disorders are intrinsic to the individual, presumed to be due to central nervous system dysfunction, and may occur across the lifespan. Problems in self-regulator behaviors, social perception and social interaction may exist with learning disabilities but do not by themselves constitute a learning disability. Although learning disabilities may occur concomitantly with other handicapping conditions (for example, sensory impairment, mental retardation, serious emotional disturbance) or with extrinsic influences (such as cultural differences, insufficient or inappropriate instruction), they are not the result of those conditions or influences. (Hallahan & Kauffman, 2006, p.172)

The prior definitions indicate controversies around learning disabilities. The definition of learning disability has long been debated. The first formal definition of learning disabilities was created by Kirk in 1962.

A learning disability refers to a retardation, disorder, or delayed development in one or more of the processes of speech, language, reading, writing, arithmetic, or other school subjects resulting from a psychological handicap caused by a possible cerebral dysfunction and/or emotional or behavior disturbances. It is not the result of mental retardation, sensory deprivation, or cultural and instructional factors. (Kavale & Forness, 2000, p.5)

The challenge in finding an agreed upon definition has been due to the vagueness of the manifestations of the disability. Kavale and Forness (2006) stated that learning disability has been so widely criticized as to suggest that learning disabilities are a myth. The definition of LD has evolved. While disagreements still plague the definition of learning disability, Kavale and
Forness suggested that there are many things upon which experts agree. Points of definitional agreement include that learning disabilities impact spoken language, academic, and thinking disorders, is present throughout life, is not a result of other conditions, involves psychological process disorders, appears to result from the central nervous system, and is marked by underachievement. One of the identifying factors of a learning disability is a difference between achievement and intellectual ability. When the federal government adopted its definitions, it stated that there must be a “severe discrepancy between achievement and intellectual ability” (Hallahan & Kauffman, 2006, p. 173).

While the debate continues, most states use the definition created by the federal government as funding is based upon it. For the purposes of this research, the federal government definition was used. This disability represents the largest population served in special education. Hallahan and Kauffman (2006) stated that more than half of the students who are served under the umbrella of special education are students with learning disabilities. Students with learning disabilities are largely represented in general and special education classrooms. Educators are compelled to find effective methods of instruction to meet the needs of students with learning disabilities. One motivating factor for finding and utilizing effective instructional methods for student with learning disabilities is that this population is at a high risk for dropping out of school. In fact, “29.4% of student with LD exit school without a diploma” (U.S. Dept. of Ed, 2000).

Written language learning disabilities defined. While the definition of learning disability covers the range of challenges previously discussed, this research addressed the particular forms of learning disabilities that impact a student’s ability to write. Writing involves the physical demand of holding a pencil, writing legibly on a piece of paper, spelling, and the ability to present ideas in a thoughtful, organized fashion. The physical limitation to write letters is called dysgraphia. This particular disorder is marked by slow writing, poor letter formation, and messy to illegible final products (Hetzroni & Schrieber, 2004). Hallahan and Kauffman (2006) claimed spelling challenges are present because of the difficulty these learners have in the correspondence between letters and sounds. Students with written language learning disabilities demonstrate writing that is of lesser quality than their peers. Their writing is less organized, shows fewer ideas, contains less important components including the introduction of main characters and settings, and uses simple sentence structures in poorly organized paragraphs.
Montgomery and Marks (2006) noted that students with disabilities in writing avoid writing, write without an organized approach, produce written pieces that are riddled with problems in spelling, punctuation and grammar, struggle to retrieve vocabulary for written language, write fewer words than their peers, and write illegibly. The obstacles present in students with writing disabilities clearly have a negative impact on school performance.

Roberts and Stodden (2005) noted Blalock’s 1981 research which estimated that 80 to 90% of people with learning disabilities have disabilities in written language. Learning disabilities in writing are prevalent. Teachers need to seek multiple avenues to assist these students with written language disabilities as traditional instruction is not enough to bring them to a level equal with their same age peers.

**Definition of assistive technology.** Assistive technology includes a broad range of devices. Day and Edwards (Hetzroni & Shrieber, 2004), stated that the learning environment that includes assistive technology assists individual productivity and is more accessible. There are items ranging from low-tech to high-tech. Low-tech devices are simpler and include Velcro fasteners and furniture adaptations. High-tech items include computers and interactive multimedia systems (Blackhurst, 1997). IDEA amendments of 1999 define assistive technology as, “any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of a child with a disability” (IDEA Amendment of 1997, Sec. 602).

While there are numerous assistive technology available, Hallahan and Kauffman (2006) argued that the ones that are most effective are the ones that have been created with a universal design for learning. Universal design is the concept that when something is constructed, it is constructed in such a way that allows access to as many people in the population as possible. Hallahan and Kauffman defined universal design as, “The design of new instructional programs to make them usable by the widest possible population of potential users” (p. 541).

One goal of assistive technology is to facilitate independence. Assistive technology serves to create a wealth of opportunities for all preschool through grade 12 students. Assistive technology allows students to reread text without waiting for someone, to increase self-determination, and to provide a model for self-actuated learning. As teacher candidates increase in their knowledge of assistive technology, they can facilitate the ending of learned helplessness.
and teach students higher level learning tasks independently, providing cognitive access for all learners. With assistive technology, teacher candidates can create parallel experiences for all learners (Nelson, 2006). The present research focused on assistive technology created to enhance academic performance. It included a broad scope of technology to help students increase their performance in academic settings. Assistive technology designed to enhance written work were the types of assistive technology of interest. The need for knowledge in the effectiveness of assistive technology, the challenges confronted in their use, and how to implement them effectively is paramount. The reauthorization of IDEA contains a demand that professionals consider assistive technology while individual education plans are written (Edyburn, 2006). In order to make those considerations, teachers need both an awareness of assistive technology and how to include them in instruction.

*Techniques for Teaching Writing to Students with LD*

*Traditional techniques.* Teachers have used myriad techniques to teach writing. Three decades ago, Binns (1977) offered suggestions for the teaching of writing to “slower learners.” The writing task was to be broken into making notes, editing/drafting, and revising/self correction. A teacher script was to be provided for each task. The script was to include discussing ideas with peers and the class and writing notes, telling students to not try to produce a final draft in the notes phase, having the students transfer their ideas from the notes page to the final draft with particular attention to correct spelling, and reading aloud the final version. In that same time period, Mills (1977) identified challenges in writing due to the development of technologies and further argued that writing continues to be a major concern of educators as they work to put writing in its proper place within the curriculum. Likely Mills did not foresee the potential benefits of the technology now referred to as *assistive technology.*

Englert, Zhao, Dunsmore, Collins, and Wolbers (2007) highlighted multiple research that demonstrated the effectiveness of instructional interventions that include an emphasis on direct instruction of text structures combined with highlighting organization techniques. The organizational tool noted by several researchers is semantic webs/graphic organizers. These graphic organizers scaffold the writing process. While organizational techniques prove beneficial, students who need more guidance, benefit from the prompting of structure and strategies (Englert et al., 2007). These instructional methods have been backed by research and are not negated. The potential is to complement traditional instruction with new technologies.
Edyburn (2003) noted extensive literature that described the promise technology holds for all writers. While these methods have proven effective for many learners, the use of assistive technology increases access to the general education curriculum for students with special needs. Hetzroni and Shrieber (2004) noted research that recognized assistive technology as helpful tools for students with learning disabilities. Assistive technology complements the proven effective writing techniques that have been a part of traditional techniques.

Techniques for using assistive technologies. Assistive technology designed to facilitate the writing process can assist the writer at several points within the process of writing. Assistive technology has been referred to as cognitive tools (Englert, Wu & Zhao, 2005) and cognitive prosthetics (Edyburn, 2006). Edyburn quoted researchers from the Institute for Cognitive Prosthetics from 2004 in their definition of a cognitive prosthetic. Specifically, a cognitive prosthetic is an

…assistive technology that helps a person with cognitive deficits function more independently in certain tasks….a compensatory strategy that directly assists the individual in performing daily activities. It helps a person to maximize their strengths and abilities to compensate for their deficits. (Edyburn, 2006, p. 63).

