THE USE OF VOICE RECOGNITION SOFTWARE AS A COMPENSATORY STRATEGY FOR POSTSECONDARY EDUCATION STUDENTS RECEIVING SERVICES UNDER THE CATEGORY OF LEARNING DISABLED

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ABSTRACT

This study expands on the current literature base that investigates the use of voice recognition software (VRS) as a compensatory strategy for written language difficulties often experienced by postsecondary education students receiving services under the category of learning disabled. The current literature base is limited to one study (Higgins & Raskind, 1995) which found that subjects' writing samples, completed with VRS, had higher holistic scores than the samples completed with a transcriber, and without assistance. While these findings are positive many questions remain unanswered. The research conducted in this dissertation investigated three such questions. The questions and corresponding findings follow.

1. After being trained on VRS will persons, in postsecondary education, receiving services under the category of learning disabled, continue to use it to complete their academic course work? Will they further use the software for purposes other than academic study? Two individuals continued to use the software. One of these two used the software for multiple purposes.

2. Does the ongoing use of VRS, by postsecondary education students receiving services under the category of learning disabled, improve their written performance when assessed with Fry's Readability Graph? Two subjects each submitted three writing samples: one completed without the use of VRS and two completed using VRS. One subject's grade level equivalency went from 4.5 (sample completed without using VRS) to 6.5 (samples completed using VRS). There was no change in the grade level equivalency of the writing samples for the second subject.
3. What are the contributing variables that influence the continued use, or non-use, of VRS by postsecondary education students receiving services under the category of learning disabled? Numerous variables emerged from the data including: time, access to a personal computer, ease of use, personal issues, use of standard English, the specific limitations associated with a person's disability, whether or not the subjects had other compensatory strategies in place, and the acquisition of the skills necessary to use the software.

The findings contribute to the field by providing a framework from which to assess who may or may not benefit from the use of VRS.
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Overview

Postsecondary education has been described as “America’s traditional gateway to the professions, more challenging jobs, and higher wages” (U.S. Department of Education Strategic Plan, 1998-2002). Yet persons with disabilities often experience limited access to and success in postsecondary education programs, resulting in poor employment outcomes (Wagner & Blackorby, 1996). In lieu of this, it is imperative that persons with disabilities begin to succeed in postsecondary educational programs. It is also imperative that we begin to understand the impact of new technologies and their effectiveness as compensatory strategies in academic and workforce arenas.

Over the past twenty years changes in the nation’s labor market have increased the importance of having a postsecondary education in order to be able to compete in the job market (Stodden, 2001). Whether it is college, adult and continuing education, or technical preparation, postsecondary education plays a major role in preparing persons for employment and career opportunities (American Council on Education, 1992). Students who continue their education after high school improve their preparedness for careers in today’s changing economy as they learn the higher order thinking and technical skills necessary to take advantage of current and future job market trends (Stodden, 2001).

Researchers have reported low rates of employment (Blackorby & Wagner, 1996; Frank, Sitlington & Carson, 1995), low earnings (Frank, Sitlington, & Carson, 1995), low rates of postsecondary school attendance (Blackorby & Wagner, 1996; Fairweather & Shaver, 1991), and low rates of independent living (Haring & Lovett, 1990) for persons
with disabilities after high school graduation. Employment rates for persons with
disabilities demonstrate a stronger positive correlation between level of education and
rate of employment than we see in statistical trends for the general population (Stoddard,
at 75.4% for persons with less than a high school diploma, 84.6% for those with a
diploma, 87.8% for persons with some postsecondary education, and 89.7% among
persons with at least four years of college. Proportionately, these labor force
participation rates increase even more sharply when compared to increasing levels of
education and persons with disabilities. Deplorably, only 15.6% of persons with
disabilities with less than a high school diploma currently participate in today’s labor
force. However, this participation doubles to 30.2% for those who have completed high
school, triples to 45.1% for those with some postsecondary education, and climbs to
50.3% for disabled people with at least four years of college (Reskin & Roos, 1990;
disabilities, a university education is highly correlated with vocational options and
financial success. Therefore, the cost of failure, both to these individuals as well as to
society is a pressing concern” (p.384-85).

Even when people with disabilities overcome barriers and enter postsecondary
education, evidence suggests that many of these students experience difficulty staying in
and completing their programs of study (Blackorby & Wagner, 1996; & Rose, 1992;
Witte, Philips, & Kakela, 1998). Failure to provide appropriate academic development
services, supports, and programs for students with disabilities may cause them to achieve
grade-point averages well below that of their non-disabled peers, which in turn may
hasten their withdrawal from postsecondary settings (Gajar, 1998). Further, Bursuck and Rose (1992) found that students with disabilities who earn a tangible certificate or degree take considerably longer to finish than nondisabled students. Clearly, postsecondary students with disabilities need more and better services, supports, and programs to access and be successful in postsecondary education and employment settings.

This is true for people with all types of disabilities including those with learning disabilities. Research indicates that the academic difficulties experienced by students with learning disabilities in elementary and secondary settings persist into adulthood (Gerber, Ginsberg, & Reiff 1992; Johnson & Blalock 1987). Moreover, an increasing number of secondary students with learning disabilities are choosing to continue their education (Higgins & Zvi, 1995). In 1991, 8.8% of full-time college freshmen reported having some form of disability, compared with 2.6% in 1978 (Henderson, 1992). Of the types of disabilities reported, learning disabilities were the largest and fastest growing group, increasing from 15% to 25% of all students with disabilities over the 13-year period (Henderson, 1992). A more recent study indicates that the number of postsecondary undergraduate students identified as having disabilities in the United States was found to be 428,280, representing 6% of the student body. Of this 6%, 45.7% identified as having a learning disability (National Center for Educational Statistics, 1999).

While these findings indicate an increase in the number of people with learning disabilities attending college, the data do not shed light on the number of students graduating. Murray, Goldstein, Nourse, and Edgar (2000), indicate that young adults with learning disabilities have low postsecondary graduation rates. Vogel and Adelman
(1992) state that people with learning disabilities tend to take longer to complete their program of study compared to their peers without disabilities. Similarly, findings from the National Longitudinal Transition Study (Wagner, Newman, D'Amico, Jay, Butler-Nalin, Marder & Cox, 1991) note that persons with learning disabilities have low rates of postsecondary school attendance; are less likely to attend 4 year colleges and university programs; and have low postsecondary school graduation rates.

Many people with learning disabilities who do succeed in postsecondary education have developed their own compensatory strategies (ways to circumvent deficits) through “trial and error” or via “training”, which help them to counterbalance their learning disabilities (Schumaker, Deshler, & Ellis, 1986). Even with the formation of compensatory strategies individuals experience persistent difficulties. Raskind (1993) indicates that although both remedial (ways to improve areas of deficiency) and compensatory strategies are beneficial for adults with learning disabilities, the compensatory approach “may offer the most expeditious means of addressing specific difficulties within particular contexts” (p 159). Raskind (1993) also discusses the frustration and burnout adults with learning disabilities experience as a result of years of remedial instruction that often yield little benefit. For individuals who have attempted remedial instruction and for those who become aware of their learning difficulties as adults compensatory strategies, as opposed to remedial instruction, may be the best option for handling the difficulties. Raskind (1993) further points to the appeal of immediate solutions to particular problems as a reason to support the use of assistive technology (AT) by adults. Some forms of AT can provide solutions that allow the individual to compensate for their disability.
One such form of AT is voice recognition software (VRS). VRS allows the user to operate the computer by speaking rather than using the keyboard and mouse. Using VRS, the user speaks into a headset-mounted microphone; the system then converts the spoken words to electronic text displayed on the computer screen and entered into a word processing document (Riviere, 2000). The document can be saved and edited. It can also be read back using a speech synthesizer. For persons with learning disabilities and or learning difficulties, who often face difficulties with written language and spelling, voice recognition allows them to use their oral language abilities, which precede and exceed their written performance (King & Rentel, 1981).

For persons with learning disabilities written performance is often an area of difficulty. Unfortunately, there is very little research related to disorders of written expression (Hooper et. al, 1994) and research on the etiology, developmental course, prognosis, and intervention for disorders of written expression (Lyon, 1996). Most information available about the prevalence of the disorder of written expression is based on studies of reading disorders or learning disorders in general (Luttinger, & Gertner, 2001).

Disorder of written expression is assumed to occur with a similar frequency to other learning disorders but the estimates of the number of individuals effected varies from researcher to researcher (Luttinger, & Gertner, 2001). Written expression, as noted by Johnson (1993), is the most prevalent of all learning disabilities. Lyon (1996) estimated that between 8% to 15% of school age children have deficits in written language whether or not they are identified as learning disabled. Blalock (1981) estimated that between 80% to 90% of persons with learning disabilities have disabilities
in written language. Others indicate that more than 90% of adults with learning disabilities report significant problems with writing and or spelling (Vogel & Moran, 1982). The problems frequently experienced are in handwriting, spelling, and written expression (Vogel & Moran, 1982). With written language problems affecting such a large number of individuals, compensatory strategies that could make the writing process easier and more productive should be investigated.

One such compensatory strategy is VRS. Many (Day & Edwards, 1996; Golden, 1998; Riviere, 1996) have anecdotally indicated the effectiveness of VRS but research supporting this is minimal. Extensive literature searches found one article that investigated the use of VRS in a postsecondary education setting with students with learning disabilities. In this study, Higgins and Raskind (1995) found that VRS is a statistically significant compensatory strategy in that, with its use, the holistic writing scores of the study participants were higher than when they wrote without assistance or with a human transcriber. The study was conducted under controlled conditions with a researcher serving as the transcriber. Higgins and Raskind (1995) did not indicate the length of time in which the essays were written (i.e. over the period of three weeks or all in the same day). Also, there is no indication as to whether or not the study participants continued to use the software outside of the controlled setting. Based upon these findings the current study expanded the research base and generated new knowledge by investigating the following research questions.

1. After being trained on VRS will persons, in postsecondary education, receiving services under the category of learning disabled, continue to use the software to
complete their academic course work? Will they further use the software for purposes other than academic study?

2. Does the ongoing use of VRS, by postsecondary education students receiving services under the category of learning disabled, improve their written performance when assessed with Fry’s Readability Graph (Appendix A)?

3. What are the contributing variables that influence the continued use, and or non-use, of VRS by postsecondary education students receiving services under the category of learning disabled?

By seeking to address the three proposed research questions this study will add to the existing literature through an investigation on the use of VRS by postsecondary education students, receiving services under the category of learning disabled, outside of a controlled setting. If VRS is used by postsecondary education students with learning disabilities it may assist in improving postsecondary outcomes (i.e., retention and completion), improving written language performance, improving confidence in the ability to express oneself in writing, and opening up professional options that may otherwise not be accessible. VRS may also open up postsecondary educational options for future generations of students with learning disabilities.

Definition of Terms

1. Assistive technology (AT): is defined 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 individuals with disabilities (The Technology Related Assistance for Individuals with Disabilities Act of 1988).
2. Compensatory strategies: ways to work around the learning difficulty, or structuring the environment so that a difficulty does not impede progress (Singh & Beale, 1992).

3. Dysgraphia: impairment of the ability to write, as a result of a neurological disorder (National Institute of Neurological Disorder and Stroke, 2001).

4. Fry's Readability Graph (Appendix A): A quantitative method used to obtain the grade level of text (Appendix A). To use Fry's Readability Graph a representative sample of text (100 words) is rated by counting the number of syllables in the words. This provides a grade level score for the text.

5. Learning disability (definition of): A disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which may manifest itself in an imperfect ability to listen, think, read, spell, or do mathematical calculations. The term includes such conditions as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, dysgraphia, and developmental aphasia. The term does not include children who have learning problems that are primarily the result of visual, hearing, or motor handicaps, or mental retardation, or emotional disturbance, or of environmental cultural, or economic disadvantage (Individuals with Disabilities Education Act of 1997).

6. Optical character recognition (OCR) software: OCR software converts images (i.e., text material, such as chapters from books, newspaper articles, and other printed material) to text and creates word processing documents. OCR is often used with a scanner.
7. Postsecondary education: Formal education after high school

8. Remedial: intended to improve poor skills in a specified field.

9. Speech Synthesis (SS): SS provides auditory feedback of computerized text via the speaker of the computer. Some SS programs actually highlight the text, word for word, as it is being “spoken”.

10. Voice recognition software (VRS): VRS converts the spoken word, via a microphone and computer, into text as a word processing document. The user dictates (word by word) into a headphone-mounted microphone. The computer hardware and software converts the spoken words to electronic text on a computer monitor (Higgins & Raskind, 1995). The document can be saved and edited. It can also be read back using a speech synthesizer. VRS can also be used to perform computer commands that are traditionally performed with a mouse or via keystrokes.

Summary

Chapter I provided an overview of persons with disabilities and the issues faced by postsecondary education students with learning disabilities. It then addressed research on the use of VRS as a compensatory strategy for written language difficulties experienced by postsecondary education students with learning disabilities. The current research in this area includes one study (Higgins & Raskind, 1995). This study does not address the continued use of VRS, but does indicate that VRS improves holistic writing scores. The information provided in Chapter I identified two significant gaps in the current literature related to the use of VRS as a compensatory strategy. The first gap is a lack of research investigating the continued use of the VRS by postsecondary education
students with learning disabilities and difficulties. The second gap is a lack of research identifying specific variables that influence the continued use of VRS by postsecondary education students receiving services under the category of learning disabled from their attending institution. These two gaps in the literature support the investigation of the proposed research questions.

Chapter II provides a review of the literature, related to the three research questions, from both historical and current perspectives. The overview is designed to provide a framework for the reader as well as a framework in which to view the research findings. The chapter begins with the current status of the use of AT, then provides a brief history of learning disabilities, and continues with an overview of learning disabilities today. The researcher then discusses the status of persons with learning disabilities in postsecondary education and issues of written expression as experienced by persons with learning disabilities in postsecondary education. The chapter concludes with an extensive review, analysis, and discussion of the literature on the use of AT by persons with learning disabilities. Chapter III explains the methodology and research design including rationale for using a mixed-methods approach. Chapter III includes research procedures including participant selection, data collection tools, data analysis, and the applied intervention. Chapters IV reports the research findings and emerging themes. Chapter V discusses the findings, implications for the use of VRS by varied audiences, and direction for future research.
Chapter II: Literature Review

Introduction

The use of AT by postsecondary education students with learning disabilities has a very short history (Raskind, 1998). Even though the use of AT supports and services by persons with learning disabilities are growing, considerable investigation, exploration, and experience is still needed to determine which technologies are the most appropriate for meeting the needs of students with learning disabilities in postsecondary education (Raskind, 1998). According to Raskind (1998), even though there is limited research in the area of AT for postsecondary education students with learning disabilities there are studies with results that lead to a number of general conclusions. These include:

(a) Select AT devices have been found effective for students with learning disabilities in compensating for specific deficits in such areas as writing and reading; (b) a technology that is beneficial for one individual with learning disabilities could be counterproductive for another; (c) it is unclear whether the use of AT leads to improved academic outcomes as measured by GPA; (d) low-tech or even "no tech" solutions may be more effective than high-tech AT; (e) specific types of technology (e.g., speech synthesis) may be helpful in compensating for one area of difficulty (e.g., proofreading) but not necessarily helpful for another (e.g., reading); (f) the fact that an AT device has compensatory value does not guarantee that it will be cost- or time-effective; (g) a technology may be more effective than alternative strategies in helping one specific area of skill deficit (e.g., speech synthesis in catching usage errors) but not others (e.g., locating grammar-mechanical errors); and (h) some AT devices seem to have a
positive behavioral and or psychological/attitudinal effect on specific students.

(p. 15)

As can be seen, in the general conclusions drawn by Raskind (1998), the use of AT is an individualistic endeavor. Thus, in order to effectively research the specific use of VRS by postsecondary education students with learning disabilities, it is important to have a basic understanding of the range of various learning disabilities, including written expression, and the needs of persons with learning disabilities in postsecondary education settings. Further, it is important to have an understanding of related research conducted on the use and value of AT devices by students with learning disabilities.

Related History of Learning Disabilities

Samuel Kirk first used the term learning disability in 1962 (Chalfant, 1998). Prior to Kirk’s coining of the term others had done pioneering research in the area. Strauss and Lehtinen (1947) (as cited in Chalfant, 1998) for instance began looking at the behavior and learning characteristics of persons with brain injury. They hypothesized that if a person with a brain injury exhibits certain characteristics then the possibility might exists that persons exhibiting similar characteristics may have a brain injury. This pioneering research led the way for other researchers to begin looking at behavioral and academic problems from the perspective that the individual may have a neurological abnormality.

When Kirk (1962) introduced the term learning disabled he used it to describe students who “displayed 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 possible cerebral dysfunction and or emotional or behavioral disturbances.” He also clarified that learning disabilities are not
the result of mental retardation, sensory deprivation, or cultural or instructional factors” (Kirk, 1962). Over the years numerous labels were created to describe these children including brain injured, hyperkinetic, neurologically impaired, dyslexic, dysgraphic, and aphasic. The definition of learning disabilities as found in the Individuals with Disabilities Act (IDEA, 1997) does not differ substantially from Kirk’s (1962) original definition.

There is much debate today about the field of learning disabilities. Some question the existence of learning disabilities and point to the lack of empirical data justifying classification and diagnosis (Algozzine, 1983; Ysseldyke & Thurlow, 1983). Others contend that learning disabilities do exist and can be explained by research using magnetic resonance imaging (MRI). MRI’s show the frontal region of the brain of children with dyslexia to be different than those without it (Shapiro, 1999). Likewise, work with brain electrical activity mapping (BEAM) uses computers to map electrical brain waves. BEAM reveals that the electrical activity in the language-related areas of the brain of individuals who have dyslexia is different from those who do not have dyslexia (Shapiro, 1999).

The method used to diagnose learning disabilities in educational systems is not as “high tech” as MRI’s and BEAM. Educational diagnoses rely on a battery of achievement and cognitive tests to determine whether a significant discrepancy exists between ability and achievement. Given this, it can be argued that many students identified as learning disabled, through the educational system, may not actually have a neurological dysfunction. Instead they may actually have general learning problems (Adelman, 1992). Researchers (Lyon et al., 2000; Adelman, 1992) support this notion
and conclude that the majority of students classified as learning disabled actually have problems with learning but do not have a neurological basis for the learning problem. Adelman (1992) points out that much of the research purporting to deal with learning disabilities actually talks more about general learning problems. He indicates that failure to differentiate underachievement caused by neurological dysfunction from that caused by other factors has interfered with the research, theory, and implications of learning disabilities and is a threat to the very integrity of the learning disability field.

With the number of children identified as learning disabled increasing every year (National Center for Learning Disabilities, 2002) it is imperative that we begin to differentiate between learning difficulties, inadequate instruction, different learning styles, and learning disabilities in order to better serve the individual. Unfortunately, the current discrepancy model for classifying children does not distinguish young children with a neurological basis for their learning difficulties from their slow learning peers. One reason for this is that it is difficult for a “severe discrepancy” to exist when a child is only in kindergarten. Also, the acquisition of literacy fosters the cognitive skills that are assessed with aptitude measures. Thus, low scores obtained on IQ tests are perhaps a consequence of learning difficulties and not indicative of the cause. Likewise, findings have demonstrated that the information processing operations that underlie the word recognition deficits of poor readers are the same for poor readers with low IQ's and high IQ's (Stanovich & Siegel, 1994). With the use of the current discrepancy model, for identifying children with learning disabilities, slow learners and children with learning disabilities get passed on only to “all” be identified as learning disabled in the later years of school, if they meet the classification criteria. This is supported by current research
that indicates that it is virtually impossible to differentiate between those labeled slow learners and those labeled learning disabled based on tests of cognitive functioning (Lyon et al., 2000).

So, who are classified as learning disabled and who are labeled slow learners?

With the current definition of learning disabilities and its exclusion of children from "different" environmental, cultural, or economic settings the majority of the students diagnosed as learning disabled are middle and upper middle class (Lyon et al., 2000). Some argue that the field of learning disabilities has expanded as an attempt to "placate" families (Lyon et al., 2000; Senf, 1986). As Senf (1986) indicates, a sociological sponge that attempts to wipe up general education's spills and cleanse its ills. Today, general education classrooms are heterogeneous and teachers are expected to address a wide range of individual differences in cognitive, academic, and behavioral development. Unfortunately, many general education teachers are not trained to accommodate different learning styles, needs, and abilities (Lyon, et al., 2000; National Center for Learning Disabilities, 2002). Without this training teachers are not prepared to teach children in the manner they learn best. Thus, children who have different learning styles may fall behind academically only to be identified as learning disabled when they simply learn in a way that is different from the instructional methods of the teacher.

Persons with Learning Disabilities in Postsecondary Education

It is estimated that the number of individuals affected by learning disabilities ranges from 5% to 20% of the population (Gerber & Reiff, 1994). The National Postsecondary Student Aid Study (NPSAS) was undertaken during the 1995-96 academic year with a sample population which was nationally representative and consisted of
21,000 undergraduates who were questioned as to whether or not they had a disability. Six percent of the respondents indicated they had a disability. In 1991, 8.8% of full-time college freshmen reported having some form of disability, compared with 2.6% in 1978 (Henderson, 1992). Of the types of disabilities reported, learning disabilities were the fastest growing group, increasing from 15% to 25% of all students with disabilities over the 13-year period (Henderson, 1992). A more recent study indicates that the number of postsecondary undergraduate students identified as having disabilities in the United States was found to be 428,280, representing 6% of the student body (National Center for Educational Statistics, 1999). Of this 6%, 45.7% self identified as having a learning disability (National Center for Educational Statistics, 1999). According to the American Council on Education (1992) the number of students with learning disabilities entering postsecondary education programs has grown faster than any other disability classification. According to Henderson (1999) students with learning disabilities are the single largest contingent of students with disabilities being served on American postsecondary education campuses.

Although the number of students with learning disabilities attending postsecondary education has risen they are still less likely than their nondisabled peers to attend college (Murray, et. al 2000; Vogel & Adelman, 1992). The National Joint Committee on Learning Disabilities (NJCLD) (1999) expressed concern that many students with learning disabilities do not consider postsecondary options. Numerous studies including Blackorby and Wagner (1996), and Fairweather and Shaver (1991) have supported this perspective. Wagner and his colleagues (1991) reported that only 14% of youth with learning disabilities who had been out of high school up to 2 years had ever
attended some type of postsecondary education. This is compared to 53% of youth in the
general population. Up to 5 years after high school 31% of youth with learning
disabilities had attended postsecondary education whereas 68% of youth in the general
population had attended postsecondary education.

For those who are able to take advantage of postsecondary educational
opportunities, higher education often fosters a positive attitudinal change for individuals
with learning disabilities (Gerber & Reiff, 1994). The flexibility inherent, and the
increased independence and concurrent strengthening of autonomy are all factors that can
make college and graduate school satisfying and rewarding. Higher education allows
students with learning disabilities to use a greater spectrum of compensatory mechanisms
than were available from kindergarten to high school. For example, many college
students who are learning disabled have been able to pass a seemingly overwhelming
course by auditing the course, sometimes more than once, before taking the course for
credit (Reiff & Gerber, 1992).

Colleges have become more aware of and responsive to the needs of students with
disabilities. With the implementation of the Rehabilitation Act of 1973, that includes
Section 504, the rights and entitlements for people with disabilities were established at
the federal level. The law is brief and simply prohibits discrimination on the basis of
disability in all programs receiving federal financial assistance. Section 504 states that:
No otherwise qualified individual with a disability in the United States shall, solely by
reason of her or his disability be excluded from the participation in, be denied the benefits
of, or be subjected to discrimination under any program or activity receiving Federal
Section 504 provides that acts of discrimination and failure to provide an appropriate public education to eligible students are a violation of a basic civil right (Rehabilitation Act of 1973). Violation of this basic civil right can jeopardize the federal funding that states and other recipients of federal funds receive. Under Section 504 a disability is a physical or mental impairment that substantially limits one or more major life activities (Rehabilitation Act of 1973). Education is considered to be a major life activity.

Section 504 provides accommodations for students with physical disabilities or sensory impairments who may only need accommodations for physical access or alternative methods of communication. Students with health needs such as asthma, diabetes, attention deficit disorder, or attention deficit hyperactivity disorder may be served under Section 504.

Under Section 504 and the Americans with Disabilities Act (ADA) "postsecondary institutions are required by law to provide any reasonable accommodation that may be necessary for those persons with an identified disability to have equal access to the educational opportunities and services available to non-disabled peers, if requested" (p. 156). As students enter postsecondary education they go from a sheltered environment under IDEA, where services are “provided”, to an environment where they are expected to self-identify and request accommodations under section 504. Even if the services are available individuals may not use them. AT in the form of VRS would serve as such an accommodation and needs to be requested by the student if it is to be provided. Though varied in quantity and quality, support services to postsecondary education students with disabilities are available at most of the nations 3,000
postsecondary education institutions (National Center for the Study of Postsecondary Educational Supports (NCSPES), 2000).

As Raskind (1993) indicates the problems experienced by persons in secondary settings are often carried over to postsecondary educational settings and adulthood. According to Reiff and Gerber (1992) available literature of longitudinal and follow-up studies suggests that a learning disability is a lifelong condition that has various manifestations in adulthood. For some adults, who are not participating in postsecondary education, their learning disabilities seem to no longer exist as academic issues become less important (Katz, Goldstein, & Beers). For others, characteristics associated with their learning disabilities persist as often new obstacles are imposed such as those related to their vocation. Reiff and Gerber (1992) point out that clear prognoses for adults with learning disabilities are tenuous.

Written Expression and Persons with Learning Disabilities in Postsecondary Education

For persons with learning disabilities written performance is often an area of difficulty. Unfortunately, there is very little research done related to disorders of written expression (Hooper et. al, 1994) and research on the etiology, developmental course, prognosis, and intervention for disorders of written expression (Lyon, 1996). Most information available about the prevalence of the disorder of written expression is based on studies of reading disorders or learning disorders in general (Luttinger, & Gertner, 2001).

Disorder of written expression is assumed to occur with a similar frequency to other learning disorders but the estimates of the number of individuals affected varies from researcher to researcher (Luttinger, & Gertner, 2001). Written expression, as noted
by Johnson (1993), is the most prevalent of all disabilities. Lyon (1996) estimated that between 8% to 15% of school age children have deficits in written language whether or not they are identified as learning disabled. Blalock (1981) estimated that between 80% to 90% of persons with learning disabilities have disabilities in written language. Others indicate that more than 90% of adults with learning disabilities report significant problems with writing and or spelling (Vogel & Moran, 1982). The problems frequently experienced are in handwriting, spelling, and written expression (Vogel & Moran, 1982).

Wetzel (1996) reported that students with learning disabilities in written language encounter problems in four major areas: "mechanics (punctuation, spelling, and word usage); schema and cohesion (lack of critical components, inclusion of extraneous ideas, and unclear referents); modes of production (mechanical aspects of writing); and also an apparent inability to develop and maintain a sense of the whole composition" (p. 371).

Graham, Harris, MacArthur, and Schwartz (1991), point out that students with written expression difficulties have problems with basic text production skills and planning and revising text. Graham and his colleagues (1991) found the writing of students with learning disabilities to be less complete and stylistically inferior to that of students without learning disabilities. The written expression difficulties experienced by secondary students with learning disabilities follow them into postsecondary settings (Gerber et al., 1992; Johnson & Blalock, 1987; White, 1985). Recent research (Higgins & Raskind, 1995) on postsecondary education students with learning disabilities indicates that AT in the form of VRS may serve as an effective compensatory strategy for overcoming these difficulties.
**AT Used by Persons with Learning Disabilities and Difficulties**

This section of the literature review examines published studies on the use of AT by students in elementary through postsecondary education who have learning disabilities and difficulties. The original intent was to examine the use of AT by postsecondary students with learning disabilities. Because there were only five studies found that related specifically to postsecondary education, two additional studies were included in the review.

The literature on the use of AT by persons with learning disabilities is limited to the investigation of reading and writing. In searching the current literature base no studies were found that reported empirical data on the use of AT by persons with various types of learning disabilities other than those related to reading and writing. Three forms of AT seem to be particularly suited to advancement of the reading and writing process for individuals with learning disabilities and learning difficulties. These include (a) OCR, (b) SS, and (c) VRS, also referred to as speech recognition.

In order to best employ these forms of AT as compensatory strategies for persons with learning disabilities and learning difficulties, an understanding of the research and strategies, which have been applied to date, is imperative. The types of AT and strategies that have been effective in the past need to be evaluated so they can be implemented to a greater degree while the ineffective strategies and devices are eliminated or revised.

The review presented here was based on seven empirically based studies from peer reviewed journals. The criteria for selection of articles included: (a) empirical studies on AT; (b) those published in refereed journals; (c) K-12 and postsecondary age participants with learning disabilities and difficulties; (d) non-mainstreamed technologies
(i.e. technology not used regularly by people without disabilities, examples of mainstreamed technologies that may be considered AT are spell checkers, grammar checkers, and word processing software).

The review of these seven articles was used to address the following questions.

• What types of AT are being used in educational settings?

• What are the outcomes for students with learning disabilities and difficulties who use AT?

• Will persons trained on AT continue to use it long term?

• Does the use of AT increase academic performance and retention rates?

• What types of AT, as used by students with learning disabilities and difficulties, need more research?

Summary of Literature Search Procedures

Four databases were searched: Educational Resources Information Center (ERIC), PubMed (MEDLINE), Info Trac (Expanded Academic Index ASAP), and PsyInfo. The timelines specified did not include a beginning or end date. The researcher reviewed the reference lists of articles that met the criteria and then performed ancestral searches. Search terms included learning disabilities, AT, learning difficulties, postsecondary education, technology, speech recognition, university, voice recognition, reading, text-to-speech, dictation, and college. These terms were searched for individually and in combinations. A total of 53,753 articles were found with a search in ERIC for the keyword technology. Due to this high number technology was combined with learning disabilities and 427 articles were found. Many of these articles appeared in the search results for all four databases. There were no articles found that reported research on the
use of AT when the keywords technology and learning disabilities were used that did not appear in the search for AT and learning disabilities. When the terms learning disabilities and AT were used ERIC yielded 49 articles, PSY INFO 13, ASAP 11, and PubMed 53. Each of these articles was reviewed to determine if they met the established criteria for inclusion in the literature review. Ancestral searches did not yield any articles that were not included in the database searches. Hand searches of the Journal of Learning Disabilities, Exceptional Children, and Learning Disabilities Quarterly were performed for the years 1999 to 2003 and yielded no additional articles. After reviewing the articles found by the database and ancestral searches, seven articles met the criteria aforementioned.

Summary of Studies Reviewed (Demographics)

Table 1 shows the demographics of the participants in each study reviewed. The number of participants in each study ranged from 1 to 192. In the studies that indicated gender there were more males than females with a ratio of approximately 3 to 2. Age and grade ranges were from age 9 to 37 and grade 4 to graduate school respectively. Disability categories were learning disabled with two studies (Leong, 1992; Leong, 1995) identifying students as having learning difficulties. IQ’s ranged from 74 to 137. Ethnicity was varied, but as seen in Table 1, the majority of study participants were Caucasian. Achievement scores were reported on a wide range of tests that were not easily comparable. In general, however, achievement levels were average. In the studies that indicated socioeconomic status the majority of participants self-identified as middle class.
As seen in Table 1 the demographics of the study participants indicated the majority were male, Caucasian, and of middle income levels. In the field of learning disabilities there are more males than females diagnosed (Murray, et al., 2000) which is a likely reason for why there are more males in the studies reviewed. IQ's and achievement scores varied. This is typical of students with learning disabilities (Lyon et al., 2000). Mean IQ scores were average to low average with a range of 74 to 137. A range of IQ's from 74 to 137 is large but does align with the current literature on learning disabilities (Lyon, et al., 2000; Murray, et al., 2000) that indicates persons are being identified as learning disabled when they may actually be slow learners. For example a person with an IQ of 74 is functioning in the low range as the average range of IQ scores is from 85 to 115 (American Association on Mental Retardation, 2002). If a person has an IQ of 74 they could possibly be considered borderline mentally retarded depending upon their functional abilities (Diagnostic and Statistical Manual of Mental Disorders-DSM-IV, 2000) which implies that they are a slow learner.