These cognitive prosthetics include the following technologies that are designed to support the writing process. Table 1 presents a summary of available types of assistive technology. Computer-assisted instruction includes the wide range of products available on computers (Wanzek et al., 2006). Voice/speech recognition software allows writers to dictate their ideas. The program converts speech to typed text. This software allows writers to see the text as they are speaking it, allowing the opportunity for rereading and dynamic planning (Quinlan, 2004). Organization programs help students to put order to their thoughts and synthesize the information (Montgomery & Marks, 2006). Features such as outlining, story webs, and concept maps assist writers by helping them organize brainstormed ideas, guiding through outlining, and creating visual images to guide the writing process. They serve as organizational tools that provide prompts through a cognitive framework (Englert et al., 2007). Speech feedback software allows the computer to “read” text. While the computer reads, the words are highlighted. For students who write and have limited ability to read the text again, this software will read it for them. This feature allows students to revisit their writing for editing purposes (Williams, 2002). Word prediction software facilitates students editing their work. Students type in the initial
letter(s) of a word, and the software will take a guess at a word that fits grammatically (Williams, 2002). Students can choose the right word from the predicted list. There are several tools within many word processing programs that offer the features of spell checker, thesaurus, and grammar checker. While these features work best when they are complemented by effective instruction, their presence provides additional tools for struggling writers (Bryant & Bryant, 1998).

While there are a variety of tools to assist with the writing process, Edyburn (2003) stated that the tools have three main focuses. These include creating alternative methods to handwriting for students who have handwriting impairment, techniques to engage the “I don’t want to,” and “I can’t” writers, and strategies that enhance the production of writing.

**Writing Assistance Offered with Assistive Technology**

Students with learning disabilities in writing often do not see themselves as writers. Due to previous failed attempts, many of these students feel enough anxiety about writing to do everything they can to avoid the task. Obviously, this avoidance results in less practice (Zhang, 2000). Montgomery and Marks (2006) summarized the frequently seen limitations in the writing of students with learning disabilities. These students display avoidance behaviors, do not approach the writing process with an organizational plan, create writing with multiple spelling and grammatical errors, use limited vocabulary, write fewer words than their peers, do not make writing revisions, and produce products that cannot be read. Assistive technology is designed to address these issues.

Assistive technology impacts instruction for students with writing learning disabilities. Zhang (2000) suggested that assistive technology provides some of the needed assistance that students with special needs require while they are mainstreamed into general education classrooms due to the prompting of No Child Left Behind. Assistive technology can provide access to the general education curriculum for students with learning disabilities. They help the learner by offloading some of the writing task onto the machine, facilitating the use of detail and organization, editing written work, and generating motivation.

**Offloading.** Assistive technology can reduce the load of the writing processes for students. Quinlan (2004) noted several research projects that addressed the writing process and its use of the working memory. Those studies found that inefficient handwriting interrupts the production of text. When students use their working memory to write the words, their remaining abilities are insufficient to address such issues as planning, revising, word storage, and text
generation (Quinlan, 2004). Quinlan hypothesized that speech recognition assistive technology allows a struggling writer to have more working memory available for text generation. His study involved using speech recognition with 11-14 year old students. He compared less fluent writers with fluent writers, distinguishing their work with pencil and paper and speech recognition. The less fluent writers had significantly fewer errors in their speech recognition narratives than in their pencil and paper narratives. It seems the speech recognition assistive technology freed working memory resources for text production by reducing transcription-related interference (Quinlan, 2004).

Englert et al. (2005) also noted the effects of offloading some of the cognitive work onto the computer. They noted research that stated that assistive technology can reduce cognitive demands by making the text structure visible. By supplying an organizational framework, the computer functions as a partner in the writing process for students with disabilities by prompting cognitive resources to generate, sequence, and arrange information to fit the demands of a writing purpose. They found that the writing tools and text structure strategies enabled students with learning disabilities to be more likely to include related details and organization. Organizational quality was improved, but the text length was unaffected.

Zhang (2000) noted that students with learning disabilities are able to focus on developing ideas and sentence and paragraph structure due to educational technology. Word processing technology, among other technologies, give opportunities to these students to maximize their power of expression in such a way that leads to similar enjoyment of the writing process as peers without writing learning disabilities. Zang’s research was prompted by the primary concern to motivate students with learning disabilities in writing to practice their writing. The results indicated that ROBO-Writer was a liberating force that freed students from the worries of poor writing and poor mechanics.

Williams (2002) conducted research with speech-feedback and word-prediction software. This software’s purpose was to reduce the mechanical demands of writing. Due to the provided reduction, her subjects were better able to work independently and write passages that were judged to be of higher quality and were longer.

the effectiveness of word-processing for improving academic outcomes in the classroom. The use of assistive technology resulted in reduced spelling errors. In this particular study, the word processor informed the students of spelling and grammatical errors. This study suggested that when students with learning disabilities use a word processor, the word processor may allow them to tackle writing assignments utilizing their strengths. Montgomery and Marks (2006) investigated the use of multiple types of assistive technology. The ability to offload many of the writing tasks onto the computer resulted in writing samples that were longer, contained fewer mechanical errors, and better overall quality. According to the teachers in this research, students spent more time engaged in the writing process and spent more time on revision.

While results in specific areas of the writing process are mixed, this research adds to the evidence that assistive technology provides writers the opportunity to share the responsibility of the writing with a computer by offloading the mechanical demands of writing onto the machine and freeing their memories to engage in text production.

Facilitation of detail and organization. Another goal of assistive technology for students with learning disabilities in writing is to help students with the organizational demands of writing. Englert et al. (2005) noted research that demonstrated the effectiveness of text structure instruction. It has proven to be an effective tool to improve the writing of expository and narrative writing. Students gain understanding of text structure and patterns of different writing requirements, improve text readability, prompt appropriate vocabulary use, enhance the right kinds of information, and improve organization. Some educators are using technology to achieve these improvements.

Englert et al. (2007) researched the effects of using the organization assistive technology, TELE-Web. TELE-Web’s features include reminders to generate introductory statements and prepare readers for what is coming next. It also reminds the student to write evidence and supportive details and concluding sentences. The results of their research using TELE-Web suggest that the writing tools and text structure strategies available within the program increase the chances that the writers would have better organization quality and story structure. This particular study also found that text length was affected.

Quinlan’s (2004) research tested the use of speech recognition assistive technology accompanied with advance planning instruction for non-fluent writers. The results of this study indicated that children who are less fluent writers benefit from writing with speech recognition
combined with advanced planning techniques. The written results included more words and fewer errors than when they wrote with pencil and paper. While speech recognition does not have, as its primary function, the facilitation of organization, the results of this study indicated that stories produced with speech recognition were longer and incorporated more background and details. The speech recognition with advanced planning strategies gave the students the chance to express their ideas more fluently.

Hetzroni and Shrieber (2004) noted an early study on the use of computers with learning disabilities in writing and found that, after keyboarding skills were learned, student writing improved. Other studies found that students who used word processing produced writing that was stronger in content quality, meaning, and writing form (Hetzoni & Shrieber, 2004). Common to these studies was investigation of the effects of assistive technology with students who demonstrated several challenges with writing, including text organization. Through using assistive technology, students produced writing that was more acceptable for class standards in that their writing showed evidence of more organization and structure (Hetzroni & Shrieber, 2004).

In Williams’ (2002) research on the use of speech-feedback and word-prediction, the writing quality was judged to be higher with the use of the assistive technology. Englert et al. (2005) noted research by Cope and Kalantzis (1993), Halliday and Martin (1993), and Williams (2003) that found that when students are taught to use text structures, they are equipped with the meta-knowledge related to how texts are organized. Englert et al. (2005) found that students with learning disabilities were more likely to support their topic with details and provide a global organization to their texts with assistive technology even though their text length was not affected.

As Montgomery and Marks (2006) took a look at using technology to build independence in writers with disabilities, they found that programs designed to assist with organization provide the writers with an easier way to brainstorm and synthesize information reducing the task of erasing and rewriting. In research conducted by Roberts and Stodden (2005), student use of voice recognition systems appeared to help with organization and flow.

While the gathered research has mixed results on overall text production, it appears that assistive technology benefits students as they assist the writer with the organization of written work. They help the writer through prompting generation of necessary sentence types within
writing, advance planning techniques, strength in content and form, higher quality writing pieces, brainstorming and synthesizing information.

*Editing written work.* Among the challenges of writers with a learning disability is that they often do not revise their work. Montgomery and Marks (2006) noted that students with writing disabilities see their written work as completed without editing (Montgomery & Marks, 2006). Researchers have studied types of assistive technology that supports the challenged writer in the work of revision.