Summary of Study Variables

Table 2 shows the various types of intervention used; the methods of selecting subjects; study design and analysis; study variables; and the findings for the seven studies reviewed. Three studies investigated the use of VRS (Higgins & Raskind, 1995; Raskind & Higgins, 1999; Wetzel, 1996) and four studies researched the use of SS and OCR software (Higgins & Raskind, 1997; Leong, 1992; Leong, 1995; Raskind & Higgins, 1995). The duration and quantity of intervention ranged from three essays being written
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>#</th>
<th>M/F</th>
<th>AGE/Grade</th>
<th>Disability</th>
<th>IQ/mean/range</th>
<th>ESL/ethnicity</th>
<th>Achievmt scores</th>
<th>SES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higgins &amp;</td>
<td>29</td>
<td>17/12</td>
<td>15% Fresh, 17% Soph.</td>
<td>LD</td>
<td>Mean 97</td>
<td>Af-Am</td>
<td>Mean Written</td>
<td>On a scale of 1 to 5</td>
</tr>
<tr>
<td>Raskind, 1995</td>
<td></td>
<td></td>
<td>29% Juniors, 27%</td>
<td></td>
<td></td>
<td></td>
<td>Lang. Score 83.5</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Senior, 12% Grad.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Avg. age 24.9yrs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higgins &amp;</td>
<td>37</td>
<td>Not</td>
<td>Not indicated</td>
<td>LD</td>
<td>Mean 97</td>
<td>Af-Am</td>
<td>Mean rdg comp.</td>
<td>On a scale of 1 to 5</td>
</tr>
<tr>
<td>Raskind, 1997</td>
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<td></td>
</tr>
<tr>
<td>Leong, 1992</td>
<td>67</td>
<td>Not</td>
<td>32 grade 6, 27 grade 7, &amp; 8 grade 8</td>
<td>Learning difficulties</td>
<td>Not indicated</td>
<td>Not indicated</td>
<td>Not indicated</td>
<td>Not indicated</td>
</tr>
<tr>
<td>Author(s)</td>
<td>#</td>
<td>M/F</td>
<td>AGE/Grade</td>
<td>Disability</td>
<td>IQ/mean/range</td>
<td>ESL/ethnicity</td>
<td>Achievment scores</td>
<td>SES</td>
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</tr>
<tr>
<td>Leong, 1995</td>
<td>192</td>
<td>Not</td>
<td>Grades</td>
<td>Learning difficulties</td>
<td>Not indicated</td>
<td>Not indicated</td>
<td>WRAT 100.86, 104.69, &amp; 105.80 for grades 4,5,6 respectively</td>
<td>Not indicated</td>
</tr>
<tr>
<td>Raskind &amp; Higgins, 1995</td>
<td>33</td>
<td>19/14</td>
<td>College age range 19-</td>
<td>LD</td>
<td>88-116 mean</td>
<td>3 Af-Am</td>
<td>Woodcock-25 mid/up-mid class</td>
<td>1 lower SES</td>
</tr>
<tr>
<td>Higgins, 1995</td>
<td>37</td>
<td></td>
<td>Avg. age 24.9</td>
<td>LD</td>
<td>101</td>
<td>25 Caucas</td>
<td>Johnson battery part II range 72-108 avg. 86</td>
<td>1 Upper Class mid-upper middle class</td>
</tr>
<tr>
<td>Raskind &amp; Higgins, 1999</td>
<td>39</td>
<td>26/13</td>
<td>Ages 9-18</td>
<td>LD</td>
<td>74-137 mean 92.1</td>
<td>1 Asian-Am 4 Af-Am 29 Caucas 5 Hispanic 1 Asian-Am</td>
<td>Not indicated</td>
<td>Wood-cock Johnson Achievmt at grade 5.7- rdg 4.0, mth 5.8, splg 3.9 &amp; word attack 3.0</td>
</tr>
<tr>
<td>Wetzel, 1996</td>
<td>1</td>
<td>1/0</td>
<td>Grade 6</td>
<td>LD</td>
<td>Full scale 111</td>
<td>Not indicated</td>
<td>Not indicated</td>
<td>Not indicated</td>
</tr>
</tbody>
</table>

LD = Learning Disability  
Af-Am = African American  
Asian-Am = Asian American  
Fresh = Freshman  
splg = spelling  
M/F = Male/Female  
ESL = English as a second language  
Grad = Graduate student  
Achvmt = Achievement  
SES = Socioeconomic status  
LD = Learning Disabled
over an unspecified time to 18 weeks of intervention. Selection of subjects was not indicated in six of the studies with one (Raskind & Higgins, 1999) indicating use of random selection procedures. Design and analysis of the studies varied with one study using a post-test only (Higgins & Raskind, 1995), two using ANOVA (Higgins & Raskind, 1997; Leong, 1992), two using ANCOVA (Leong, 1995; Raskind & Higgins, 1999), one using z-scores (Raskind & Higgins, 1995), and one study not indicating an analysis method (Wetzel, 1996).

**Dependent variables.** Dependent variables in the studies reviewed were: composition performance; reading comprehension; spelling; word recognition; proofreading; long-term effects on academics; behavior; attitudes and retention; written language difficulties; and cost effectiveness. The most frequently reported dependent variables were reading comprehension which was investigated in four studies (Higgins & Raskind, 1997; Leong, 1992; Leong, 1995; Raskind & Higgins, 1999) and written language/composition performance which was investigated in two studies (Higgins & Raskind, 1995; Wetzel, 1996). The seventh study investigated proofreading (Raskind & Higgins, 1995).

**Independent variables.** Independent variables included the three major AT's used: VRS, OCR, and SS. Other compensations used included a human transcriber (Higgins & Raskind, 1995), text read out loud (Higgins & Raskind, 1997), on-line reading (Leong, 1995), explanation of difficult words (Leong, 1992), and meta-cognitive activities (Leong, 1995). Pre-training was provided in six of the seven studies with three using OCR/SS (Higgins & Raskind, 1997; Leong 1992; Raskind & Higgins, 1995) and three using VRS (Higgins & Raskind,
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Duration &amp; Quantity of Intervention</th>
<th>Selection of subjects</th>
<th>Design/Analysis</th>
<th>Dependent Variable</th>
<th>Major AT</th>
<th>Other Compensation</th>
<th>Pre-training</th>
<th>Researcher involvement</th>
<th>Overall</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higgins &amp; Raskind, 1995</td>
<td>5.8 avg. hrs of VRS 3 essays written</td>
<td>Not indicated</td>
<td>Post-test only</td>
<td>Composition</td>
<td>VRS</td>
<td>Human transcriber</td>
<td>5.8 hrs on Speech Recognition</td>
<td>Study/Instructions</td>
<td>VRS +</td>
<td>VRS on written composition significant (p&gt;.05); long term savings of $310.00 per student; dropout rate reduced to 1.4%</td>
</tr>
<tr>
<td>Higgins &amp; Raskind, 1997</td>
<td>3 sessions, read: w/out assistance, w/human reader, w/ OCR/SS</td>
<td>Not indicated</td>
<td>ANOVA</td>
<td>Reading Comprehension</td>
<td>OCR/SS</td>
<td>Read aloud</td>
<td>45 mins training, avg. practice Time 23 mins</td>
<td>Study/Instruction</td>
<td>OCR/SS +</td>
<td>Inverse correlation between silent reading comprehension and OCR/SS</td>
</tr>
<tr>
<td>Leong, 1992</td>
<td>18 weeks</td>
<td>Not indicated</td>
<td>ANOVA</td>
<td>Verbal reports &amp; pre &amp; posttests</td>
<td>Reading comprehension</td>
<td>Text-to-speech (SS)</td>
<td>Explanation of difficult words</td>
<td>Practice examples</td>
<td>Text-to-speech (SS) Not significant</td>
<td>Improvement in reading comprehension. For 10 of 12 passages</td>
</tr>
<tr>
<td>Author(s)</td>
<td>Duration &amp; Quantity of Intervention</td>
<td>Selection of subjects</td>
<td>Design/ Analysis</td>
<td>Dependent Variable</td>
<td>Major AT</td>
<td>Independent Variable</td>
<td>Other Compensation</td>
<td>Pre-training</td>
<td>Researcher involvement</td>
<td>Overall</td>
</tr>
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</tr>
<tr>
<td>Leong, 1995</td>
<td>4 mths</td>
<td>Not indicated</td>
<td>ANCOVA</td>
<td>Comprehension, Word recognition</td>
<td>(1) On-line reading &amp; SS, (2) 1+ explanation of difficult words, (3) 1 &amp; 2 plus metacog activities</td>
<td>Not indicated</td>
<td>Metacog activities</td>
<td>SS +</td>
<td>significant differences for grade p=.001; reading level p=.006; and overall passage effect p=.000. Word recognition improved with SS</td>
<td></td>
</tr>
<tr>
<td>Raskind &amp; Higgins, 1995</td>
<td>Proofread 3 essays, 1 SS, 1 read out-loud, &amp; 1 with no assistance</td>
<td>Not indicated</td>
<td>z-scores</td>
<td>Proofreading</td>
<td>SS</td>
<td>Not indicated</td>
<td>15-20 mins.</td>
<td>Not indicated</td>
<td>SS +</td>
<td>SS on proofreading sign (p&gt;.005) for 7 of 9 conditions</td>
</tr>
<tr>
<td>Raskind &amp; Higgins, 1999</td>
<td>19 part. 50 mins. a wk for 16 wks, 20 part. In ctrl group rec’d basic computer instruction</td>
<td>Random</td>
<td>ANCOVA pre-mid-posttests</td>
<td>Word recognition, Reading comp., and spelling</td>
<td>VRS</td>
<td>Not indicated</td>
<td>Two training sessions</td>
<td>Researcher and or teacher in each session</td>
<td>VRS +</td>
<td>VR significant on: word recognition (p&lt;.0001), spelling (p&lt;.002), &amp; rdg comprehension (p&lt;.01)</td>
</tr>
</tbody>
</table>
Table 2 (continued). Study variables

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Duration &amp; Quantity of Intervention</th>
<th>Selection of subjects</th>
<th>Design/Analysis</th>
<th>Dependent Variable</th>
<th>Independent Variable</th>
<th>Findings</th>
</tr>
</thead>
</table>
| Wetzel, 1996 | 14, 30-minute sessions spent with the researcher | Not indicated | Not indicated | Written language difficulties | VRS | Not indicated | 1st session | Fourteen 30-minute sessions spent with the researcher | VRS - | VR not mastered enough to deem it effective, recognition of speech ranged from a low of 23% to a high of 74%

Metacog = metacognitive  
ctrl = control  
rec'd = received  
rdg = reading
The pre-training provided instruction and training on the use of the OCR, SS, and VRS before the research began. Researchers and or assistants involvement was indicated in all but one study (Raskind & Higgins, 1995). When indicated the researchers and assistants were mostly involved in providing training and instruction.

**Discussion of Study Variables**

Only one study indicated subject selection procedures (Raskind & Higgins, 1999). Based on the information provided in the remaining articles it is likely that the selection of subjects was convenience sampling. For example Leong (1995) indicates the sample consisted of 64 grade 4 students, 68 grade 5 students, and 60 grade 6 students. It is possible that these numbers represent two students with learning difficulties from classes at each grade level and that students were selected because they were members of the class.

The design and analysis procedures varied from study to study. This made statistical comparison of the results difficult. Thus, this researcher presented more overall outcomes rather than specifics. The lack of continuity in the findings leaves room for additional research to take place that seeks to replicate the studies being reviewed.

The dependent variables were similar across studies with three investigating written language difficulties (Higgins & Raskind, 1995; Raskind & Higgins, 1999; Wetzel, 1996), three investigating reading comprehension (Higgins & Raskind, 1997; Leong, 1992; Leong, 1995), and one investigating proofreading (Raskind & Higgins, 1995). It is clear that the AT currently being used by persons with learning disabilities is of the three types mentioned previously. VRS is being used to compensate for written language
difficulties while OCR and SS are being used to compensate for reading comprehension and proofreading difficulties.

Table 2 also shows independent variables used including: the use of a human transcriber in composing essays and comparing this to the use of VRS (Higgins & Raskind, 1995); the use of a human reader in comparison to the use of SS when investigating reading comprehension (Higgins & Raskind, 1997); and the explanation of difficult words plus SS as compared to SS alone when investigating reading comprehension (Leong, 1992). Another variable considered was the use of SS (DECTalk) with on-line reading and simplification of passages to form a comparison between this group of participants and participants using only SS (Leong, 1995). Pre-training was indicated in six of seven studies (Higgins & Raskind, 1995; Higgins & Raskind, 1997; Leong, 1992; Raskind & Higgins, 1995; Raskind & Higgins, 1999; Wetzel, 1996). Pre-training was necessary to insure participants understood the AT they were expected to use. Researcher involvement varied from study to study and was indicated in six of the seven studies (Higgins & Raskind, 1995; Higgins & Raskind, 1997; Leong, 1992; Leong, 1995; Raskind & Higgins, 1999; Wetzel, 1996).

As discussed, the studies reviewed had a broad range of characteristics with no one study being replicated. This provides data that are difficult to categorize, because the variables explored in the studies are diverse. While the data are difficult to categorize, the studies reviewed do provide insight into the literature review questions posed previously as discussed in the following text.
Literature Review Questions

The findings from the studies reviewed (see Table 2) were consistent across each of the studies indicating positive outcomes for AT use with the exception of Wetzel’s (1996). The studies by Higgins and Raskind (1995 & 1997), and Raskind and Higgins (1995) are the most relevant to this research. Higgins and Raskind (1995 & 1997) and Raskind and Higgins (1995) researched the use of OCR, SS, and VRS by postsecondary education students. Over a period of three years they analyzed data on reading comprehension, proofreading and written composition, long-term effects on academic success and retention, and behavior and attitudes. All forms of AT were found to be effective compensatory strategies. AT was found to be more cost effective than traditional strategies, such as note takers and readers. They also found that retention rates for persons with learning disabilities using AT were significantly higher than those with learning disabilities who did not use the technology as well as individuals from the general population. Students in the studies for all three years had a drop-out rate of 1.4% as compared to 34% for the matched control group over the same three-year period, and 48% for the non-disabled population over four years.

Raskind and Higgins (1995) also found VRS to be an effective tool for improving holistic writing scores. This study was done in a clinical and controlled setting at California State University at Northridge (CSUN). CSUN’s Upper Division Written Proficiency Exam was the assessment tool employed. According to Higgins and Raskind (1995) it is a timed essay test that is scored holistically on a scale of 1-6, with a grade of 4 required for passage. Study participants were asked to write three essays: one without assistance; one dictating to a human transcriber; and one using VRS. One of six
questions was randomly assigned to each administration of the exam. Students were granted extra time if needed (up to one hour) which, according to Higgins and Raskind (1995), is the normal procedure practiced by CSUN to accommodate students with learning disabilities. The instructions and test question were read aloud by one of the researchers as each student followed along. Analysis of the writing samples found that when learning disabled students used voice recognition their written performance was not significantly different from their non-disabled peers whereas without the VRS their written performance was significantly lower.

Higgins and Raskind, (1997) found a significant correlation between silent reading scores and improvement under the SS technology condition such that the greater the individuals comprehension difficulties the more the technology enhanced performance. This implies students with the most severe learning disabilities and or learning difficulties will benefit the most from the use of AT. This finding is supported by Raskind’s (1993) statement that although both remedial and compensatory strategies are beneficial for adults with learning disabilities, the compensatory approach “may offer the most expeditious means of addressing specific difficulties within particular contexts” (p 159).

Of the four studies that investigated the effectiveness of OCR and SS, three of them were investigating the effects on reading comprehension (Higgins & Raskind, 1997; Leong, 1992; Leong, 1995). In all three cases OCR and SS were found to be effective. In the fourth study (Raskind & Higgins, 1995) SS was used to research proofreading ability and it was found that individuals detected more errors when using the SS compared to having the material read to them, or when reading it themselves. Leong, in
her 1995 study with younger children, obtained similar results when investigating the use of SS for increasing comprehension. This result was different from Leong’s 1992 study where SS did not prove statistically significant but where it still indicated positive results in 10 of the 12 passages read by study participants.

The seven articles were reviewed with the intent of addressing the questions posed. The answers to these questions, based on the studies reviews are as follows.

*What types of AT are being used in educational settings?* The type of AT's used in educational settings for persons with learning disabilities were VRS, OCR, and SS. These forms of AT were used to improve reading and writing.

*What are the outcomes for students with learning disabilities who use AT?* Outcomes were positive for most participants in the studies reviewed. Two of the studies (Leong, 1992; Wetzel, 1996) found that the AT intervention did not improve reading and writing. For the five other studies the AT intervention improved the reading, writing, and proofreading abilities of the study participants as determined by the data analysis procedure applied in each study.

*Will persons trained on AT continue to use it long term?* Interestingly long-term use was not addressed in any of the studies. This question remains to be answered. As it stands the use of AT does improve reading, writing, and proofreading abilities but the question remains as to whether or not people will actually use it. If people are not going to use the AT they obviously will not benefit from it.

*Does the use of AT increase academic performance and retention rates?* In the study that explored the impact of AT on retention rates (Higgins & Raskind, 1995) the findings were positive. Academic performance was not indicated in any of the studies.
However, Higgins and Raskind (1995) found that the drop out rate for persons in their study dropped to 1.4% compared to 34% for the match control group and 48% for the non-disabled population. There are additional variables that may have influenced participants drop out rate with the main one being that they were part of a 3-year study which included support that students not in the study did not receive. Based on this it cannot be assumed that the use of AT alone decreased the drop out rate but it may have impacted it.

*What types of AT used by students with learning disabilities need more research?*

Additional research is needed on all forms of AT for use by persons with learning disabilities. The preliminary findings from the seven studies reviewed are promising but they leave room for additional inquiry.

Overall, the results indicated that the types of AT investigated (i.e., OCR, SS, and VRS) are effective compensatory tools for persons with learning disabilities and or learning difficulties. The difficulty most frequently experienced by people with learning disabilities is phonetic awareness (Stanovich, Cunningham, & Freeman, 1984; Adams, 1990). With a lack of phonetic awareness the ability of individuals to comprehend written material is reduced. By using OCR and SS electronic text can be “read” to an individual. This minimizes the required decoding and improves comprehension. Speech synthesis was also found to improve proofreading abilities when compared to reading alone or having text read by a human reader to an individual (Higgins & Raskind, 1997). This again is not unexpected, as people with learning disabilities have difficulty reading and are so focused on the words that they do not comprehend the larger meaning. Speech synthesis was found to be more effective than reading alone or using a human reader for
proofreading text (Raskind & Higgins, 1995). This may be due to the independence provided by the use of AT as the person doing the proofreading does not have to be concerned with bothering the reader. The individuals using the software can replay the text as many times as they like, thus possibly catching more errors.

Although VRS did not prove to be an effective compensatory strategy in one study (Wetzel, 1996) it was in two others (Higgins & Raskind, 1995; Raskind & Higgins, 1999). A possible reason for VRS not being effective in the 1996 study by Wetzel is that voice recognition software and hardware has improved greatly since then. Dragon Naturally Speaking (DNS) can now be minimally trained in about twenty minutes. With this minimal training DNS has about 98% recognition accuracy (S. Krysler, personal communication, April 30, 2001). This is providing the computer has a good quality sound card and a fast processor. The 98% recognition accuracy is also based on the users consistently and clearly enunciating their words. Since DNS has improved the implications for persons with learning disabilities and or learning difficulties is far greater. To be able to speak ones ideas and not get caught up in the intricacies of spelling and grammar can, as indicated by Higgins and Raskind (1995), improve written composition.

There are numerous weaknesses in the studies reviewed. For instance, several of the studies did not indicate pertinent demographic information. Likewise, effect size was not indicated in any of the studies reviewed. In addition, if there were more empirical studies available there may be more variety in the populations investigated which may provide different results. For example, persons with learning disabilities from culturally
and linguistically diverse backgrounds may not fair as well with VRS, OCR, and SS due to their linguistic differences.

Overall, the greatest limitation of this literature review on the use of AT by persons with learning disabilities and or learning difficulties is the fact that there are so few empirical studies investigating the use of AT. One reason for the lack of research may be that the technology is relatively new. Other possible reasons may include lack of teacher experience in using technology; and manufacturers of the technology looking to venues other than the educational arena as their market and area for research. With the lack of empirical research available it is necessary to keep in mind that the results indicated in this review cannot be considered conclusive.

As indicated by Raskind (1993) the appeal of immediate solutions to particular problems is a very good reason to begin researching the use of AT. Many (Day & Edwards, 1996; Golden, 1998; Riviere, 1996) have indicated the effectiveness of AT but research supporting this is limited. The problem of determining whether or not AT is an effective compensatory strategy for persons with learning disabilities thus enabling them to succeed in educational endeavors requires systematic investigation. Future research should replicate the current studies in multiple settings to determine if the results are generalizable. This may include a larger mix of ethnicity, gender, and socioeconomic status.

A new area of research may be to investigate the partnering of SS, OCR, and VRS. The use of these three forms of AT in conjunction with each other thus allowing one to compose with ones voice and have what was "typed" read back has great potential.
The technologies investigated, as they continue to improve, should be incorporated into daily instructional lessons throughout the educational arena. Voice recognition may also be beneficial for individuals with quadriplegia, visual tracking problems, fine motor control problems, and cerebral palsy. Additional research is needed to document effective and ineffective strategies across all disability categories.

The current literature on the use of AT by persons with learning disabilities is limited. Though not conclusive, the data indicate that AT is beneficial as a compensatory strategy for persons with learning disabilities in a variety of settings and for various problems (i.e. written composition, proofreading, word recognition, and reading comprehension). The questions of whether or not people will continue to use AT, after they are trained on it, and the variables that influence use, present a gap in the current literature. Because written language difficulties are estimated to affect between 80% and 90% of persons with learning disabilities (Blalock, 1981), and between 8% to 15% of the school age population (Lyon, 1996); VRS has improved since the Higgins and Raskind study of 1995; there is limited research on the variables that influence use of VRS; and there are no studies available indicating long term use and effectiveness of VRS. This dissertation study begins to fill a gap in the research base by addressing the following research questions:

1. After being trained on VRS will persons, in postsecondary education, receiving services under the category of learning disabled, continue to use it to complete their academic course work? Will they use it for purposes other than academics?
2. Does the ongoing use of VRS, by postsecondary education students receiving services under the category of learning disabled, improve their written performance when assessed with Fry's Readability Graph?

3. What are the contributing variables that influence the continued use, or non-use, of VRS by postsecondary education students receiving services under the category of learning disabled?

Summary

Chapter II provided an overview of the current status of AT use. This was followed by an overview of the history of learning disabilities and learning disabilities today. Next, the status of persons with learning disabilities in postsecondary education and issues associated with their written performance were discussed. The chapter concluded with an extensive review of the literature on the use of AT by persons with learning disabilities and difficulties. The information presented and reviewed in Chapter II led to the investigation of the three research questions that are addressed in this dissertation study.
Chapter III: Methodology and Research Design

Introduction

The questions of whether or not people will continue to use VRS, after they are trained on it, and the variables that influence use, present a gap in the current literature. In order to address these gaps the current study will investigate the three research questions posed previously through the research methods and design presented in Chapter III. Chapter III begins with a description of the subjects followed by the research methods applied. Next, the intervention, including equipment and training is described. This is followed by a description and rationale for each of the data collection tools utilized. Which data collection tools were used with each subject and how the data were collected are also stated. Next a description of the data analysis procedures is provided followed by a chapter summary.

Subjects

Demographics

Subjects were 15 (9 male and 6 female) postsecondary education students, receiving services under the category of learning disabled, from their attending institution. Seven participants were attending a 2-year college, three were attending a 2-year college with a 4-year preparation program, and five were attending a 4-year research institution. Subjects ranged in age from 19 to 56. IQ (Full Scale) scores ranged from 78 to 116 with a mean of 94. Eight subjects were Caucasian, two Hispanic, and one African-American. The remaining four subjects displayed characteristics localized to the State of Hawai‘i. All subjects have been assigned pseudonyms in order to protect their anonymity.
Recruitment

All subjects took part in the research on a voluntary basis. They were recruited using criterion sampling. Criterion sampling uses some pre-determined “important” criterion to select study participants (Menckel & Carter, 1985). In this study, the criterion of being enrolled in a postsecondary education program and receiving services under the category of learning disabled, were pre-determined.

The researcher, with the assistance of the disability support office personnel at each institution, used multiple means to recruit subjects. The means of recruitment included:

1. Referrals made by the disability services program coordinators at each institution;
2. Mailing information, describing the opportunity to participate in the study, to all students receiving services under the category of learning disabled at the 2-year college and the 2-year college with a 4-year preparation program;
3. Flyers posted on all campuses;
4. Advertisements in the student newspaper;
5. Presentations of the opportunity to participate in classes at each institution; and
6. Flyers (Appendix B) handed out by the disability support officers at each institution.

Each recruitment method was employed on each of the participating campuses, other than the 4-year research institution where the disability support coordinator did not agree to mail study information to the students receiving services under the category of
learning disabled. The disability support officer at the 4-year research institution did however, agree to pass out flyers (Appendix B) to prospective subjects.

The recruitment process took place approximately two months prior to the beginning of the Fall, 2001 and Spring, 2002 semesters. A total of fifteen (nine first semester and six second semester) people contacted the researcher and met the criteria established for participation. The established criterion was for individuals to be receiving services, from their attending institution, under the category of learning disabled. Eight other individuals contacted the researcher but did not meet the established criteria. The reasons for not meeting the criteria varied. Examples included English as a Second Language learners who were not receiving services for a disability and students receiving services for physical, not learning disabilities. Students meeting the established criterion varied from institution to institution; for instance, at the 2-year community college one person who experienced a stroke (Bill), and another diagnosed as ADHD (Clay), were receiving services under the category of learning disabled. This draws attention to a larger problem regarding the definition of learning disabilities, as discussed in the literature review, where discrepancies exist between individuals classified as learning disabled. For clarity in viewing the study findings it is important to remember that subjects were receiving services under the category of learning disabled from their attending institution and not necessarily diagnosed with a learning disability.

The recruitment materials included the contact number and e-mail address of the researcher. In response to the recruitment request, interested individuals contacted the researcher via telephone or e-mail. If the first contact was made via e-mail the researcher requested that the individual telephone the researcher or provide the researcher with a
telephone number for the researcher to initiate a telephone conversation. In one case involving Rhonda, the researcher contacted her based upon the recommendation from the disability support officer. Rhonda gave the disability support officer permission for the researcher to call her.

For all prospective subjects, upon initial telephone contact the researcher asked them if they were receiving services from their attending institution under the category of learning disabled. If prospective participants said they were receiving services under the category of learning disabled the researcher provided them with a verbal overview of their projected role in the research project. Following a set protocol, the overview explained the purpose of the study and detailed the content of a 4-hour training session to be required for participation in the study and to occur at the beginning of the semester. The overview also explained that, if they agreed to participate, all subjects would be asked to submit three writing samples, use the software to complete coursework during the semester they participated in the study, and take part in a focus group or interview near the end of the semester. Prospective subjects were informed that training beyond the initial four hours, technical assistance, and additional support would be provided upon their request. When prospective participants indicated they were receiving services from their attending institution under the category of learning disabled, and were interested in participating in the study, they were informed of available training dates. The prospective participants then chose a training date and the training session was set-up. Subjects from the neighbor islands were provided with flight coupons and transportation to the training site. They were also provided with breakfast and lunch.
Research Methods

This dissertation study used a mixed-methods approach to investigate the following three research questions. Research questions one and three were investigated through qualitative measures. Research question number two was evaluated with the quantitative measure, Fry's Readability Graph. The research questions influenced the selection of methodology.

1. After being trained on VRS will persons, in postsecondary education, receiving services under the category of learning disabled, continue to use it to complete their academic course work? Will they use it for purposes other than academics?

2. Does the ongoing use of VRS, by postsecondary education students receiving services under the category of learning disabled, improve their written performance when assessed with Fry's Readability Graph?

3. What are the contributing variables that influence the continued use, or non-use, of VRS by postsecondary education students receiving services under the category of learning disabled?

As indicated by Tashakkori and Teddlie (1998) pragmatists consider the research question to be more important than the method they use. Researchers generally prefer addressing their research questions with the methodological tools that best align with the questions (Tashakkori & Teddlie, 1998). Thus, this researcher used various qualitative data collection tools and Fry's Readability Graph because they aligned with the research questions. The multiple qualitative data collection tools used also provided flexibility in obtaining data from the subjects in a manner that was conducive to their lives (i.e., during
times they were available). The data collection tools used will be described in detail later in this chapter. The rationale for using both qualitative and quantitative methodology is described in the following text.

**Quantitative**

Research question two was evaluated with Fry's Readability Graph, which is a quantitative method used to obtain the grade level of text (Appendix A). To use Fry's Readability Graph a representative sample of text (100 words) is rated by counting the number of syllables and sentences. This ratio provides a grade level equivalency for the text. Fry's Readability Graph was chosen as the means for measuring participants written performance as it is an objective measure that can be compared across settings. Fry's Readability Graph does not evaluate grammar and spelling errors thus the participants' use of spelling and grammar checking programs did not effect the outcomes. The researcher used Fry's Readability Graph to determine if the continued use of VRS by postsecondary education students, receiving services under the category of learning disabled, influenced their written performance.

**Qualitative**

Research questions one and three were investigated through qualitative measures. Determining whether or not participants continued to use the software (research question one) after training lends itself to asking the participants. Being that the research reported here was preformed in a "typical" setting as opposed to a controlled setting the researcher was not in a position to monitor software use by the subjects. Thus, asking the participants if they used the software is an appropriate data collection tool that aligned with the question. Likewise, determining the variables that influenced continued use or
non-use of the software (research question three) also lends itself to asking the participants and investigation through qualitative measures. As Marshall (1986) indicates qualitative methodology is particularly valuable for addressing research areas whose relevant variables have yet to be identified. This is the case in this study, particularly related to research question number three. Research question number three seeks to address the question of what variables contributed to the continued use or non-use of the VRS. A discussion of the general rationale for using qualitative methods and multiple qualitative data collection tools, to answer research questions one and three follows.

The research procedures for qualitative designs are varied, as are the types of research. According to Merriman (1998) there are five main types of qualitative research: ethnography, phenomenology, grounded theory, case study, and basic or generic. This study used a basic or generic (hereafter referred to as basic) qualitative research design. The researcher, using basic qualitative research, seeks to discover and understand a phenomenon, a process, or the perspectives of the people involved (Merriman, 1998). The main purpose of this research was to discover the variables that influence the use of VRS by postsecondary education students receiving services under the category of learning disabled. This purpose was pursued while investigating the continued use of VRS and its effect on the written performance of study participants. In addition, the research sought to understand the phenomenon of why some individuals continue to use the software and others do not, from the perspective of the research subjects.

Qualitative data may consist of detailed descriptions of situations, events, people, interactions, and observed behaviors; direct quotations from people about their
experiences, attitudes, beliefs, and thoughts; and excerpts or entire passages from documents, correspondence, records, and case histories. The detailed descriptions, direct quotations, and case documentation of qualitative measurement are raw data from the empirical world. The data are collected as open-ended narrative without attempting to fit program activities or peoples' experiences into predetermined, standardized categories such as the response choices that comprise typical questionnaires or tests (Patton, 1980).

Qualitative methods are flexible (i.e., they can change) (Martella, Nelson, & Marchand-Martella, 1999). Therefore, there are no specific steps used in the design of qualitative methods that are the same for all types of research inquiries. There are steps often utilized in qualitative research designs but these are not set in any prescribed order (Martella, Nelson, & Marchand-Martella, 1999). Martella et al. (1999) indicated the following five phases that occur before and during qualitative investigation.

1. Ask a research question.

2. Decide on how to collect the data, for how long, and the methods of data collection.

3. Decide on a sample.

4. Analyze data throughout the investigation based on the purpose of the investigation.

5. Based on the data, conclusions are made and understanding is gained.

The conclusions drawn may be in the form of descriptions, interpretations, theories, assertions, generalizations, and evaluations. The steps prescribed by Martella et al. (1999) were implemented in this study with the findings and conclusions drawn in the form of descriptions, interpretations, assertions, and generalizations.
Intervention

The main intervention in this study was a four-hour training session on VRS that was mandatory for each research participant. Additional interventions, that were not mandatory, included ongoing training, technical support, and information provision. While the researcher attempted to keep the study consistent with typical supports the intervention did take the study out of the realm of typically provided supports. The rationale for this is discussed in the following text.

Rationale for the use of the Selected Interventions

The training, technical assistance, and information provision provided as interventions in this study were above and beyond those types of services and supports offered by the institutions attended by the research participants. While section 504 of the Rehabilitation Act of 1973 and ADA require that accommodations be provided, neither mandates that training be provided on any form of AT. For example, in the institutions targeted in this study VRS is available but training it not provided. The study presented here investigated the use of VRS in a non-controlled setting as a means of keeping the study aligned with what actually occurs in disability support offices. Through the provision of ongoing training, technical support, and information provision the level and type of supports provided to those participating in the study went beyond the realm of typical supports offered in postsecondary settings and into an atypical realm.

As indicated by Raskind (1998), postsecondary programs vary considerably in regard to the specific services provided, including the extent and mode of training and support. As indicated in a national survey administered to more that 1,500 disability support officers at public, private, 2-year, and 4-year institutions approximately 47.4% of
respondents from public institutions indicated they offered skills training on equipment and software between 25% and 75% of the time. (National Center for the Study of Postsecondary Educational Supports, 2000). While this percentage indicates that skill training, on equipment and software, is available it does not indicate the intensity, duration, or type of training. Likewise, the findings do not indicate how many persons actually receive training. For example, in the study presented here the targeted institutions have VRS available to students for use but do not provide specific training. By the researcher providing participants with training and software (for their personal computers) the study moved beyond the typical supports provided at each institution (the provision of the software on campus) to atypical supports (the provision of the software for personal use, initial software training, ongoing training, technical assistance, and information provision).