In Montgomery and Marks’ (2006) synthesis of articles about technology used as a writing tools, they note the results of several researchers regarding the specific editing function of the spell checker. Lewis, Graves, Ashton, and Kieley (1998) found that spell checkers facilitated independence and gave writers the needed revisions with spelling. McNaughten, Hughes, and Clark (1997) found that spell checkers made editing for spelling errors easier. However MacArther, Graham, Haynes, and DeLaPaz (1996) found places where spell checkers fell short because of challenges in effective use. Montgomery and Marks (2006) identified several issues with spell checkers, including not identifying all errors, not providing a needed option, homonyms, students’ inability to identify correctly spelled words, and student failure to recognize proper spelling from the suggested list. Montgomery and Marks also found that grammar checkers can be helpful in the editing process but are complex in terminology. The terminology must be taught explicitly for grammar assistive technology to be effective.

Engert et al. (2005), noted research that found that text to speech assistive technology made editing easier. While Englert, et al.’s (2005) research did not directly address editing, their work found the self-monitoring tasks were facilitated by speech to text software which included the spell checker function. When Zhang (2000) researched the use of the audio feedback feature of ROBO-writer, students noticed spelling errors and poor sentences. The novel approach to noting errors encouraged writers to eagerly correct their writing.

The editing features of assistive technology were found to increase students’ ability to orally read their writing from 87% to 91% to 98% accuracy. This was attributed to the software features that increased student awareness of grammatical and spelling errors and the spacing of words (Hetzroni & Shrieber, 2004). Quinlan (2004) found that student writing produced with speech recognition resulted in more readable texts because surface errors had been edited.
The preceding review and the research point to a clear and positive impact assistive technology use can have on students’ writing. This was evidenced through the facilitation of independence, text to speech feature allowing students to hear their writing, and increased student ability to orally read their writing.

**Motivation.** Students with learning disabilities in writing tend to avoid activities where writing is required. Zhang (2000), among others, noted that students with learning disabilities often refuse and avoid writing activities. Zhang noted that assistive technology provides students with new opportunities to express themselves more effectively to such a degree that they can enjoy the writing process as much as their peers without learning disabilities. In this research, the teacher conjectured that the past failures of these writers contributed to fear of the process. In contrast, the students found assistive technology to liberate them from the worries of poor handwriting and mechanical skills. Because their final works looked professional, the students in his study were more willing to share their work with peers, teachers, and family (Zhang, 2000). Williams (2002) noted writers’ motivation to use the assistive technology because they said it was “fun.” The targeted students did not typically use such vocabulary to describe writing. Hetzroni and Shrieber (2004) noted that the features of assistive technology that help students to produce work they are more proud of can encourage writing. Their research concluded that assistive technology allowed students to have more control of their writing and helped them to produce more readable text. The consequences of that facilitated an attitude change in the writers and the teachers towards the written work of students with learning disabilities in writing.

Edyburn (2003) found that assistive technology engages writers in a way that ultimately leads to increased students’ effort to use writing as a way to express themselves. Montgomery and Marks (2006) found that a combination of features of assistive technology including outlining, thesaurus, spell and grammar check, and text to speech resulted in students enthusiastically sharing their work with their classmates and teachers.

When students are discouraged about their writing skills, Zhang (2000) noted they are less likely to be motivated to practice their writing. Assistive technology makes it possible for students to practice idea generation in their writing because of the help it offers them.

When assistive technology has the added impact of motivating the learner, students benefit from assistive technology implementation. If motivation results in practice, the assistive
technology promotes practice. It allows students with learning disabilities to focus on the generation of ideas as they practice (Zhang, 2000).

**Effective AT use when combined with instructional techniques.** Assistive technology can be an asset to the classroom, but it is not intended to be used as a solo device. While Zhang’s 2000 research found benefits to assistive technology, it also warned,

“Misapplied technology, technology without a sound curriculum, or technology that does not support the learning process can be more of a distraction than an asset. This is particularly true when technology is not universally available in a classroom or school, demoting its status to one of providing novelty rather than sound instructional support.” (p.475)

This sentiment was reiterated in Williams’ (2002) work, noting that assistive technology does not replace the valuable instruction offered by a teacher. Quinlan (2004) used speech recognition in his research accompanied by advance planning. The advance planning consisted of instruction in planning strategies and was noted to work in tandem with the speech recognition software. Wanzek et al. (2006) noted the research of MacArthur, 1998, that found that improved spelling with the use of a spell checker was only effective when it was accompanied by the speech prediction function. MacArthur found spelling improvement occurred when speech synthesis and word prediction assistive technology were combined; furthermore, the spell checker feature was successful only when it was used along with explicit instruction for how to effectively use it. Englert et al. (2007) found that the scaffolds in assistive technology produced the strongest writing when they were accompanied with guided instruction. Montgomery and Marks (2006) found that students only gain the full benefit of assistive technology if they are given direct instruction in strategies for how to best use them for writing. Spinks, Wells, and Meche, 1997 (as cited in Montgomery & Marks, 2006) stated that grammar checkers use specific, complex grammar terminology. Students use grammar checkers more effectively when they know the terms used within that feature. In the research of Engert et al. (2005), teachers put custom prompts into the outlining assistive technology. Those prompts served to remind students of instruction already given by the teacher. Bryant and Bryant (1998) cited the research of MacArthur’s 1996 research, emphasizing that technology’s potential can only be reached when it is combined with the principles of effective instruction.
Generalities of the research note that assistive technology is not a panacea. It is a spectrum of tools to assist the writer that work best when appropriate instruction accompanies their use.

**Impact of Assistive Technology**

Broad statements of assistive technology can be made through the culmination of the described research. Hetzroni and Shrieber (2004) quoted the work of Owston and Wideman (1997) stating,

“A longitudinal study comparing two groups of elementary school students with and without access to a word processor found that the students who were using word processing demonstrated significantly greater writing competence in meaning, in content quality, in writing form, and in surface features” (p. 2).

Quinlan’s (2004) research found that speech recognition software reduces the “bottleneck” that impedes the progress of writers who struggle with handwriting. Quinlan also found that students with learning disabilities in writing improved in fluency and accuracy with the use of speech recognition. In contrast, however, Quinlan found that speech recognition made no impact with fluency or accuracy with students who were more fluent writers. Zhang (2000) summarized a collection of research that demonstrated that word processing helped to increase text quantity while other summarized research found students wrote longer texts with pencil and paper. Zhang (2000) noted research that demonstrated no difference between handwritten work and writing with a word processor. In Hetzroni and Shrieber’s (2004) research, there was evidence of effectiveness. Work was cited as finding that word processing resulted in quality improvement for K-12 writers. Students with learning disabilities had a marked improvement in quality. Williams’ (2002) research found that students expressed less writing apprehension and produced longer text with the use of assistive technology. Englert et al. (2007) found that when students had assistive technology, they were more likely to utilize the writing tools that had been introduced by the teacher. Hetzroni and Shrieber (2004) cited research that found when technology is integrated into classroom instruction, it can address the needs of students with learning disabilities. They also noted a study which found that, with the use of a computer, students with learning disabilities demonstrated improvement in organization, motivation, and clearness of output. Hetzroni and Shrieber’s (2004) research found that word processing caused
a reduction in spelling errors, facilitated the organization of writing, and reduced the mistakes students made when reading their own texts.

In spite of the variation of results found in research, Zhang (2000) expressed optimism about assistive technology, noting research that found that technology, including computers, offer great potential to bolster the academic demands of all ages of people with learning disabilities. Evidence validates use of assistive technology for students with learning disabilities in writing. That being the case, further study into implementation must be investigated.

Factors Impacting Implementation

The evidence of the effectiveness of assistive technology for students with writing learning disabilities clearly supports its use. The optimistic portrayal of assistive technology seems to indicate utilization without reservation. As is the case with all research, the research to date on the use of assistive technology with students with specific learning disabilities has bred a multitude of questions. Zhang (2000) stated that further study is needed to determine how to best include technology into the classroom. Englert et al. (2007) noted that further research is needed to determine the connection between the implementation of technology and the level at which students achieve. Zhang (2000) suggested that if it is found that assistive technology is advantageous, further research is needed on how to incorporate them into the classroom.

Suggestions for further research prompt research on effective implementation of assistive technology by teachers. The research further suggests challenges teachers are facing as they attempt to implement assistive technology for students with learning disabilities in writing. Are teachers using assistive technology? If teachers are using them, are they using them effectively?

Research reveals that one reason teachers use assistive technology in a limited fashion is that they often lack the education and training. Lahm and Sizemore (2002) interviewed professionals, teachers included, responsible for making assistive technology decisions in schools. Eighty-three percent did not feel that their educational background prepared them for assistive technology use. Their interviewees discussed that assistive technology was not a common intervention during their college years. Several of them wondered if current teacher education might be better preparing their candidates for work in this field. Thorkildsen (1994) discovered the dynamic of the lack of appropriate teacher training, stating that, while assistive technology is researched and developed, training is often not effectively addressed. Thorkildsen also found that the majority of teachers who work with students with special needs have not had
an education that has included the use of devices for education adaptation. In a synthesis of education technology literature, Edyburn (2004) delved into the plethora of information in technology, suggesting that there is such a high rate of change with new technologies that teachers are challenged to stay current in their education about such technology.