To maximize the effects of the atypical supports provided, attempts were made to keep the interventions (training, technical support, and information provision) aligned with the procedures followed in postsecondary education settings. This was done by providing additional training, (the initial four hour training is mandatory) technical assistance, and support, when requested by the study participants. This is aligned with the expectation of the law that requires students with disabilities in postsecondary education to request accommodations and supports. All subjects were informed that ongoing training; technical assistance (on both their own and the campus computers); and information would be provided, on an individualized basis, upon request. Subjects were informed that they could make requests for additional support by calling the researcher
and trainer. In addition, the researcher followed up with subjects on a regular basis and inquired into their ongoing needs as related to their use of DNS.

Equipment

Dragon Naturally Speaking version 5.0 was used as the VRS program because it is recognized as one of the leading products on the market (Dragon Systems, 2000). It is designed to allow users to speak at a natural pace and have their voice, entered as text, into a computer-based, fully operational word-processing document. As individuals continue to use the software they continue to train it and accuracy should increase.

For maximum performance DNS requires a computer with a high quality sound card and 128mb of RAM. The minimum system requirements are: Windows 98, 2000, Millennium, or Windows NT 4.0 (with SP-6 or greater); 266 MHz processor; 64 MB RAM; 150 MB free disk space; Dragon Systems - certified sound card (the hardware compatibility list can be found at http://www.dragonsys.com/support); CD-ROM drive for software installation; speakers; and a noise-canceling headset microphone (included with the software). According to the Hawai‘i representative for Learnout and Hauspie (the software manufacturer) the type of processor that is in the computer can also make a difference in how well the software works. For instance a Pentium III’s processor will allow the software to work better than a Celeron processor (personal communication with S. Krysler, 2001).

DNS was available to study participants on all campuses. In addition to the availability on campus the researcher contacted Learnout and Hauspie and received the donation of six complete sets of software that were given to participants who had personal computers that met the minimum requirements to run the software.
Training

The mandatory 4 hour training session took place at a computer lab with 10 computers running DNS. The researcher and the trainer verified, prior to each training session, that the computers and software were working. Participants were given directions to the lab. Participants from the neighboring islands were provided with flight coupons and transportation. Breakfast and lunch were provided for all subjects. Each session began at 9:00 AM and ran until 2:00 PM with an hour break for lunch.

On the day of the initial training (this was the first face to face contact between the subjects and the researcher) the study procedures were explained again. Participants were asked to sign a consent to participate form as mandated by the University of Hawai‘i at Manoa Committee on Human Subjects (Appendix C). The consent form and study procedures were explained. The consent form was read to the prospective subjects to ensure they understood the conditions of participating in the study. The subjects were verbally informed that they could withdraw from the study at anytime. They were also informed that additional training, technical assistance, and information provision would be available upon request. After verbally indicating they understood what they were being asked to do they were asked to sign the consent form (Appendix C).

Upon completion of the initial training, participants were again informed that additional training, technical assistance, and information provision would be available upon request. It was explained that additional training was available over the winter and summer breaks as well as other times upon request. Participants were informed that the additional training and support would be individualized to their specific needs. They were provided with the researchers, and the trainers contact information. In order to keep
the study closely aligned with the practices of the disability support offices at each institution the researcher did not try to persuade individuals to use the software or to take advantage of additional training opportunities. The researcher offered support but accepted the participant's responses.

Learnout and Hauspie is the maker of DNS. The Hawaiʻi representative for the company was paid to train participants during four hour sessions held in a computer lab. The trainer used the same protocol (Appendix D) and training methods for all subjects. Dragon Naturally Speaking must be trained to individual users voice patterns through the dictation of a selected passage into a microphone connected to the computer. The user chooses 1 out of 11 pre-selected passages from books such as: Alice in Wonderland; 3001: The Final Odyssey; Being a Cheerleader; and Dave Barry in Cyberspace. The training passages vary in difficulty, writing style, and interest. The initial training period takes approximately 20 minutes and should allow for approximately 90% accuracy. All 15 subjects took part in an initial 4-hour training. Because Rhonda and Brent had poor reading skills the researcher read the training paragraphs to them in a low voice. They repeated what they heard into the microphone. All other subjects trained the software independently.

The trainer used a LCD projection of his computer monitor to instruct subjects on the computer they were using in the lab. The trainer began by teaching the participant how to create a user. This step involves testing the microphone position, and the users voice output. If the microphone is interfacing effectively with the computer the software will provide the user with a score indicating effectiveness. After the microphone has
been approved the user begins to read the selected passage. When the passage is complete the software has, in theory, been trained to recognize the users voice patterns.

After the software was trained the trainer instructed the subjects on how to turn the microphone on and off. This can be done through voice commands, mouse control, or keyboard commands. Next, the trainer instructed the participants on how to dictate text and punctuation marks. This should be done using ones natural speaking voice.

Each subject was presented with a user's guide and the trainer explained how to use it. The trainer showed the participants the accuracy center, online help, and the sample command windows. These were explained and explored.

The trainer then showed the subjects how to correct recognition errors in their dictated text. This can be done by correcting in the spell dialog box or by using the mouse and keyboard. When using the spell dialog box the computer continues to be trained because the corrections are spoken. If the mouse and keyboard are used, this additional software training, does not take place.

The trainer also explained using the playback feature to assist in correction. This feature plays back what users have stated, in their own voice. This may aid the user in recognizing speech patterns that are confusing to the software. The trainer covered saving and deleting recorded dictation.

The trainer thoroughly instructed the participants on how to edit and format their documents. The steps involved included: navigation commands, selection commands, and replacing text. The participants were instructed on how to perform these steps by using voice commands. The trainer also instructed the participants on how to dictate numbers and special text (e.g., all caps).
The trainer showed the participants how to control their computer desktop and applications including: Starting and closing applications by voice; switching between applications by voice; "clicking" menus and submenus by voice; and "clicking" dialog box controls by voice.

Lastly the trainer explained to the participants the need for ongoing training. Ongoing training should improve accuracy. There are several ways to do this. One is through customization of the users' vocabulary. The trainer showed the participants how to customize their vocabulary through methods such as adding a short phrase or a word.

Participants were instructed on each step and then asked to perform the operations. The trainer and researcher worked with the subjects in an attempt to ensure they understood how to use the software. Each subject was provided with a training manual.

Contact for additional training, technical assistance, and information provision varied from subject to subject based upon their requests and needs. The trainer was paid for these additional training and technical assistance sessions. The additional training, technical assistance, and information support provisions requested, and provided to the subjects, will be discussed on a case by case basis in Chapter IV.

The researcher followed-up with subjects on a weekly basis for the first month of the study and periodically there after. The follow-up took place as a means of determining if participants wanted additional training and support. The researcher also checked to see how the individual was proceeding with the VRS use. Additional training and support was not mandatory but was offered to those who wanted it. Follow up contacts were made via telephone, e-mail, and the disability support offices at each
institutions. Those subjects who had their own computer, with the minimum requirements necessary to run the software, were given complete copies of DNS. The researcher and trainer were available for troubleshooting home and campus computers. The provision of training, technical assistance, and information was available during the semester the subject was trained and for the subsequent six months.

The provision of training, technical assistance, and information took various forms including: advanced skills training; a repeat of the initial training or certain aspect of it; computer troubleshooting; software installation; assistance in training the software; and answering various questions. This will be elaborated upon in the narrative description of each participant in the findings section.

**Data Collection**

Merriman (1998) indicates that the goal of qualitative research is for the results to be consistent with the data collected. The researcher purposefully avoids controlling the research conditions and concentrates on recording the complexity of situational variables and interrelations as they occur. The researcher’s goal is to discover this complexity by altering research strategies within a flexible research design (Marshall, 1986). Accordingly, and due to the variant participation of the subjects, multiple data collection strategies were used. Table 3 provides a visual representation of the data collection methods used with each research subject. These data include telephone conversations prior to, and after, the initial training.

Degree of participation by the research subjects varied. Thus, several examples are provided to illustrate this variance. For example, Clay informed the researcher that he was not available for the focus group meeting but was on campus when the meeting took
place. Similarly, several research participants did not return phone calls and e-mails. Other subjects were not available for person-to-person contact. Table 3 shows the data collection instances that actually occurred between the subjects and the researcher. If a telephone call was made and a message left, but the subject did not call back, this was not included in the table. The researcher telephoned, paged, and or e-mailed all subjects weekly during their first month of participation in the study. After the first month follow up attempts took place about twice a month. These attempts varied depending upon the subjects' responses during the first month. For example, Chuck was no longer at the telephone number he provided. The researcher attempted to reach him through the disability support office and was told that he had not been attending classes. The researcher followed up with the disability support officer two additional times during the semester. She did not have any additional information on Chuck. The findings section of Chapter IV explains the attempts made by the researcher to contact each subject.

Data Collection Tools

This dissertation study used multiple data collection tools, including: face-to-face and telephone interviews; a focus group; observations; record reviews; e-mails; telephone conversations; surveys; conversations during the initial training and during technical assistance provision; and writing samples. The rationale for each data collection tool and how each was implemented are explained in the following text. Each data collection tool is listed, followed by RQ, which is an acronym for research question. RQ is followed by the number(s) of the research question the particular tool was used to explore.

Interviews: RQ's 1 & 3. Interviews provide rich, substantive data, and are a major part of qualitative research work (Janesick, 1998). According to Janesick (1998)
“interviewing is a meeting of two persons to exchange information and ideas through questions and responses, resulting in communication and joint construction of meaning about a particular topic” (p. 30). In this study the format for the interviews was unstructured. An unstructured format allows the researcher to respond flexibly to the emerging views of the participants (Merriman, 1998).

Unstructured interviews are guided by a list of questions to be explored. Neither the exact wording nor order of the questions is predetermined (Merriman, 1998).

- Face to face interviews were held with Brenda and Clay from the first semester and Alicia from the second semester. These were tape recorded and transcribed. Field notes were compiled. The protocol for the running the interview is in Appendix E.
- Telephone interviews were held with three first semester participants (Richard, Kim, and Betty) and two second semester participants (Jim, and Ernest). The researcher took notes during the telephone interviews.

**Focus groups: RQ's 1 & 3.** Focus groups are a qualitative methodology used to gain a more complete understanding of issues such as motivation, behavior, feelings, or decision-making strategies (Krueger, 1988; Morgan, 1988). Focus groups are designed to discuss issues relevant to a specific topic. Focus groups provide an environment where participants can express their ideas in a spontaneous manner that is not influenced by the researcher's prejudices and expectations (Bertrand, Brown, & Ward, 1992). In a group, participants often feel more secure discussing sensitive topics, the group helps to encourage more candid expressions of their opinions and perceptions (Byers & Wilcox, 1988). In this study the format for the focus group was unstructured. As in interviews an unstructured format allows the researcher to respond flexibly to the emerging views of
the participants (Merriman, 1998). Unstructured focus groups are guided by a list of questions to be explored. Neither the exact wording nor order of the questions is predetermined (Merriman, 1998).

- One focus group was held with Ron and Bill two first semester participants. The focus group was tape recorded and transcribed. The protocol used to facilitate the focus group is in Appendix F.

Observations: RQ's 1& 3. Observations are an effective means of obtaining additional data. When observing, an outsider may notice things that have become routine to the participants themselves but lead to a better understanding of the context (Merriman, 1998). Observations were planned and held with individuals who continued to use the software, as well as those who request additional assistance. The researcher observed the subjects and tried to gain insight into the following questions designed by Miles and Huberman (1984). (1) What were the main themes or issues in the contact? (2) Which research questions did the contact bear most centrally on? (3) What new hypotheses, speculations, or guesses about the field situations were suggested by the contact? The researcher took field notes during observations. Triangulation took place with analysis of the observation data.

- Observations took place with Clay and Brenda. The observations took place during a visit to the computer center at the college they attended. Field notes were taken during the observations. The researcher attempted to gain insight into the questions posed in chapter III.
### Table 3. Data collection methods by subject

<table>
<thead>
<tr>
<th>Subject</th>
<th>F-t-F</th>
<th>Focus</th>
<th>Observ</th>
<th>Phone</th>
<th>Record</th>
<th>E-mail</th>
<th>Phone</th>
<th>Survey</th>
<th>Conv/initial &amp; F/U Train &amp; TA</th>
<th>Writing</th>
<th>Samp</th>
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</table>

F-t-F = Face to Face  
Observ = observation  
Interv = interview  
Conv = conversation  
Conv/initial & f/u train & TA = conversation during initial and follow-up trainings and during technical assistance support  
Samp = sample
Record reviews: RQ’s 2 & 3. According to Merriman (1998) using documents as data is not all that different from using interviews or observations. As, in other forms of data collection in qualitative research, the process is guided by questions, educated hunches, and emerging findings (Merriman, 1998). Institutional records were reviewed at the beginning of each semester after receiving consent from each participant. Records indicating semester grades for the participants were reviewed when they became available (i.e. January for 1st semester and May for 2nd semester). During the records review the researcher investigated the participant's classification and obtained IQ and performance scores, when indicated. Other information obtained from the records review indicated participants academic strengths and weaknesses; and preferred learning styles. The researcher analyzed the records with a form of content analysis that involves the simultaneous coding of raw data and the construction of categories that capture relevant characteristics of the content (Merriman, 1998). Content analysis was used as a means to code data and verify previously established themes. Record data were also analyzed to obtain insight into the variables and characteristics that may be indicators of continued use r non-use of the VRS. The researcher reviewed documents in order to glean information on the area affected by the disability (i.e., written language, reading, mathematics) as this may influence the use or non-use of VRS. The document review was also used to support emerging themes. As is the case with focus group and interview data, records can verify and advance emerging categories and themes. The records, in some cases, verified contributing variables that influence the use of VRS as found in the focus groups, interviews, and observations.

• Records on file with the disability support offices were reviewed for all subjects.
E-mails: RQ's 1& 3. E-mail correspondences were used as a data collection source. E-mail provided a means of communicating that also provided a written record of such communications.

- E-mail exchanges took place with Alicia, Jim, Rhonda, Ron, and Kim. These were used during data analysis.

Open-ended Conversations: RQ's 1& 3. Conversations that took place with the study participants were used as a data source. Conversations are sometimes referred to as informal conversational interviews (Martella, Nelson, & Marchand-Martella, 1999). The informal conversational interview is usually an open-ended interview where the interviewer asks spontaneous questions. The interview format is that of a normal conversation, thus the reference throughout this text as the data collection method of conversations (Martella, Nelson, & Marchand-Martella, 1999).

- Telephone conversations took place with eight participants (Brenda, Clay, Alicia, Jim, Ernest, Rhonda, Richard, and Ron). The researcher took notes during the conversations

- Conversations that were held on the day the subjects were trained on the software were noted by the researcher and included in the data analysis.

Surveys (Appendix G): RQ 3. The research subjects were asked to complete a demographic survey (Appendix G). The survey requested background information on the participants including college major, college minor, high school completion, high school GPA, computer skill, disability, and first language spoken in the home. It provided the researcher with information that illuminated the reasons for other variables that impacted use of the software.
Surveys (Appendix G) were completed by all participants on the day they received training.

**Writing samples: RQ 2.** The collection of writing samples was utilized as a data collection method in order to compare the samples completed without the use of the software to those completed with the software. Participants were provided with a list of questions they could respond to (Appendix H) or they could submit compositions completed for coursework.

All participants other than Jim, Melissa, Ernest, Brent, Richard, and Bill completed writing samples, without the use of the VRS. Brenda and Alicia submitted additional writing samples completed using the VRS.

Extensive follow up data were not available for three persons who were trained the first semester and one who was trained the second semester, Frank, Brent, Chuck, and Melissa respectively, as they did not respond to telephone calls, e-mails, and contact attempted through the disability support offices. Brent responded to one follow-up call by the researcher as explained in Brent's narrative presentation of background and intervention data.

The data collected are reported in table and narrative format to provide the reader with a foundation on which to view the findings. The researcher believes that the rich descriptions of each individual subject's experience with the VRS shed light on, and provide insight into, the use of the software and the influential variables.

**Data Analysis**

Quantitative and qualitative data analysis procedures were utilized to analyze the data collected. These are describe in the following text.
Quantitative

Writing samples were evaluated using Fry’s Readability Graph, which is a quantitative method for obtaining the reading level of text (Appendix A). To use Fry’s Readability Graph a representative sample of text (100 words) is rated by counted the number of syllables and sentences in it. This provides a grade level score for the text. Fry’s Readability Graph was chosen as the means for measuring participants written performance as it is an objective measure that can be compared across settings. Fry’s Readability Graph does not evaluate grammar and spelling errors thus the participants’ use of spelling and grammar checking programs did not effect the outcomes. The researcher used Fry’s Readability Graph to investigate the continued use of VRS by postsecondary education students receiving services under the category of learning disabled and how it influenced their written performance.

Qualitative

The qualitative data collected were analyzed using the constant comparative method (Glaser & Strauss, 1967). Using the constant comparative analysis method the researcher began with a particular incident or participant response from the data collected and compared it with other incidents or responses in the same set of data or in another set. These comparisons lead to tentative categories that were compared to each other. A coding system was developed to identify key words and patterns that ran through the data. The patterns and themes that emerge were similarities and differences among individuals. When using the constant comparative method comparisons are constantly made within and between levels of conceptualization until a theory can be formulated. Because the basic strategies of the constant comparative method are compatible with the
inductive, concept-building orientation of all qualitative research, it has been adopted by many researchers who are not seeking to build substantive theory (Merriman, 1998) as is the case in this research. The purpose of this study was not to build a theory. Rather, the constant comparative model of data analysis was chosen because it is an effective method for identifying patterns in the data, which is a purpose of this study.

**Triangulation**

Triangulation is a technique used in data analysis where data from three sources are compared. Triangulation was used in this study to build a coherent justification for emerging themes (Creswell, 2003). The researcher also utilized triangulation to corroborate findings for each research question by identifying, comparing, and contrasting pertinent data from multiple sources across data sources, individuals, time, and settings (Miles & Huberman, 1994).

**Summary**

Chapter III describes the methodology and research design used in this study. A mixed-methods approach was chosen based upon the research questions posed. Using the qualitative methods explained, naturally occurring data were collected. Through the use of the multiple methods of data collection, as explained, an overall picture of the subjects' experiences unfolded. Quantitatively, Fry's Readability Graph provided data on the use of VRS and its' influence on written performance. Findings from the data that were collected are described in Chapter IV.
Chapter IV: Findings

Introduction

Chapter IV presents the research findings beginning with the participants’ demographic information. This is followed by a narrative presentation of the qualitative and quantitative data findings on all subjects, accompanied by tables. The tables present the demographic background of the research subjects and the themes that emerged from the data that contributed to the ongoing use of the software. The chapter concludes with a presentation of the findings as they pertain to each research question.

While VRS has been deemed an effective compensatory strategy for written language difficulties often experienced by postsecondary education students with learning disabilities (Higgins & Raskind, 1995), this determination was made, in a controlled educational setting. While Higgins and Raskind (1995) found VRS to be an effective compensatory strategy for improving the holistic written language scores of postsecondary education students with learning disabilities they did not determine whether or not students would continue to use the software after they were trained or outside of the controlled setting. The research study, presented here, explored this area through investigation of the following research questions.

1. After being trained on VRS will persons, in postsecondary education, receiving services under the category of learning disabled, continue to use the software to complete their academic course work? Will they further use the software for purposes other than academic study?

2. Does the ongoing use of VRS, by postsecondary education students receiving
services under the category of learning disabled, improve their written
performance when assessed with Fry's Readability Graph (Appendix A)?

3. What are the contributing variables that influence the continued use, and or
non-use, of VRS by postsecondary education students receiving services
under the category of learning disabled?

Demographics of the Study Participants (quantitative data)

Demographic information on each of the research subjects is provided in table 4. This information is provided as a framework from which to view the narrative findings. The demographics charted include age, with a range of 19 to 56 and a mean of 32; gender, with six females and nine males; the attending institution with seven participants (Brenda, Clay, Frank, Ron, Chuck, Bill, and Kim) attending the 2-year college; four (Betty, Rhonda, Brent, and Richard) attending the 2-year college with a 4-year preparation program; and four (Alicia, Jim, Melissa, and Ernest) attending the 4-year research institution. IQ is indicated with a range of 78 to 116 and a mean of 94.

Subject’s academic standing is presented. Academic standing varied substantially, as shown, with five subjects (Rhonda, Brent, Frank, Ron, and Chuck) enrolled in remedial classes and one (Alicia) working on a Masters Degree. Likewise, subject’s major area of study varied. The only similarities in major areas of study were for those who were undecided. All subjects, other than Chuck, received a high school diploma. Chuck, as self-reported, received a certificate of completion.

Table 4 also indicates when the individual was identified with the disability that qualifies them to receive services under the category of learning disabled from their attending institution. Brent self reported as having dyslexia but his records were
Table 4. **Demographic background on each research subject**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Age</th>
<th>M/F</th>
<th>Inst. Attend</th>
<th>IQ</th>
<th>Academic standing</th>
<th>Major</th>
<th>H.S. Diploma/Certificate granted</th>
<th>When diagnosed</th>
<th>Speaks</th>
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<tr>
<td>Brenda</td>
<td>25</td>
<td>F</td>
<td>2-yr</td>
<td>89</td>
<td>Sophomore</td>
<td>Criminal justice</td>
<td>Diploma</td>
<td>K-12 Y</td>
<td></td>
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<td>Clay</td>
<td>32</td>
<td>M</td>
<td>2-yr</td>
<td>NI</td>
<td>Sophomore</td>
<td>Liberal arts</td>
<td>Diploma</td>
<td>Adult N</td>
<td></td>
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<td>F</td>
<td>Univ</td>
<td>116</td>
<td>MA degree</td>
<td>Public administration</td>
<td>Diploma</td>
<td>Adult Y</td>
<td></td>
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<td>Jim</td>
<td>26</td>
<td>M</td>
<td>Univ</td>
<td>115</td>
<td>Senior</td>
<td>Elementary and special education</td>
<td>Diploma</td>
<td>Adult Y</td>
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<td>Melissa</td>
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<td>F</td>
<td>Univ</td>
<td>97</td>
<td>Junior</td>
<td>Liberal studies</td>
<td>Diploma</td>
<td>Adult Y</td>
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<tr>
<td>Ernest</td>
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<td>M</td>
<td>Univ</td>
<td>108</td>
<td>Junior</td>
<td>History/anthropology</td>
<td>Diploma</td>
<td>Adult Y</td>
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<td>2, 4-year</td>
<td>84</td>
<td>Junior</td>
<td>Early childhood education</td>
<td>Diploma</td>
<td>Adult Y</td>
<td></td>
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<td>19</td>
<td>F</td>
<td>2, 4-year</td>
<td>NI</td>
<td>Remedial</td>
<td>Hotel management</td>
<td>Diploma</td>
<td>K-12 other Y</td>
<td></td>
</tr>
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<td>Brent</td>
<td>19</td>
<td>M</td>
<td>2, 4-year</td>
<td>78</td>
<td>Remedial</td>
<td>Agriculture</td>
<td>Diploma</td>
<td>K-12 Y</td>
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Table 4 (continued). Demographic background on each research subject

<table>
<thead>
<tr>
<th>Subject</th>
<th>Age</th>
<th>M/F</th>
<th>Inst. Attend</th>
<th>IQ</th>
<th>Academic standing</th>
<th>Major</th>
<th>H.S. Diploma/ Certificate granted</th>
<th>When diagnosed</th>
<th>Speaks</th>
<th>Stand Eng</th>
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<td>39</td>
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<td>88</td>
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<td>ITS</td>
<td>GED</td>
<td>Adult</td>
<td>N</td>
<td>Eng</td>
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<td>2-yr</td>
<td>84</td>
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<td>Social work</td>
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<td>Adult</td>
<td>N</td>
<td></td>
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<td>M</td>
<td>2-yr</td>
<td>NI</td>
<td>Remedial</td>
<td>Undecided</td>
<td>other</td>
<td>Adult</td>
<td>N</td>
<td></td>
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<td>Chuck</td>
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<td>M</td>
<td>2-yr</td>
<td>78</td>
<td>Remedial</td>
<td>Liberal arts</td>
<td>Certificate</td>
<td>K-12</td>
<td>N</td>
<td></td>
</tr>
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<td>M</td>
<td>2-yr</td>
<td>NI</td>
<td>Freshman</td>
<td>undecided</td>
<td>Diploma</td>
<td>Adult</td>
<td>N</td>
<td></td>
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<tr>
<td>Kim</td>
<td>19</td>
<td>F</td>
<td>2-yr</td>
<td>91</td>
<td>Freshman</td>
<td>undecided</td>
<td>diploma</td>
<td>NI</td>
<td>Y</td>
<td></td>
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</tbody>
</table>

M/F = Male/Female  Inst attend = Institution attending  Ind = individual  H.S. = high school  NI = not indicated
Stand Eng = Standard English  2-year = 2-year community college  Univ = Category I research institutions
2, 4-year = 2 year community college with a 4-year preparation program  ITS = information technology services
incomplete thus this was not officially corroborated. The disability support officer from
the institution Brent was attending confirmed his self-report of dyslexia. When the
researcher observed Brent it was evident that he had severe difficulty reading. Likewise,
Kim self-reported as learning disabled but her records were not on file at the disability
support office. According to the disability support coordinator Kim’s records had been
requested from her high school. Four individuals (Brenda, Rhonda, Brent, and Chuck)
were identified with their qualifying disability while attending elementary or secondary
schools. All others were identified as adults.

Lastly, table 4 indicates whether or not each participant spoke Standard English as
determined by the researcher through conversations held with each subject. Please note
that there may be variance in the researchers’ perception of what is and is not Standard
English. While a scientific measure was not utilized to determine whether or not an
individual spoke Standard English the researchers perception was included because
previous research indicates that dialectical differences may be a variable that affect the
use of VRS (Higgins & Raskind, 1995). This is supported by Higgins and Raskind
(1995) in that the phonetic model to which the speaker is matching his or her vocabulary
(when training and using VRS) is in standard GLAD (Great Lakes Area Dialect; Davis,
1949 as cited in Higgins & Raskind, 1995) apparently spoken by a male in his late
twenties. Table 4 charts personal characteristics for each participant that may have
influenced the use of DNS. For instance, the three participants (Brent, Frank, and Chuck)
who dropped out of college were each enrolled in remedial classes. Information from
table 4 will be further utilized in the discussion of the results
Qualitative Data Findings on all Subjects

Following is a personal and demographic description of each research subject. The description also includes the subjects self reported experience with the VRS. The descriptions are based upon face-to-face and telephone interviews; a focus group; observations; record reviews; e-mails; telephone conversations; surveys; conversations during the initial training period and during technical assistance provision; and writing samples.

Brenda

Brenda is of African American descent and grew up in Hawai‘i. She speaks Standard English as observed by the researcher. While participating in the study she was a sophomore at a 2-year community college. Her Full Scale IQ was reported as 89. She was 25 years old and hoping to complete her AA degree and go on to a 4-year college to get a degree in criminal justice. She was receiving assistance from Division of Vocational Rehabilitation (DVR) for expenses associated with her college education. During the semester she participated in the study she changed phone numbers three times. The researcher would try to contact her and the number would be disconnected. Fortunately, she would call the researcher periodically and provide another contact number. The researcher was also able to consistently contact her through the disability support office at her attending institution. Since the initial training Brenda and the researcher have had numerous contacts as presented in table 3. She is the only participant who took advantage of additional training by attending a second, advanced, 4-hour training session. Eleven telephone conversations took place between Brenda and the researcher. These include two prior to the initial training, and contacts initiated by the
researcher and Brenda after training. Brenda did not respond to e-mails. All contacts took place over the past 14 months as opposed to strictly during the semester she was trained on the software.

Brenda is diagnosed with learning disabilities in the areas of written language, math, and reading. She was clearly able to verbally express her ideas, thoughts, and opinions as observed by the researcher and as indicated in her records on file with the disability support office. When asked why she used the software she said that "my vocabulary skills, my writing skills are okay but my spelling is horrible, even when I do spell it right I am always wondering if I did". Brenda used the software extensively on campus as she did not have her own computer. During her interview she said

I love it; I am very impressed by the software. It has cut my workload in half. It took awhile to adjust and figure out what words worked really well and what ones the system had difficulty recognizing. "Scratch that" didn’t work but "delete that" did, so I use the “delete that” command. It's so cool because of the fact that I can say anything, words that I have a hard time spelling I can use. Words I hadn't even dreamed of writing could be said. The program matched my vocabulary with my writing. Using words like imaginary, legend, big words that can really capture my thoughts and what I want to say. I can use numbers and translate that to billions or turn words into numbers, I can say numbers and then translate back into words.

During the semester Brenda was trained on the software she asked for and received an additional four-hour training session, which she indicated helped her. At
times though she had problems with the software not recognizing her voice. She said that it started acting up in November and she was trained in September.

She stated "after awhile the program started to act up, glitch. I tried to retrain it but it would be okay for a while and then go back to not picking up words like “this”, “that”, and “yes”. It would get slower and every word would have to be spoken slowly and pronounced clearly. It would get fixed for a little while (after retraining) and then go back to the same thing."

The Hawai’i representative for DNS (who was the trainer) and the researcher went to campus to assist Brenda. The DNS representative attempted to trouble shoot the problems on the computer Brenda used. He adjusted the amount of resources being used on boot-up. The computer was using 33% of its resources just by starting up. He and the person who runs the computer lab spoke about the need to defragment the hard drives. The discussion turned to the use of a USB microphone that was supposed to work better than the traditional one. The researcher purchased a USB microphone. Brenda tried the USB microphone and compared it to the standard one. She read the same passage under both conditions and had close to the same number of errors with both microphones. Brenda still continued to use the software even though she experienced problems.

During the technical support session described, the researcher observed Brenda and recorded field notes. The researcher noted that the software did not recognize many of the words she spoke. Brenda was okay with this. She did not get flustered. She would use the "delete that" command and say the word again. She exhibited advanced skill in using the software. The software would not recognize a word and she would quickly train it using voice commands and the procedures she learned during training.
The researcher observed her using words to type numerals with ease. She exhibited complete competence with the software.

Brenda used the VRS for personal purposes as well as academic. She used voice commands to open and close windows, to save, and for most features that are traditionally done with a mouse. She explained that she used the voice commands because the mouse hurt her wrist when she used it too much. She said she was starting to get carpal tunnel syndrome.

Fourteen months after she was initially trained on the software she called the researcher and said that she used version 6.0 and it works even better than version 5.0. She was very excited about this and reported that another study participant (Clay) was also using version 6.0 and it worked better for him.

Brenda submitted three writing samples. Analyzing her writing samples with Fry's readability graph (Appendix A) found that her grade level increased from 4.5 to 6.5 when comparing her first writing sample, which was completed without the use of the VRS, to her second and third writing samples that were completed with the use of the software.

*Clay*

Clay is native to Hawai‘i and speaks Pidgin. He was born and grew up in Hawai‘i. During the semester he took part in the study he was a sophomore at the 2 year community college (see table 4). He was 27 years old and intending on becoming a substance abuse counselor. Clay's records did not indicate an IQ score. Clay reported that his reading and writing skills are average. He also reported that he has difficulty focusing and attending to tasks. His records validated this with a statement of a diagnosis
of ADHD. His evaluation, on file with the disability support office, states that he suffers from a medical condition that interferes with his ability to learn and process information and that he will benefit from accommodations. His records do not state a specific diagnosis of learning disabled.

After the initial training Clay did not always respond to contacts made by the researcher. For instance, within the first two weeks after the initial training the researcher paged him three times before he returned a call. This became a pattern.

The DNS representative and the researcher worked with Clay while they were on campus assisting Brenda. Clay was on campus and agreed to take the time to be provided with technical assistance. In observing Clay using the software it seemed apparent that his local dialect interfered with the word recognition of the software. For example when Clay pronounced the word three it sounded like tree. Thus, the VRS translated the word as tree. Clay became observably frustrated and irritated.

Clay and the researcher had three face-to-face meetings including an interview. Six telephone conversations were held between Clay and the researcher over a 14-month period. When the researcher made contact with Clay and asked if he would be available for a focus group meeting he said that he could not make one because he had to work. When the researcher completed the focus group with the other participants Clay was sitting in the disability support office. At this point the researcher asked him when he would be available for an interview and a date and time was set. In his interview he indicated that the software works sometimes and not other times. He was using the software on the campus of the 2-year college. He said that he tried the software for several months and it did not work for him. He self-reported as a single finger typist and
indicated that he hoped the software would help him. He said that he was specifically frustrated because "I say words and get different words." He also said that it "types words when nothing is said." This is quite common if people breathe heavily or make extraneous sounds, such as sighs.