Zhang (2000) addressed the issue of education, noting that practicing teachers graduated in an era lacking exposure to technology that current graduates have. Additionally, Zhang noted that even more recent graduates demonstrate an obvious weakness in applying available technology. Bryant and Bryant (1998) researched the use of assistive technology to facilitate participation of students with learning disabilities in the cooperative learning environment. While this research found assistive technology to be helpful, Bryant and Bryant (1998) noted research that identified barriers to use. Specifically, despite the fact that teachers rated themselves as “proficient” with technology, the assistive technology complexity and required time for training functioned as obstacles in implementation. Furthermore, while colleges of education are integrating technology education into their programs, there exists a problem with generalizing that knowledge to classroom realities. Evidence seems to suggest that teachers are not fully prepared through education and training to effectively implement assistive technology in their classrooms.

Researchers have recommended ongoing professional development that includes study and problem solving among teachers as a way to transform schools through education of teachers (Feiman-Nemser, 2001). According to Ball and Cohen (1999) professional development is mandatory to produce significant change in instruction, which has been recommended as a need by researchers in the area of assistive technology (Edyburn, 2000). Feiman-Nemser’s (2001) research stated that teachers must know the theories and facts, the way to connect the ideas of the subject, and the proven rules of the subjects they teach. Ball and Cohen (1999) added to this stating development of pedagogy is necessary for teachers to disseminate their knowledge of the content. Learning is a primary role of practicing teachers, not just pre-service teachers (Feiman-Nemser, 2001). She suggests effective professional development continues the learning process for teachers. Ball and Cohen placed emphasis on the building of collegial relationships for professional development. Thoughtful discussions, including discourse, among professionals prompts improvement as they share challenges (Ball & Cohen, 1999). Teachers need the freedom to try new practices, look into the problems of those new practices, and analyze
situations that evolve with the new practice (Feiman-Nemser, 2001). “This means turning confusion into questions, trying something out and studying the effects, and framing new questions to extend one’s understanding” (Feiman-Nemser, 2001, p.1030). Researched based practices for professional development could address implementation issues of assistive technology.

Another factor found by researchers that inhibits effective use of assistive technology can be grouped under the category of teacher attitude. Some teachers are simply reluctant to use assistive technology. Weston (2004) found research indicating that teachers were hesitant to part from teaching techniques on which they have historically relied. Lahm and Sizemore (2002) noted several studies revealing that one barrier to implementation was a less than positive attitude towards and a fear of technology. Zhang (2000) also referred to the fear factor by suggesting fear caused teachers to avoid implementation of instructional technology. In Weston’s (2004) exploration of implementation of technology, he noted research that highlighted that people do not always do what they are told to do. Just because technology is available and suggested by authorities, including the federal government and school administrators, does not mean it will be implemented. The reality is that some people are “downright resistant” (p. 54). Research from the National Center for Educational Statistics (2000) and research cited by Weston (2004) found that technology implementation in schools is accompanied by a less than enthusiastic response to do so. There exists a strong presence of apathy towards educational technologies among teachers. Weston (2004) noted research that found that teachers need to see a profound educational impact to implement technology. Weston (2004) noted further research indicating that negative teacher attitudes regarding technology have a stronger impact on implementation than limited access. Since implementation is impacted by attitude, the research suggests there is wisdom in further investigation regarding a notable presence of negative attitudes towards technology among teachers.

A third factor that strongly impacts the use of assistive technology is the accessibility of them, including whether devices are compatible with the school’s existing technology. “Compatibility, in strictly technical terms, involves software fitting operating platforms, hardware, software plug-ins, and other technical infrastructure” (Weston, 2004, p.58). Weston (2004) noted that the problems with compatibility in this technical sense come from designers’ challenge to foresee how their assistive technology will function in a classroom that is not
controlled for experimental purposes. Problems that typically impact technology in a school are related to programming and capabilities. Schools may not have the specialized features such as video cards, processing capabilities, and monitors to run the applications effectively. When this is the case, implementation may fail to occur. Thorkildson (1994) discussed how the barriers to getting assistive technology increase as the demand for them also increases. Some of the barriers cited include insufficient funding or an inadequate understanding of where funding can be found and school districts’ demand that the assistive technology stay in the classroom. Zhang (2000) discussed the issue of access from a different concern, noting that federal regulations do not allow students to be alone in a computer lab. That being the case, teachers confront obstacles of providing the individual instruction needed by students with a learning disability in writing. Unfortunately, classrooms have only a few computers. Some students are given that computer access, but teachers must meet the needs of all students and are not necessarily meeting the individual demands of students with learning disabilities. Yet another angle concerning access was addressed in Weston’s (2004) report that found that the classroom climate, demanding attention to behavior and time management, creates obstacles to teachers implementing the changes necessary to include technology in their instruction. Weston (2004) and Bryant and Bryant (1998) found that teachers have a strong desire to implement changes in instruction that include technology, but the requirement of time for training, funding and integrating the technology have all proven to be barriers. These barriers impact access to the assistive technology. Access to assistive technology is interrupted by technical compatibility, appropriate time to learn how to use them, insufficient funding to pay for assistive technology, and the daily demands of the classroom.

Weston (2004) stated the obvious. Evaluation of assistive technology is based on the implementation of them. It is important for researchers to know if a technology actually reaches implementation and, if it does, how well it works? Weston further supported this notion summarizing research that noted the climate needed for implementation. That climate includes easy access to hardware and applications, effective technical support, professional development, a school culture of collegiality and the use of technology with some exemplary users on staff. Rationale and Purpose

The laws of NCLB and IDEA were created with a goal of improving instruction for student with disabilities. These laws measure improved instruction by including most students
with disabilities (one percent of the school population, about one-tenth of those with disabilities) in assessments of educational practice. One ramification of these laws is an emphasis on giving students with disabilities access to the general curriculum (Hallahan and Kauffman, 2006). One way to facilitate that access is through the use of assistive technology. Edyburn (2006) reminded that the 1997 reauthorization of IDEA states that assistive technology must be considered in the individual education plan (IEP) for students with disabilities.

While the laws state that assistive technology must be considered, previously noted research indicates that teachers confront obstacles that impede and possibly prevent implementation of assistive technology. Suggestions for future research cited by several authors urge the exploration of assistive technology implementation and integration. Bryant and Bryant (1998) noted research that stated the need for further research on models for the integration of technology. Bryant and Bryant (1998) narrowed this down further by positing the need to learn from schools where effective use of assistive technology has occurred. Those schools have found ways to effectively integrate assistive technology and have overcome barriers in such a way as to incorporate assistive technology to the benefit of its students. Hetzroni and Shrieber (2004) suggested that future research should investigate the significance of assistive technology for secondary students. Edyburn (2004) stated, “Certainly the current context of No Child Left Behind demands increased research and development efforts associate with knowledge utilization” (p.69). Later, Edyburn (2006) concluded that, “While advances in technology have made the potential of cognitive prostheses more viable than ever, much work remains to be done to understand the array of implementation issues that will impact their value and use for students with mild disabilities” (p.64). Edyburn (2000) revealed a multitude of issues to be addressed. Some of the highlighted issues include the demand for assistive technology to play a central role in the preparation of special education teachers, the paradox of teachers facing the demand to consider assistive technology when they do not know what is available, and the discrepancy between the effectiveness of assistive technology and the current practice in using them. This group of researchers prompts future research on implementation of assistive technology.

The purpose of this study was to investigate teacher knowledge and use of assistive technology. Another concern addressed was the obstacles that impede implementation of such devices.
The hypothesis was: While research supports the effectiveness of assistive technology in writing to assist students with learning disabilities and the law demands that they be considered, a substantial percentage of teachers are not using the devices or are only using them in a limited fashion due to educational limitations of the teacher and other barriers to implementation.

In addition to the formalized hypothesis, the following research questions were also examined.

RQ1: What assistive technology for writing, if any, do teachers employ?

RQ2: What would prompt teachers to further employ assistive technology for students with specific learning disabilities in writing?

RQ3: Do teachers value the use of assistive technology? Does the value they place on them affect implementation?

Method

The purpose of this study was to investigate, through teacher surveys, the validity of the hypothesis that a substantial percentage of teachers are underutilizing assistive technology for students with learning disabilities in writing due to various barriers to implementation. The instrument used was modified from a previous instrument created by Parker (2006), used to measure use of instructional software. His purpose was to collect information pertinent to teachers’ knowledge of assistive technology, the challenges that obstruct the use of assistive technology, whether or not assistive technology is employed by teachers, what would prompt further use of assistive technology, and the value teachers see in using assistive technology as a tool for instruction.

Participants

The participants in this research were special education teachers from Ohio. The list of potential survey recipients was found on the Ohio Department of Education web site (Ohio Department of Education, July, 2007). In an effort to view use of assistive technology in diverse settings, the survey was conducted with a random sample of 112 teachers from the population of over 18,000 special education teachers in Ohio. One or two participants per page were selected by finding teachers with verifiable employment and contact information. Verification was gathered through school websites. The demographic information sought from participants included highest degree held, primary teaching assignment, age, years of teaching experience, year of most recent college course, and data from the Ohio Department of Education report card.
Demographic information from the 61 respondents, representing a 54.5% response rate, was collected and documented. Much of the gathered data for this instrument were compared to national data gathered, as seen in Table 3, in a report by Boyer and Mainzer (2003). While the data from this present research and the research of Boyer and Mainzer demonstrate differences, some trends were revealed. In both cases, a high percentage of special educators hold a master’s degree, males represent a small percentage of the special education work force, and the median age was about 40 years old. These similarities seem to indicate that the gathered data from Ohio special education teachers may be representative of the national population of special educators.

Other demographic data collected on the respondents included primary teacher placement, years of teaching experience, and the year of the most recent college course taken. The majority, 62.7%, of the respondents chose “mild/moderate educational needs” as their primary teaching assignment. Moderate/intensive educational needs was chosen by 25.4% of the respondents. The remaining respondents replied as follows: gifted 6.8%, hearing impaired 1.7%, and other 3.4%. No one chose visually impaired as the primary teaching assignment. Ninety one point four percent of the respondents said they have students with learning disabilities in their classrooms. The range of years of teaching experience spanned from 1 to 33 years. The mean years of experience was 15.73 years. The year of most recent college courses taken ranged from 1995 to 2007.

The remainder of the demographic data was collected from the Ohio Department of Education website (Ohio Department of Education, July, 2007). The data was found through Education Management Information System data warehouse reports. The information was gathered from the State Report Cards issued to the school in which the participants taught. A comparison was made between the responders and the non-responders. The goal was to note if there was a link between the responders and their report card data and non-responders and their report card data. The data gathered from each report card were the school’s designation, percentage of graduates, percentage of white students, percentage of economically disadvantaged students, percentage of students with limited English proficiency, and percentage of students with disabilities. Figure 1 reveals that more responders than non-responders came from schools ranked with an excellent or effective report card designation. In fact, 81.3% came from those two designations. In Table 5, the demographic information of responders and non-responders was averaged. On average, the responders came from schools with a higher percentage of
graduates, higher percentage of white students, and lower percentage of economically disadvantaged. The percentage of students with limited English proficiency and percentage of students with disabilities did not reveal a notable difference.

Procedure

The instrument (see Appendix A) used was a 10 question survey. A combination of online and paper surveys was used. Individuals who did not respond to the initial e-mail invitation within one week were sent an e-mail reminder with the survey link available. Those who did not respond to the electronic survey were sent a hard copy approximately four weeks after the initial e-mail survey had been sent. All participants were given a recruitment letter explaining the project (see Appendix B) and requesting their participation. An informed consent form was completed by all respondents (see Appendix C). The present research received approval from the Institutional Review Board for Human Subjects Research (See Appendix D).

Instrumentation

The basis for this research survey was a study conducted by Parker (2006). His project included the use of a 44 question survey about technology knowledge, use, and beliefs by general education teachers. Parker developed a Likert-type survey with the following purpose:

The purpose of this study was to examine the use of technology in the general education classroom. Specifically it examined how the educational level, teaching assignment, age, years of service, and type of educational certification affect general education teachers use of technology to help students with learning disabilities in their integration into the general education setting. Furthermore, this study investigated general educators’ knowledge of technology applications and its effectiveness in helping students with learning disabilities in the general education setting. (Parker, 2006, p. 5)

He systematically collected data about teacher behavior, underlying attitudes, beliefs, and intentions. The original survey instrument was created using Leedy and Ormrod’s (2005) guide for the construction of a questionnaire (Parker, 2006).

Modifications were made from the original survey instrument to address specific assistive technology rather than instructional software. The instrument modifications also were made to address brevity in an attempt to encourage greater participation.

The current instrument paralleled Parker’s instrument. Both instruments asked participants their beliefs about technology. Parker did this with four questions, but the current
instrument formatted them into 1 four-part question. Parker then asked participants to rank their use of the technologies relevant to his research through nine questions. The current instrument formatted this to a four-part question pertaining to assistive technology used for learning disabilities in writing. Both instruments sought if teachers viewed specific technologies as an effective accommodation and if they believed that assistive technology helped students with disabilities learn the curriculum more efficiently. Parker’s instrument had 11 questions, and the current instrument had 2 five-part questions to seek this information. Parker’s survey concluded by asking participants to make any additional comments and to list instructional software programs participants used. The current instrument formatted this question into two extended response questions asking what assistive technology participants used and what would prompt further use of assistive technology. Demographic data collection duplicated Parker’s research with the exception of teacher placement. This was to address the contrast of Parker’s research of general education teachers and current research of special education teachers.

Generally, Parker’s instrument asked four questions about each instructional software investigated. The current instrument took those questions and re-formatted them into a style that attempted to enhance response rate. Parker’s wording of questions was kept in tact, and his Likert-type scale was duplicated. The technologies used for investigation in the current instrument were based on research done by Montgomery and Marks (2006). Their research grouped assistive technology for students with a learning disability in writing into organizational programs, word prediction, voice output, and spell checker/thesaurus/grammar checker.

Data Analysis

The data were analyzed using the following statistical methods. Descriptive statistics such as means and range were used to analyze demographic information. Means were also used to describe the state profile of participant’s schools, including percentage of graduates, percentage of white students, percentage of economically disadvantaged students, percentage of students with limited English proficiency and percentage of students with disabilities. Calculations included comparing the responders with the non responders to determine the kinds of schools responders came from. Correlations were made between the number of years of teaching experience and responses to questions regarding value and use of assistive technology. Correlations were also made between the most recent year of college course work and responses to questions regarding value and use of assistive technology. Correlations between variables
were made. Other comparisons, such as t tests and ANOVA, were not used due to the homogeneity of responses.

Results

The survey was conducted with a random selection of 61 special education teachers across the state of Ohio, comprising a 54.5% response rate. The results revealed that special education teachers value the use of technology but have had limited experience using assistive technology for students with learning disabilities in writing. About half of the respondents listed one or two types of assistive technology they have used including a wide range of assistive technology. As teachers were asked what would encourage further use of assistive technology, the largest percentage suggested they needed more training and increased resource availability. The next largest percentage expressed that they would use assistive technology if student need prompted it.

*Assistive technology for Writing Used by Teachers*

Research question one sought to discover information about teacher use of assistive technology. Two questions in the survey gathered data on this issue. More than 40% of the respondents said they have never used three of these technologies. Between one and 5.5% responded that they “always” used the three technologies. Again, spell checker/thesaurus/grammar checker was shown to be used more; 20.3% said they “always” use it, and 32.2% said they usually use it. Further details of this data are revealed in Figure 4. An open-ended question asked teachers to list any specific technology they used. The responses included a plethora of devices: Boardmaker, tape recorders, Write Out Loud, Kurzweil, Zoomtext, Earobics, Smart Board, CPS system, Power Point, Math Rock, Inspiration and Kidspiration, switches, taped books, Intellitools and Intelliekeys, Accel Reader, Accel Math, Kurzweil, Brail-N-Speak, the internet, Classworks, word processing, CoWriter, Edmark Reading Program, Premier AT, Say It With Symbols, Pictures Paired, point books, Study Island, Orchard, and One More Story. This data were analyzed by determining the number of assistive technology listed by each participant. Twenty-four of the respondents answered this question. Of these special education teachers, 80% wrote two items. The one or two types of assistive technology that teachers wrote in were a mix of the above mentioned assistive technology. These data are presented in Table 2. They did not reveal a consistent use of any particular assistive technology.
Prompt Further Use of Assistive Technology

The survey data revealed issues that impact implementation, addressing research question two. The largest obstacles to use of assistive technology were training and availability of the particular resource. Sixty-four percent of the respondents expressed this as their primary need in order to implement assistive technology. It was also noted that 28.4% of participants said they would use assistive technology if their students needed it. The remaining concerns of teachers noted through this research included: more time, small class sizes, limitations of assistive technology, and seeing the assistive technology as a distraction to students. Table 4 reveals the data regarding things teachers said would encourage them to further use assistive technology.