Clay also indicated that the software might have more difficulties when there are other people and noises in the room, as they seem to interfere with the voice recognition. He said he was frustrated because "I work better with more people around rather than in isolation so to use the software in isolation is distracting." Clay was trained on the software in September and in his interview in December he said "I don't want to try again for now, I've reached my breaking point." He stated that he thinks it could be useful but not during the school year. He said that he wanted to use the software in his career because he has difficulty writing.

Fourteen months after his initial training, Clay called the researcher and said that he tried version 6.0 and that it works really well. He asked the researcher to write a letter to the DVR on his behalf telling them that he was trained on the software and that he could benefit from its use. He was hoping that DVR would purchase it for him. He asked how much the software cost. When he was told it was around $200.00 he said he thought it was more expensive and that he could buy it for himself. The researcher paged Clay approximately two weeks after this contact but he did not respond. There has been no further communication.

Alicia

Alicia is Vietnamese-American and grew up in the South Eastern mainland United States. She speaks Standard English as observed by the researcher. Her Full
Scale IQ was listed as 116. She was 31 years old during the semester she participated in the study. She was working on her Master's degree in public administration. She was applying for Law School in Australia. Alicia reported that she was in and out of special education classes during her first few years of school. This was because of a language barrier as her mother speaks Vietnamese so she sometimes had difficulty understanding English. She was only recently, at age 27, diagnosed with a learning disability. She speaks very well but through observation and conversation it was apparent that her mind was working faster than she could speak (even though she speaks rapidly) which causes her to loose her train of thought. She appears to have a lot of thoughts all at one time. Perhaps because of this she does not always complete sentences and thoughts. This was also verified in her learning disability evaluation, which indicates she has a verbal processing deficit.

Alicia was given DNS with a microphone and manual on the day of the initial training. The researcher contacted her the week following the initial training and she said that she had gotten the software installed but thought she needed a better microphone. After this conversation Alicia e-mailed the researcher and asked if she had to disconnect the microphone in order to be able to use the speakers. The researcher explained that on most computers one could use them simultaneously. The researcher explained how to do this. Another e-mail exchange included Alicia informing the researcher that she purchased a better microphone. When asked if she would like additional training Alicia said no, not during the semester. When asked if she would like training over the summer she said yes. The researcher attempted to contact her (via e-mail and telephone messages) to set up an additional training over the summer and did not get a response.
until after the summer semester was over. Alicia explained that she was in Australia for
the summer. She said that she did not have time for training during the Fall semester.
Additional e-mails were exchanged over the semester including submission of writing
samples.

Alicia and the researcher had a face-to-face interview after the semester she was
initially trained. Alicia reported that she liked the software but that it needed
improvement. She stated that "in a noisy environment it doesn’t work well... need a
sound proof room. In my apartment it picks up the background noise and changes words.
I live off from a busy street so it picks up the outside noise. If I use it at 2:00 or 3:00 in
the morning it seems to work better because it is quieter outside." She also stated that
"my rate of speaking has to slow down for it to recognize the words I speak." She said
that "speaking at the rate I'm thinking still doesn't work well", this was what she had
hoped it would do.

She said she had problems with things like “four” and “for”; and “too”, “two”,
and “to”. She felt that the quality of the microphone was important so she purchased a
new one but it did not seem to make much of a difference. She said that the concept and
theory are great but it was not as easy to use as she thought it would be. She also said
that she did not have enough time to learn all the aspects of the software. Even though
problems existed she was still using the software. The researcher told her that some
people had better luck with version 6.0 and she said she would check the campus
bookstore to see about the possibility of purchasing version 6.0. The researcher
suggested that she call the DNS Hawai’i representative if version 6.0 was not available at
the bookstore.
Alicia submitted one writing sample without the use of DNS. She submitted six writing samples that were class work and completed with the VRS. These were analyzed with Fry's Readability Graph (Appendix A). There was no difference among the writing samples (pre and post samples) with all of them having a grade level equivalency above 12 indicating college level writing.

Jim

Jim is Caucasian, from the mainland U.S. and speaks Standard English. During the semester he took part in the study he was 26 years old and a senior at the 4-year research institution. His Full Scale IQ score was indicated at 115. He was planning on graduating at the end of the semester. He was getting his bachelors degree in elementary and special education. He was student teaching at the time. He was also moving to another island, in the process of purchasing a home, and planning his wedding.

Three days after the initial training the researcher delivered DNS to the disability support office on Jim's college campus so that he could pick it up. Over the next few weeks Jim and the researcher spoke several times and exchanged two e-mails. All contacts were similar in that he said he had not had time to use the software.

Jim and the researcher spoke again after he moved to another island. Jim said he tried to install the software but had problems. He said that he was running Windows XP. The researcher contacted the trainer and got the directions for installing the software on an XP system. The researcher forwarded this information to Jim. When the researcher followed up with Jim he said that he had gotten the software installed and tried to use it but it did not work well. He said he would return it. The researcher told him he did not have to return the software.
Jim and the researcher also had a telephone interview. In the interview he said he just did not have time to use the software. After overcoming the installation problems he tried it but it did not work very well. He said that he had not tried again because with the move and problems with his new house he just did not have the time.

Melissa

Melissa was a 35 year old junior at the 4-year institution when she took part in the study. She is Caucasian, from the U.S. mainland, and speaks standard English. She was majoring in Liberal studies. During the initial training she indicated she was recently diagnosed as learning disabled. Her records indicated that she was learning disabled, not otherwise specified and a Full Scale IQ score of 97. After her initial training she did not respond to four telephone messages left and three e-mails sent. Because she did not respond additional data were not available.

Ernest

Ernest grew up on the U.S. mainland, is Caucasian, and speaks Standard English. He was a 27 year old junior at the 4-year institution when he took part in the study. He was majoring in History and Anthropology. He was diagnosed as learning disabled with ADHD as an adult. His records indicated a Full Scale IQ score of 108. The researcher gave Ernest DNS on the day of his initial training for use on his home computer. He and the researcher spoke on the phone four times including initial contact and a telephone interview. Several messages were left and not responded to. During the conversations that did take place Ernest said he had not had time to use the software. When asked if he would like additional training he replied that he was doing okay without the software and that he did not want to take the time away from his studies to try to learn it. He said that
he was not sure if he would try it in the future. He said that he is a pretty good typist but sometimes has problems focusing when attempting to complete writing assignments. He and hoped the software would help him focus.

Betty

Betty is from the U.S. mainland, is Caucasian, and speaks Standard English. She was a Junior and 45 years old when participating in the study. She indicated she is getting her degree in early childhood education. She indicated that her computer skills are below average and her writing skills are average. She was diagnosed with a learning disorder in April of 1999. According to her academic records her GPA was 3.84. She was diagnosed with adjustment disorder/NOS, learning disorder/NOS, and primary insomnia by self-report. Her Full Scale IQ was reported as 84. Another area of her psychological evaluation states the she has a mild learning disability.

Prior to the initial training Betty and the researcher spoke five times. Betty was very anxious about participating in the study. She agreed to participate and the researcher was at the post office preparing to mail the air coupons when Betty called. She still was not sure that she wanted to participate. She said she was concerned that she would not complete the study. The researcher assured her that she was free to drop out at anytime. When the researcher picked her up at the airport and during the initial training Betty expressed that she was only recently diagnosed as learning disabled. She also said that she was verbally abused as a child and told she was stupid a lot. She appeared very anxious. She was very kind and seemed to be concerned about letting the researcher down.
After the initial training the researcher contacted Betty and received a writing sample completed without the use of DNS. The researcher picked this up at the disability support office. Messages were not returned until near the end of the semester when a telephone interview was held. During the interview Betty said "I am really sorry but I didn't have time to try to use the software. Writing is not one of my weak points. I can type really well. My learning disability is more in organizing my thoughts."

Rhonda

Rhonda is Caucasian, from the U.S. mainland, and speaks Standard English but with a slur. At the time she participated in the study she was 19 years old. She was enrolled in a certificate program at the 2-year college with the 4-year preparation program. Her father, who was a psychologist, diagnosed her with a learning disability. Her records, on file with the disability support office, indicated that she was in special education during her K-12 years. Her records do not indicate an IQ score.

The disability support officer gave the researcher Rhonda's telephone number. The disability support officer had told Rhonda to expect a telephone call. The number provided was to a vacant line on the campus. The researcher called campus information and could not get a working number. The researcher proceeded to speak with the disability support officer who told Rhonda to call the researcher. Rhonda called the researcher and said that she would like to participate in the study. This contact was made three days before the next training. Rhonda said she had air coupons that her father had given her and that she could use these to get to the training site. The researcher said she would provide her with replacement coupons. After this conversation Rhonda called the researcher and said that her father had some questions regarding the research. The
researcher called the father and answered his questions. He agreed to let his daughter take part in the study. Rhonda would be trained on a Saturday and then spend the rest of the weekend with her father.

During training the researcher read the passages to Rhonda and she then repeated what was said into the microphone. Her reading abilities were poor. She would try to read and speak the words before the researcher said them. In doing this she would say the wrong word and the computer and software would attempt to adjust. Based upon this it took Rhonda about 10 minutes longer than for the other subjects to train the software.

Rhonda provided the researcher with an initial writing sample without the use of DNS. She completed this while waiting for the initial training session to begin.

The researcher contacted Rhonda by e-mail after the initial training. Rhonda indicated that she had gotten a computer. The researcher went to Rhonda's apartment, on a neighboring island, and installed the VRS. The researcher then worked with Rhonda, to train the VRS. In the telephone interview Rhonda reported that she was in a certificate program that does not require a lot of writing. Based on this she was not using the software. She said that she may use it in the future but really did not have a need at the moment.

Brent

Brent is Hispanic with Caucasian adoptive parents. He spoke standard English with a slight accent. He was in special education classes through out his K-12 years. While participating in the study he was 19 years old and enrolled at the 2-year community college with a 4-year prep program. He reported that he was getting a degree in agriculture.
Prior to the initial training Brent and the researcher spoke once. The researcher also spoke with Brent's mom. His mom had some concerns about him traveling to Oahu. The researcher assured her that Brent would be picked up and dropped off at the airport. When Brent was picked up at the airport he told the researcher that he only recently could travel alone because he used to be very fearful. He said that he was treated for obsessive compulsive disorder (OCD) but was doing really well. He did not say how his OCD was exhibited and the researcher did not question him further.

Brent's records from the disability support office were not complete. The records indicated that based on the WISC III his full scale IQ was 78. This was a test done on 4/30/96 when he was in eighth grade. Brent self-reported as dyslexic during a conversation on the day he was trained on the software. He also reported that he gets help from the disability support office in the form of note takers and that his mom helps him at home with typing and spelling.

Brent had difficulty reading the passage into the microphone during the initial training the software. Thus, the researcher read the passage to him and he repeated what was spoken. He appeared to be severely learning disabled. He wanted to use the software to write reports required in his position as a campus security officer.

Brent's initial VRS training took place prior to the researcher receiving DNS from the manufacturer. After the software was received the researcher left a message for Brent that a copy would be provided. The researcher left the software at the disability support office. When the researcher followed up with Brent he said that he had installed it at home but that he really needed to use it on campus to complete paperwork required for his job. He said that he was working security on campus and that every night he had to
do paperwork. He said that the computers are on the other side of campus and that he can
not get over there to use them. Additional attempts to reach Brent via telephone and e-
mails were not successful. Follow up with the disability support coordinator revealed
that Brent had been diagnosed with cancer and had withdrawn from college.

Richard

Richard is Hispanic and speaks English as a second language. He was 39 and a
sophomore at the 2-year community college with a 4-year prep program when he
participated in the study. He was majoring in information technology services. He is
now going to school to become a mathematics teacher and is supported in this endeavor
by the Veterans Administration (VA) as reported to the researcher by the disability
support officer. According to his evaluation Richard has a learning disorder/Not
otherwise specified and academic and occupation problems. His full scale IQ is 88. His
evaluation states that his spelling and reading are clinically significantly lower than what
would be expected based on his obtained IQ scores and thus are indicative of a learning
disability.

Richard was not provided with the DNS software because he did not have a home
computer while participating in this study. The researcher followed-up with Richard
after his initial training. He said that he tried to use the software on campus but that it did
not recognize the words he spoke. When asked if he would like additional training he
said, “not now”. He said that he would submit a writing sample but this was never
received.

After many attempts the researcher contacted Richard near the end of the
semester. Richard said that he did not have time for a focus group meeting but would be
available for a phone interview. The researcher asked him if he could do it right now and he said yes. During the interview he said he thinks he would use the software if he had a computer at home. Using campus computers was difficult because the ones with the software installed are not available at night. He does not have time during the day to use the on campus computers. He said that he was going to try to get the Veteran’s Administration (VA) to buy him a computer with DNS. He said that he was going to have VA pay for the Hawai’i representative for DNS to provide training. When the researcher followed up with him about a month later he had not contacted VA about the computer and was not using the software. Likewise, the DNS representative had not heard from Richard regarding VA paying for him to provide training.

Frank

Frank is local and speaks pidgin. At the time he participated in the study he was enrolled in remedial coursework at the 2-year community college. His records indicated a Full Scale IQ of 84. His records state that he may have an auditory processing difficulty with his greatest difficulty in writing. He is diagnosed with a learning disability in written expression. Frank came to the initial session with a writing sample. His wife had proofread this sample but he indicated it was a rough draft. He also presented the researcher with an article about himself that was published in a local newspaper. For purposes of confidentiality the researcher will not go into this any further other than to say the article was about Frank’s learning disability.

While participating in this study Frank was taking remedial English at the 2-year community college. He said that he would like to be a social worker. He was only recently diagnosed with a learning disability. During the training session he said that
when he was in high school he used to threaten to beat kids up if they did not do his
homework for him. He indicated that he was always very frustrated with school and felt
relieved when he found out he had a learning disability. He stated that his wife
proofreads his course work prior to his submitting it. Due to personal problems, as
reported by another participant and the disability support officer, he dropped out of
college during the semester he was a participant. He did not respond to three voice
messages and one person-to-person message left at his home number.

Ron

Ron is originally from New Zealand. He speaks with a New Zealand accent that
is not considered GLAD. He self-reported that he had a stroke but his record on file at
the disability support office, indicated that he had traumatic brain injury (TBI). Use of
his right side was limited as indicated in his file and as observed by the researcher. This
was his prominent side so he was forced to use his less prominent side to perform most
activities. His records did not indicate an IQ score.

While participating in the study Ron was 35 years old and attending the 2-year
community college and was not sure what he was going to major in. He did indicate that
he liked to write. During the focus group he showed the researcher the college creative
writing publication for students. Ron had a story published in it. He was very proud of
this and expressed that he enjoys writing and may want to become a writer. Ron was
provided a copy of DNS. He picked it up from the disability support office. With his
limited ability to use his right side the VRS seemed like a viable alternative to single
finger typing.

Ron was a participant in the focus group. When asked what it was like for him,
using the software, he said "I like it". Ron tried to use the software and had limited success. When asked why it did not work for him he responded, "not enough memory in the computer part, we got a memory but it's still on the counter because no one knows really how to put it on. A couple do but they've been slacking because the surf's been really good so everyone's been surfing."

He also stated that "the microphone we got we upgraded to the best one we could find like $60, $70, it's ok but I haven't actually used the computer, tried to use it for like um, for about 3 months". This was implied to mean that he tried to use it three months ago and had not tried since. He also stated that once they get the memory put into the computer he would try the software again. Ron stated "it's a beautiful system, the system is beautiful".

Ron also spoke about his New Zealand accent and that it might affect the use of the VRS. He said "it isn't the same as Australian, and it isn't the same as English, and it isn't the Same as American, Um, probably the closes to it is English or Australian."

Chuck

Chuck is local and speaks Pidgin. He was 20 years old and a Freshman at the 2-year community college intending to major in liberal arts. During the semester he was in the study he was taking remedial English. His records indicate that his Full Scale IQ is 78. He was in special education classes in high school and was the only participant to exit high school with a certificate of completion rather than a diploma or GED.

Chuck arrived early for his initial training. The researcher explained the study, and his role in it, to him. The researcher asked him if he would like to use the time
before the training to complete his first writing sample, which he did. During the initial training Chuck indicated he did not have a permanent residence. Attempts to contact him after the initial training were not successful. According to the disability support officer Chuck stopped attending classes. Attempts to contact him were not successful.