Teacher Value and Implementation of Assistive Technology

Nearly 95% of the respondents agreed or strongly agreed that technology brings value to student learning. While few respondents who stated that they had no experience or training using technology, 10.5 percent had no experience using technology to include students with learning disabilities, and nearly 30 percent had no experience using assistive technology for writing. A significant number of respondents had no experience with assistive technology in the current instrument. One-fourth to one-third of the respondents had no experience with four of the five categories. Only 8.3 percent responded that they had no experience with spell checker/thesaurus/grammar checkers.

Almost 95% agreed or strongly agreed that technology is valuable to student learning. However, more than one-fourth of them had no experience with assistive technology. Figure 2 summarizes the data gathered on teacher beliefs regarding technology. Figure 3 reveals participant beliefs regarding assistive technology that address learning disabilities in writing. The data gathered addresses research question three. “Do teachers value the use of assistive technology? Does the value they place on them affect implementation?”

Comparisons were made between year of most recent college courses taken and beliefs and use of technology. A correlation was found between year of most recent college courses and the value teachers believed technology brought to their students ($r = .301, p = .03$). In particular, the more recently a participant had taken a course, the more likely they were to strongly agree that technology brought value to students.
Comparisons were also made between years of teaching experience and beliefs and use of technology. A negative correlation was found between years of teaching experience and the value teachers believed technology brought to their students \( (r = -.309, p = .02) \). Specifically, the less years of teaching experience the participant had, the more likely they were to strongly agree that technology brought value to students. When comparisons were made between years of teaching experience and belief that organizational/outline programs help students with learning disabilities learn the curriculum more efficiently, a negative correlation was found \( (r = -.337, p = .05) \). This correlation indicated that the less years of experience a participant had, the more likely they were to strongly agree that organizational/outline programs were beneficial. When the remaining data were compared there was no further evidence of correlation between variables.

Discussion

A survey was conducted with a random sample of special education teachers across the state of Ohio. The instrument sought the value teachers place on assistive technology and how that impacts implementation, teacher knowledge and use of assistive technology, and what would prompt teacher use of assistive technology. Value placed on technology, current education, and years of teaching experience did not seem to cause participants to feel adequately trained to use assistive technology or have an impact on how much they integrated assistive technology into their instruction.

The hypothesis stated that while research supports the effectiveness of assistive technology in writing to assist students with learning disabilities and the law demands that they be considered, a substantial percentage of teachers are not using the devices or are only using them in a limited fashion due to education limitation of the teacher and other barriers to implementation. The research supported this hypothesis. While nearly all of the respondents agreed that technology is valuable to student learning, more than one-fourth of them noted that they had no experience with assistive technology. Almost half of the respondents have never used or seldom use organizational programs, voice output, or word recognition. With the exception of spell checker/thesaurus/grammar checker, less than one-fifth stated that they used specific assistive technology usually or always.

The demographic information gleaned from the participants created points of interest. Nearly every respondent completed a question asking the year of their most recent college
course. The range of that data was from 1995 to 2007. Of the 57 who responded to this question, 49 had taken courses within the last five years. In Lahm and Sizemore’s (2002) research, teachers responded to how they felt about their education in relation to assistive technology. Eighty-three percent of them did not feel their education prepared them adequately. Their respondents proposed that current teacher education might be better preparing them for work in this field. While the present research did not ask specific course work, generally speaking, they had had current education. These participants did not feel that they had been adequately trained in spite of recent course work. This was indicated through more than half of the respondents who felt they needed more training and resource availability to more effectively use assistive technology. In spite of the fact that nearly three quarters of the respondents had earned a master’s degree, respondents still felt they needed further training. This data seems to indicate that current teacher education programs are still not adequately preparing their students to effectively use assistive technology. However, there was a correlation between more recent course work and the value teachers believed technology brought to their students.

The current instrument asked teachers the number of years they had been teaching. The purpose was to find if the number of years of teaching experience impacted whether or not a teacher used assistive technology. The range for those numbers was from one to 33 years with a median of 12 years of teaching experience. It did not appear that years of experience were related to use of assistive technology. However, statistically significant correlations were found between years of teaching experience and the value teachers felt technology brings to their students and the value they saw in organizational/outline programs. The less experience a teacher had, the more value they placed in technology. This information stands beside data found by Parker (2006). Parker found that while the majority of his respondents had not used computer-assisted instruction, those that reported using it at least half of the time had been teaching from six to 20 years. This may indicate that more special education teachers have become aware of assistive technology and therefore, the users of assistive technology are representative of the general population of special educators.

The collection of demographic data seems to indicate that, among these participants, special education teachers continue to feel their education is not preparing them for the effective integration of assistive technology. Also, there was no correlation between years of teaching experience and use of assistive technology in the classroom. This is a point of interest because
one might suspect that teachers with less experience would have assistive technology training within their teacher preparation programs. While the participants in this study tended to come from districts with a higher designation on their report card, their use of assistive technology was limited. One might suspect that teachers from wealthier districts would use assistive technology more because of better access to the technology. If less experienced teachers and teachers from wealthier districts are either not using assistive technology or using them minimally, it could be indicative that more seasoned teachers and teachers in poorer districts would be using assistive technology even less.

The current study sought teacher value and beliefs about technology and assistive technology. While respondents indicated that they felt technology was beneficial to education, a high percentage of them had little to no experience with assistive technology for students with writing disabilities. One might expect that if teachers value technology, it would positively impact implementation. This research indicates that there remains a chasm between the belief that a teaching method is beneficial and the ability to effectively implement that method. What impedes implementation will be discussed later, but the present study seems to indicate that there is not a positive relationship between value and beliefs regarding technology and implementation of it. Weston (2004) noted that successful implementation is related to beliefs. He went on to cite research by Ely (1999) who identified conditions that cultivate or impede implementation. He found that educational technology was more likely to be used when characteristics such as commitment, peer participation, and leadership were in the educator environment. Additionally, teachers participated more readily when extrinsic rewards, such as extra pay, and intrinsic rewards such as satisfaction with student performance were present. Weston found that teachers needed to see a powerful benefit to implementing educational technology. He found that these factors had a more powerful impact on implementation than did limited resources and access.

As the data unfolded around teacher beliefs and technology, it became evident that participants seemed to view technology as valuable to student learning. The paradox is that while participants appeared overwhelmingly to view general technology as positive for student learning, more than one-fourth of them have no experience with assistive technology. Perhaps Weston’s (2004) conditions that cultivate or impede implementation play a role in this disparity. While teachers see technology as valuable, they may be lacking the extrinsic and intrinsic awards they need to actually implement something they view as valuable.
One of the goals of this research was to find out what assistive technology for writing teachers use. More than half of the respondents chose never or seldom about the use of organizational programs, voice output, or word prediction. Less than 25% chose usually or always. When special educators were asked to list any assistive technology they have used, 30 items were listed by 24 participants.

The numbers revealed that a high percentage of teachers never or seldom use assistive technology known to enhance the writing of students with learning disabilities in writing. Lahm and Sizemore’s (2002) research found factors that contribute to or hinder actual use of assistive technology. Their research focused on the people who make decisions regarding the use of assistive technology. Decisions to use assistive technology are impacted by parent and family expectations, money and time limitations, and fearful attitudes about technology. Weston (2004) noted the work of Becker, 1998; Cuban, 2002; National Center for Education Statistics, 2000 which explained that the increased amount of personal computers misleads people into believing that computers are used in schools more than they actually are. They also suggested that issues of access, cost and poor technical support as reasons for slow implementation.

Perhaps what this research suggests is that limited assistive technology use is impacted by access, cost, and poor technical support. While some teachers are willing to pursue the use of assistive technology because of personal interests, many teachers hesitate to use them or use them for a limited time. Thorkildsen (1994) highlighted an additional problem that may explain the people who claim seldom use of assistive technology. He found that nearly 30% of devices were abandoned due to the performance of the device, change in user needs, and convenience of use.

When teachers were asked what might encourage them to further use assistive technology, more than half of the respondents indicated that they needed more training and resource availability. This research bolstered the research of several other research efforts. Lahm and Sizemore (2002) found that most participants in their research did not feel their education adequately prepared them for implementation of assistive technology in spite of the fact that most of their participants held master’s degrees. Edyburn (2004) suggested that the high rate of change for new technologies posed challenges to teachers’ learning. Zhang (2000) also noted that even recent graduates demonstrated a weakness in applying assistive technology.
McGregor and Pachuski, 1996, (as cited by Bryant & Bryant, 1998) found that the time required for training functioned as an obstacle to implementation.

Student needs was stated by more than one-fourth of the respondents as something that would prompt further use. Weston (2004) cited MacArthur’s 1998 research that found teachers must see a powerful learning benefit for the student in order for full implementation to occur. This may indicate that teachers do not see how assistive technology will benefit their students or are not aware of assistive technology created to help students with learning disabilities.

In the literature review, it was noted that teachers themselves wondered if recent college graduates had more exposure than they had. That has not proven to be true in the survey data collection. While one might suspect that age, years of teaching, and most recent educational experience might relate to use of assistive technology, the survey did not indicate such a relationship. In spite of a high percentage of the highly educated participants being from wealthier districts, it was found that assistive technology is minimally implemented.

Implications

The present research highlighted issues to be addressed regarding the effective implementation of assistive technology. The research indicated the discrepancy between teacher beliefs about the benefits of technology to instruction and implementation of assistive technology. Another issue that evolved was the call for more effective teacher training with assistive technology. The need for training was revealed through two components of the data collection. More than 64% of participants said that more training and resource availability would prompt them to further implement assistive technology. More than 28% of participants expressed that student needs would prompt them to utilize assistive technology. Possible implications from this research indicate that training through professional development may be the needed impetus to facilitate proper utilization of assistive technology for students with learning disabilities in writing.

When considering the best avenues to disseminate training for assistive technology, one needs to consider research based practices that indicate positive impact on teacher performance. Reflecting back to the literature review, the work of Ball and Cohen (2001) and Feiman-Nemser (1999), pointed to promising possibilities through carefully planned professional development.

One step in professional development is to help teachers to understand the subject they teach. Ball and Cohen (2001) suggested that teacher education and professional development
need to be designed in a way that cultivates inquiry oriented teaching. With regards to implementing assistive technology, many teachers are approaching them as a “new subject.” Assistive technology for students with learning disabilities, are relatively new. Part of teaching about assistive technology as a new subject includes teaching educators to see where assistive technology can benefit learners. Teachers need to have freedom to utilize professional judgment and approach the use of assistive technology through inquiry. Teachers need to know more than procedures and information; they need to know meaning and connections (Ball & Cohen, 1999). This suggests that while teachers need procedures and information about assistive technology, they need to see meaningful connections to their instruction. Teachers need to not only have command of the content they are teaching but also need strong pedagogy. Feiman-Nemser (2001) suggested pedagogy requires teachers to use alternative explanations for knowledge that students find difficult. Good teachers are able to approach assessment, curriculum, and instruction in multiple ways (Feiman-Nemser, 2001). Assistive technology can be yet another way and need to be added to teachers’ pedagogical practices.

Another aspect of effective professional development is the need to help teachers view it not as an isolated, fragmented event but as an ongoing process. Teachers need to learn before they teach and while they are teaching (Ball & Cohen, 1999). Feiman-Nemser (2001) stated that pre-service teachers need to understand a primary role of teaching is learning. She also suggests teachers need opportunities to test theories and use the knowledge they are getting from the education. Teachers must be participants in substantive and sustained learning. If teachers philosophically understand that knowledge must be ongoing throughout their careers, perhaps they will be able to expand and morph their knowledge as it pertains to implementation of the ever-changing world of assistive technology.

Professional development can be created in a way that facilitates teachers working together in collegial relationships. Indeed newer approaches to professional development involve teachers doing the talking, thinking, and learning through critical conversation (Feiman-Nemser, 2001). This body of research may indicate that teachers need to increase knowledge of assistive technology through understanding them as a subject, but additional efforts need to be made that better facilitate implementation. Professional development that encourages teachers learning from teachers may hold a key to increased use of assistive technology. One way this collegiality can take shape is through strong mentoring programs. Feimen-Nemser (2001)
suggested that this occur over three years. This relationship traditionally allows the novice teacher to learn from the experienced.

To further implement assistive technology, a paradigm shift may include novice teachers sharing their understanding of assistive technology, as assistive technology becomes an increased piece of teacher preparation programs, and having the freedom to implement them thus having a mentor/mentee relationship where both teachers share the role of learner/teacher. Feimen-Nemser stated that teachers must be able to ask themselves and their colleagues hard questions, proceed by trying something new, investigate student learning, and explore new perspectives. Ball and Cohen (1999) bolstered this by stating that serious education contains the element of thoughtful discussions and observations among teachers as it is the conduit for communication of ideas, practices and values. Possibility exists through utilizing teachers who are effectively implementing assistive technology working in collegial relationship with their peers in ways that cultivate learning while teaching.

Assistive technology provides possibilities for students who have learning disabilities in writing. Feiman-Nemser (2001) stated emphatically that teachers need to form visions of what is possible through teaching. She suggested that, “This means turning confusions into questions, trying something out and studying the effects, and framing new questions to extend one’s understanding” (p. 1030). A purpose of professional development is to create an environment where knowledge and skills are enhanced, and teachers find effective methods to help students learn. Professional development focusing on implementation of proven effective assistive technology holds promise for improved writing performance for student with disabilities in writing.

Limitations

This study concentrated on special education teachers within the state of Ohio. The original appeal for respondents included 112 teachers. Participants were selected from 18,000 special education teachers, listed on the Ohio Department of Education web site (Ohio Department of Education, July, 2007). Sixty-one teachers responded to the survey. While efforts were made to glean information from a sample of teachers that would represent all demographic data, a higher percentage of the respondents came from schools ranked as excellent or effective in their report card designation. Additionally, respondents taught at schools with a higher percentage of graduates, a higher percentage of white students, and a lower percentage of
students who were economically disadvantaged. Of note is that the bulk of participants had a master’s degree. Further research is needed with special education teachers who teach in wider cross-section.

Present research relied on teacher perception and self-reporting. No efforts were made to verify teacher responses. It is possible that teachers may or may not accurately report on their beliefs, implementation, and knowledge of assistive technology. Teachers shared what they thought would prompt them to further use assistive technology. Those suggestions would have to be implemented to verify the truth in those statements.

Conclusion

Assistive technology for students with learning disabilities in writing holds great promise. Research demonstrates that writing improvements are possible for these challenged writers when there is appropriate implementation of these devices.

In the present research, it was found that the majority of the participants agree that technology brings value to student learning. In contrast, however, it was revealed that participants use assistive technology minimally. Participants suggested that increased training and resource availability would prompt further implementation of assistive technology. A strong representation of participants stated they would use assistive technology for students with disabilities in writing if they felt student needs demanded it. In spite of recent, higher education, and a strong representation of participants from affluent schools, assistive technology is under utilized.

Previous research indicated multiple issues that impact implementation of assistive technology including teacher value, presence of intrinsic and extrinsic rewards, peer participation, and leadership. Research has also indicated that teachers expressed optimism that more recently educated teachers would be better prepared to implement assistive technology. Present research did not indicate that current teacher education programs are facilitating assistive technology use. While there is a plethora of issues that impact implementation, with the data supporting the benefits of assistive technology to learners, it is wise to pursue avenues to better integrate assistive technology into the learning environment.

Professional development holds possibility for assistive technology implementation. Best practices in professional development focus on teachers viewing themselves as ongoing learners. A significant part of their learning can come from collegial relationships that cultivate asking
challenging questions, observing each other, and conducting productive conversation where teachers learn content and capability of assistive technology and work in an environment that allows teachers to implement new practices, evaluate themselves and their peers, and build pedagogical knowledge that includes assistive technology as an avenue to clearer understanding for students.
References


## Teaching and assistive technology

### 1. Beliefs and use of ATs

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>No Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology brings value to my students learning in my classroom.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>I have had enough training in technology to effectively use technology in my classroom.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Technology is helping to include students with learning disabilities into my classroom.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Writing assistive software is an effective accommodation to use with students with learning disabilities.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

### 2. I have used the following assistive technology in my classroom:

**Assistive Technology (AT):** "...any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customied, that is used to increase, maintain, or improve the functional capabilities of a child with a disability." (IDEA amendment of 1999)

<table>
<thead>
<tr>
<th>Never</th>
<th>Seldom</th>
<th>Half the time</th>
<th>Usually</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>organization programs (allow students to brainstorm and synthesize information easily)</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>voice output (computer &quot;reads&quot; orally the written text)</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>word prediction (writer types the initial letters and the computer gives a guessed list of words)</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>spell checker, thesaurus, grammar checker (traditional features of word processing software)</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

### 3. I believe that the following AT is an effective accommodation to use with students with learning disabilities.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>No Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>voice/speech recognition</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>organizational/outline programs</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>speech feedback</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>word prediction</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>spell checker/thesaurus/grammar checker</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>
2. Beliefs about ATs Cont'd

4. I believe that the following AT helps students with learning disabilities learn the curriculum more efficiently.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>No Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>voice/speech recognition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>organizational/outline programs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>speech feedback</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>word prediction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>spell checker/thesaurus/grammar checker</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Extended Response

5. If you are not using the ATs listed above, what might encourage you to use them?

6. Please use the space below to let us know if you have used specific instructional software not mentioned above. List the names of the programs used.

1.

2.

3.
4. Demographics -- Last Page!

7. Highest degree held
   □ Bachelor's
   □ Master's
   □ Doctorate

8. Main teaching assignment (select ONE):
   □ Gifted
   □ Mild/Moderate Educational Needs
   □ Moderate/Intensive Educational Needs
   □ Visually Impaired
   □ Hearing Impaired
   □ Other

9. Please respond to the following questions about yourself.
   your age
   □
   years of teaching experience
   □
   year of most recent college courses
   □

10. Do you have students with learning disabilities in your class/classes?
    □ Yes
    □ No
Appendix B

Participant Recruitment Letter

September 28, 2007

Dear ______________________,

As an intervention specialist, I am interested in special educators’ use of assistive technologies. I would like to ask for your participation in a short research study for my Master’s thesis.

The purpose of this study is to learn what assistive technologies you use in your classroom and your opinion about these technologies.

Participation involves completing the enclosed brief survey (5-10 minutes). Please return the completed survey in the addressed, stamped envelope. Confidentiality is assured; you have been assigned an ID number, and your name will not appear on any record.

Thank you for your help.

Sincerely,

Diane L. Bigelow, Miami University
Kings Junior High Intervention Specialist
Appendix C

Informed Consent

The purpose of this study is to investigate teacher knowledge and use of assistive technologies. Another concern to be addressed is the obstacles that impede implementation of such devices.

You will be asked to participate in a survey as part of this study. The survey has 13 questions. Participation is expected to take about five to ten minutes. No risks are anticipated.

In order to maintain individual confidentiality, you will be assigned an ID number, and all information gathered about and from you will be coded with that ID number. Your name will not appear on any record. All information collected will be maintained within the home of the researcher from Miami University.

Your involvement in this research project is voluntary. You have the right to withdraw from this project at any time. You may refuse to answer any and all questions without penalty. Withdrawal from this project, or refusal to participate, will not adversely affect you in any way. If you have questions or concerns, or would like more information about the study, please contact Mrs. Diane Bigelow (513-583-8696) or her advisor, Dr. Leah Wasburn-Moses (513-529-0409). If you have any questions regarding your rights as a participant in this project, you may also contact the Office for the Advancement of Scholarship and Teaching (513-529-3734 or humansubjects@muohio.edu) at Miami University.

I have read and understand the purpose of the project, the procedures, and my rights as a participant. I understand that submitting this survey indicates my agreement to participate in this project.
Appendix D

Miami University IRB Approval Letter

Date:  August 20, 2007

To:  Ms. Diane L. Bigelow, Educational Psychology
     Dr. Leah Wasburn-Moses, Educational Psychology, Faculty Advisor

From:  Jhan Doughty Berry, Director of Research Compliance
        Institutional Review Board for Human Subjects Research

Re:  Human Subjects Project:
     Special Educators Knowledge and Use of Assistive Technology for Students with Learning Disabilities in Writing

Thank you for submitting the above-referenced protocol to the Institutional Review Board for Human Subjects Research. The committee has reviewed and approved your proposal as Exempt Status category 1.

Your proposal approval number is:  07-039

Approval of this project is in effect until:  August 19, 2008

Should you decide to change your procedures relating to the use of human subjects in the above project, you must obtain approval from the Committee prior to instituting any changes.

Miami University policy requires periodic review of human subjects for all ongoing projects. If your project will continue beyond the approval date mentioned above, you will need to submit an Application for Continuing Review so that the committee may review your application in a timely fashion.

Please submit your next application for continuing review by:  July 19, 2008

On behalf of the committee and the University, I thank you for your efforts to conduct your research in compliance with the federal regulations that have been established for the protection of human subjects. Thank you for your attention to this matter, and best wishes for the success of your project.
Table 1

*Types of ATs and Their Functions*

<table>
<thead>
<tr>
<th>Type of AT</th>
<th>What AT does</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice/Speech Recognition Software</td>
<td>The writer dictates into a microphone and the voice is translated to typed text.</td>
</tr>
<tr>
<td>Organizational/Outlining Programs</td>
<td>Designed to assist with brainstorming, story webs, outlining. Prompts can also be a part of this technology.</td>
</tr>
<tr>
<td>Speech Feedback Software</td>
<td>This allows the computer to “read” text orally.</td>
</tr>
<tr>
<td>Word Prediction</td>
<td>The writer types the initial letters and the computer gives a guessed list of words.</td>
</tr>
<tr>
<td>Spell checker, thesaurus, and grammar checkers</td>
<td>These functions are part of most word processing software.</td>
</tr>
<tr>
<td>Number of ATs listed</td>
<td>Percent</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------</td>
</tr>
<tr>
<td>1</td>
<td>41.7%</td>
</tr>
<tr>
<td>2</td>
<td>37.5%</td>
</tr>
<tr>
<td>3</td>
<td>8.3%</td>
</tr>
<tr>
<td>4</td>
<td>12.5%</td>
</tr>
</tbody>
</table>
Table 3

*Special Education Teacher Respondent Demographic Information Compared to National Special Education Teacher Demographic Information*

<table>
<thead>
<tr>
<th></th>
<th>Current study</th>
<th>Boyer, Mainzer Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent with master’s</td>
<td>71.2% master’s</td>
<td>46.5% master’s</td>
</tr>
<tr>
<td>Median age</td>
<td>39 years</td>
<td>43.8 years</td>
</tr>
<tr>
<td>Percent male</td>
<td>8%</td>
<td>15.1%</td>
</tr>
</tbody>
</table>
Table 4

*What Would Prompt Further Use of ATs*

<table>
<thead>
<tr>
<th>Issue</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>More training and resource availability</td>
<td>64.1%</td>
</tr>
<tr>
<td>More time/small class size</td>
<td>2.6%</td>
</tr>
<tr>
<td>AT viewed as a distraction</td>
<td>2.6%</td>
</tr>
<tr>
<td>Student needs</td>
<td>28.2%</td>
</tr>
<tr>
<td>Limitations of AT</td>
<td>2.6%</td>
</tr>
</tbody>
</table>
Table 5

*State Profile of Participants’ Schools*

<table>
<thead>
<tr>
<th></th>
<th>Responders</th>
<th>Non-responders</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Grads</td>
<td>92.2%</td>
<td>88.2%</td>
</tr>
<tr>
<td>% White</td>
<td>81.4%</td>
<td>74.6%</td>
</tr>
<tr>
<td>% Economically Disadvantaged</td>
<td>30.6%</td>
<td>41.1%</td>
</tr>
<tr>
<td>% Limited English Proficiency</td>
<td>1.6%</td>
<td>1.2%</td>
</tr>
<tr>
<td>% Students with Disabilities</td>
<td>14.7%</td>
<td>15.1%</td>
</tr>
</tbody>
</table>
Figure 1. School’s Designation.
Figure 2. Participant beliefs regarding technology.

- Technology brings value to students learning in my classroom.
- I have had enough training in technology to effectively use technology in my classroom.
- Technology is helping to include students with LDs into my classroom.
- Writing assistive software is an effective accommodation to use with students with LD.
Figure 3. Participant beliefs regarding assistive technologies for students with learning disabilities in writing.

- I believe voice/speech recognition is an effective accommodation to use with students with LD.
- I believe outline programs are an effective accommodation to use with students with LD.
- I believe speech feedback is an effective accommodation to use with students with LD.
- I believe word prediction is an effective accommodation to use with students with LD.
- I believe spellcheck/thesaurus/grammar check is an effective accommodation to use with students with LD.
Figure 4. Participant use of assistive technologies.

- I have used organizational programs in my classroom.
- I have used voice output in my classroom.
- I have used word prediction in my classroom.
- I have used spell checker/thesaurus/grammar checker in my classroom.