**Bill**

Bill is local and speaks Pidgin. He was 56 years old and a sophomore at the 2-year community college during the semester he participated in this study. Bill’s records do not indicate a Full Scale IQ score. Bill had a stroke while working as a manual laborer. The stroke affected his memory capabilities. He said that he wants to get his Bachelors degree so he can teach special education. He was interested in teaching special education because he has a grand child with Down's syndrome. He assists with Special Olympics every year. Bill took part in the focus group meeting. In reference to using the software he said:

> But it's the kind of thing that I'm not confident to knock out a report and then go to class with it. It would take me longer right now to fool with the system trying to understand it. It is easier for me right now to fumble through with my old reliable ways. I could see if I had more time maybe say on the weekend when I'm knocking out papers and I have a lot of time like a two-day thing I could spend 8 to 10 hours on it you know like when I'm baby sitting. When I get to school you know, I get dropped off get picked up I don't have the extra time, like flextime."

When asked whether or not he had a computer he said, "I do but it crashed but DVR is giving me a new main board, cause yea it crashed, but DVR is giving me one so yes I do have a computer." He did have a computer but based upon his report it was not
working. During the initial training Bill indicated he had an older computer. The DNS trainer and Bill spoke and determined that the computer did not have the right specifications to run the software.

Kim

Kim grew up on the U.S. mainland and as perceived by the researcher speaks Standard English. During the semester she took part in this study she was 19 years old and a Freshman at the 2-year community college. She had not decided what field of study she would pursue. She was receiving services under the category of learning disabled but her records do not clearly indicate a learning disability. Her records indicate that she is stronger in expressing basic concepts in sentences than she is in her ability to correctly use capitalization and punctuation. Her records indicate a Full Scale IQ of 91.

After the initial training the researcher contacted Kim via e-mail as she had said that this was the best way to reach her. Kim indicated that she was having problems with the program. She tried to use the computer on campus because she does not have a computer at home. She left notes for the researcher at the disability support office. She stated in writing that, "it doesn't recognize the words that I speak." She also wrote that it does not recognize the statement "quotation marks" and that this will be entered into the computer as question marks, typed in words rather than as a punctuation mark. She indicated similar problems with the software recognizing the command "period" as a punctuation mark. Kim indicated that she tried to use the software to complete an English assignment and it did not work well for her. She stated that "whatever I say it says something else".
The researcher e-mailed Kim and asked if she would like additional training. Kim e-mailed back that she did not have time. She indicated that she is a good typist and does not want to try the software anymore. The researcher e-mailed Kim and left telephone messages regarding her attendance at the focus group meeting or the possibility of setting up an interview. Kim did not respond.

Summary

The narrative presentation of the qualitative data collected on each research subject provided insight into what occurred with each subject during the study. Fifteen subjects were initially trained on the use of the VRS. After the initial training three of the subjects (Melissa, Frank, and Chuck) did not respond to attempts to contact them as indicated in the narratives on each subject. The researcher does not know if these three subjects continued to use the software.

The researcher was able to obtain data from the remaining 12 subjects through the use of various qualitative tools. Nine (Brenda, Clay, Alicia, Betty, Rhonda, Frank, Ron, Chuck, and Kim) out of the 15 subjects submitted initial writing samples, completed without the use of the VRS, near the beginning of the semester they participated in the study. Of the 9 subjects who submitted initial writing samples two (Brenda and Alicia) also submitted samples mid-semester, and near the end of the semester that were completed with the use of the VRS. Brenda and Alicia were the only participants who continued to use the software. Five other subjects (Clay, Jim, Richard, Ron, and Kim) attempted to use the software but did not continue.
Findings by Research Question

The findings from the qualitative and quantitative data collected and analyzed are used to address the research questions in the following text. The themes that arose from the data, as variables that influenced the ongoing use or non-use of the VRS, are presented in table 5. These variables are presented by subjects' responses.

Research Question One

After being trained on VRS will persons, in postsecondary education, receiving services under the category of learning disabled, continue to use it to complete their academic course work? Will they use it for purposes other than academics? The findings can be broken down into three categories of use: attempted use, non-use, and ongoing use.

Summary of findings from subjects who attempted but did not continue to use the software. Five of the research subjects (Clay, Jim, Ron, Richard, and Kim) attempted to use the software but did not continue. The themes and associated variables that emerged from the data as to the reasons subjects stopped using the software were similar for all five. These included:

DNS failed to accurately recognize the words spoken. All five subjects stated that the VRS would type words that they did not speak or type words inaccurately. Subjects indicated that DNS frequently typed the wrong word and that it is difficult to correct.
<table>
<thead>
<tr>
<th>Subject</th>
<th>Attempt/cont'd to use VRS</th>
<th>Time</th>
<th>Personal Ease</th>
<th>Personal Use of</th>
<th>Use of</th>
<th>Disability (area affected)</th>
<th>Other compensatory strategies</th>
<th>Acquisition of skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brenda</td>
<td>Cont'd</td>
<td>No</td>
<td>No</td>
<td>Easy No</td>
<td>Yes</td>
<td>Specific LD, rdg d/o, math d/o, written expression d/o</td>
<td>No struggles without the VRS</td>
<td>Yes</td>
</tr>
<tr>
<td>Clay</td>
<td>Attempt</td>
<td>Yes</td>
<td>No</td>
<td>Diff No</td>
<td>No</td>
<td>ADHD primarily inattentive type w/features of impulsivity</td>
<td>No continues to struggle with writing</td>
<td>Yes</td>
</tr>
<tr>
<td>Alicia</td>
<td>Cont'd</td>
<td>Yes</td>
<td>Yes</td>
<td>Both No</td>
<td>Yes</td>
<td>cognitive processing deficit</td>
<td>Yes and No she uses the software to get her thoughts onto paper</td>
<td>Yes</td>
</tr>
<tr>
<td>Jim</td>
<td>Attempt</td>
<td>Yes</td>
<td>Yes</td>
<td>NA Yes</td>
<td>Yes</td>
<td>Dyslexia</td>
<td>Yes others type for him</td>
<td>Yes</td>
</tr>
<tr>
<td>Melissa</td>
<td>Not sure</td>
<td>NA</td>
<td>Not sure</td>
<td>NA No</td>
<td>Yes</td>
<td>LD, Nos</td>
<td>Not sure</td>
<td>Not sure</td>
</tr>
<tr>
<td>Ernest</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>NA Yes</td>
<td>Yes</td>
<td>Dysgraphic, problems with written expression, ADHD</td>
<td>Not sure</td>
<td>Yes</td>
</tr>
<tr>
<td>Subject</td>
<td>Attempt/cont'd to use VRS or not sure</td>
<td>Time</td>
<td>Personal computer of use</td>
<td>Ease</td>
<td>Personal issues</td>
<td>Use of Standard</td>
<td>Disability (area effected)</td>
<td>Other compensatory strategies</td>
</tr>
<tr>
<td>---------</td>
<td>-------------------------------------</td>
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<td>--------------------------</td>
<td>------</td>
<td>-----------------</td>
<td>-----------------</td>
<td>------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Betty</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
<td>No</td>
<td>Yes</td>
<td>Mild LD AD, nos adjustment d/o, nos</td>
<td>Yes self reported she is a good typist &amp; disability not with writing</td>
</tr>
<tr>
<td>Rhonda</td>
<td>No</td>
<td>NA</td>
<td>Yes</td>
<td>NA</td>
<td>No</td>
<td>Yes</td>
<td>Dyslexia diagnosed by father (psychologist)</td>
<td>No doesn't do a lot of writing</td>
</tr>
<tr>
<td>Brent</td>
<td>No</td>
<td>NA</td>
<td>Yes</td>
<td>Diff</td>
<td>Yes cancer</td>
<td>Yes</td>
<td>Dyslexia self reported, only DOE information on file, minimal information</td>
<td>Yes has others type and spell for him</td>
</tr>
<tr>
<td>Richard</td>
<td>Attempt</td>
<td>Yes</td>
<td>No</td>
<td>Diff</td>
<td>No</td>
<td>Yes</td>
<td>Learning d/o, nos</td>
<td>not sure</td>
</tr>
<tr>
<td>Frank</td>
<td>Not sure</td>
<td>Not sure</td>
<td>Not sure</td>
<td>NA</td>
<td>Y</td>
<td>N</td>
<td>Maybe an auditory processing difficulty, greatest difficulty in writing LD in written expression</td>
<td>Yes Has other type for him</td>
</tr>
</tbody>
</table>
Table 5 (continued): Emergent themes

<table>
<thead>
<tr>
<th>Subject</th>
<th>Attempt/cont'd to use VRS</th>
<th>Time</th>
<th>Personal Ease</th>
<th>Personal Use of Standard</th>
<th>Disability (area effected)</th>
<th>Other compensatory strategies</th>
<th>Acquisition of skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ron</td>
<td>attempt</td>
<td>Y</td>
<td>Y</td>
<td>NA</td>
<td>Y</td>
<td>TBI, cognitive d/o, nos (records)</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes types but can only use one hand</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Self-report of something like a stroke</td>
<td></td>
</tr>
<tr>
<td>Chuck</td>
<td>Not sure</td>
<td>Not</td>
<td>Not sure</td>
<td>NA</td>
<td>Y</td>
<td>Specific LD, math d/o, d/o of written expression</td>
<td>Not sure</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not sure</td>
<td>Not sure</td>
</tr>
<tr>
<td>Bill</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>NA</td>
<td>N</td>
<td>Mini stroke that affects memory</td>
<td>Yes scans in research</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes materials, has others type for him</td>
<td>Yes</td>
</tr>
<tr>
<td>Kim</td>
<td>attempt</td>
<td>N</td>
<td>N</td>
<td>Diff</td>
<td>N</td>
<td>Self reported LD, records not on file</td>
<td>Yes self reported</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>good typist</td>
<td></td>
</tr>
</tbody>
</table>

Attemp/cont’d to use VRS = attempted and or continued to use VRS  
d/o = disorder  
NA = not applicable  
LD = learning disabled  
rdg = reading  
diff = difficult  
ADHD = attention deficit hyperactivity disorder  
nos = not otherwise specified  
TBI = traumatic brain injury
DNS does not misspell words but does misinterpret what has been spoken; for example the word fence spoken by the user may go into the text as friends. For many persons with learning disabilities it is difficult to recognize that this is the wrong word and once they do recognize the wrong word it is time consuming to find the correct spelling).

- Two participants (Jim and Clay) stated that they could get work done quicker just by typing rather than trying to correct the VRS.
- Time was a variable that influenced the ongoing use of DNS by these five subjects. They stated directly or implied that, trying to learn a new software program while keeping up with their academic workload was not a priority. They indicated they did not have time to learn a new program. Three (Clay, Richard, and Ron) stated they would be willing to try VRS, in the future, if they had more time to learn it.
- Time was also a variable as related to the use of computers on campus. The campus computers were not available at night when Richard would have been able to use them.
- Two subjects (Clay and Richard) stated that they would try the software again if it improves and recognizes their voices better. This is related to ease of use.

Clay called the researcher 14 months after his initial training and said that he tried version 6.0 and it worked for him. He attempted to use version 5.0 while participating in the study and became frustrated and stopped using it. Data related to Clay were included in the narrative on the subjects who attempted, but did not continue, to use the software because he did not respond to attempts by the researcher to follow-up with him on his use of version 6.0.
Summary of findings from subjects who did not attempt to use the software. Five research subjects (Ernest, Betty, Rhonda, Brent, and Bill) did not attempt to use the software after the initial training. The variables that emerged from the data related to their reasoning for not attempting to use the software included:

- Time, as reported by Ernest, Betty, and Bill who indicated they did not have enough time to learn a new software program.
- Lack of computer access either at home or during convenient times on campus.
- Personal issues that interfered with their use of the software. For instance, Brent was diagnosed with cancer during the semester he was trained on the software and he withdrew from college.
- Disability not being specific to written composition. Betty indicated that her disability is more in organizing her thoughts rather than in writing.
- Other compensatory strategies in place as indicated by Bill. Bill’s compensatory strategies included using his wife to proofread his work.
- Low need as indicated by Betty in her statement that written composition was not a great difficulty for her and that she types really well.

Summary of findings from participants who continued to use the software.

Brenda and Alicia were the two subjects who continued to use the VRS after being trained on it. The following findings are from the data related to Brenda and Alicia.

- Brenda stated that she loved the software and indicated it cut her workload in half.
- Alicia indicated that she used DNS to get her thoughts down.
- Follow-up with Brenda indicated that she trained on version 6.0 and it works even better for her.
Writing samples evaluated with Fry’s Readability Graph indicated an increase for Brenda, with the use of VRS, as her grade level increased from 4.5 (not using the software) to 6.5 (with the use of the software). No change was indicated between conditions for Alicia who also submitted writing samples under both conditions.

The second part of question number one was: Will subjects use the VRS for purposes other than academics? Brenda indicated that she used the software for all computer work whether academic or personal. For example she used the VRS to organize a collection of trading cards. Alicia used the VRS mainly for academic coursework. Alicia did not use voice commands for opening and closing windows and other typically mouse controlled options, Brenda did.

**Research Question Two**

Does the ongoing use of VRS by postsecondary education students, receiving services under the category of learning disabled, improve their written performance when assessed with Fry’s Readability Graph? This question was addressed through comparison of essays written without the use of the VRS to those written with the VRS, after training. The first writing sample, without the use of the software was requested at the beginning of the semester. The next two samples, completed with the use of the VRS were requested mid semester and near the end of the semester. Brenda and Alicia were the two subjects who continued to use the VRS and submitted writing samples completed under both conditions. Both Brenda and Alicia submitted their first writing sample, completed without the use of the VRS, near the beginning of the semester. Brenda submitted two other writing samples that were completed using the VRS; one mid-semester completed as a course assignment, and one near the end of the semester completed for personal use.
Alicia submitted 4 writing samples completed using the VRS. These writing samples were completed for her coursework. Brenda’s grade level equivalency did improve on her writing samples that were completed with the use of DNS. Analysis of her writing samples, with Fry's Readability Graph, showed a grade level equivalency change from 4.5 (first sample completed without VRS) to 6.5 (second and third samples completed with VRS). While these scores are low for a person in college, an increase in grade level equivalency of 2 years indicates an improvement. Alicia’s grade level equivalency as measured by Fry's Readability Graph was at the college level on all samples submitted.

Qualitatively, Brenda reported that the VRS allowed her to use larger words and to match her vocabulary with her writing. Higgins and Raskind (1995), in a stepwise multiple regression for individual measures, found that the single most sensitive predictor of the holistic writing scores of their subjects was words of seven or more letters. This was evident in Brenda's writing samples. Those composed with VRS used longer words, thus the increase in grade level equivalency. Alicia's writing samples did not indicate a difference, under the two conditions, when evaluated with Fry's Readability Graph.

Research Question Three

What are the contributing variables that influence the continued use, or non-use, of VRS by postsecondary education students receiving services under the category of learning disabled?

The emergent themes that arose from the data and influenced participants use of the VRS included: time, use of a personal computer, ease of VRS use, personal issues, use of standard English, disability, other compensatory strategies, and acquisition of the
skills necessary to use the software. These eight categories represent the variables that influenced the ongoing use of DNS. They are indicated in table 5.

*Time.* A key variable that affected the use of VRS was time. Time emerged from the data as a theme with numerous associated variables. The variables related to time include the lack of time to learn a new program; poor timing for the training that took place; time associated with the use of campus computers that were not available at night; and time as related to it being quicker to use strategies already in place. Of the 12 participants who provided feedback, 8 indicated that time was a factor (see table 5). Six of these participants (Jim, Ernest, Betty, Richard, Ron, and Bill) stated they did not have enough time to try to use DNS while keeping up with their coursework. Alicia indicated she used the software but did not have time to learn all aspects of the program.

Time was also related to individuals expressing that they could type and use other compensatory strategies quicker than using the VRS. For instance Bill stated "I know it (VRS) can't work for me for like term papers cause it would be easier for me to write the two to three pages in the front and two to three in the back and just scan in all my research... it would be easier for me to go somewhere, pay someone to scan it". Likewise, Betty stated "I didn't have the time to try to use the software plus writing isn't one of my weak points. I can type really well. My learning disability is more in organizing in my head".

Lack of time was a key variable that influenced participants' acquisition of the skills necessary to fully utilized the VRS. Because the participants' perception was that they did not have enough time to continue to train the software after the initial training many indicated that they did not use it.
**Personal computer.** Computer access was also a category that arose from the data. Three participants (Bill, Richard, and Ron) indicated they would probably use the software if they had a computer at home. Ron had a computer at home but said, in the focus group meeting, that "not enough memory in the computer part. We got a memory but it's still on the counter because no one knows really how to put it on. A couple do but they've been slacking because the surf's been really good, really good, so everyone's been surfing." Bill and Richard also stated that they would be more likely to use the VRS if they had convenient access to a computer.

**Ease of use.** Another emerging category was the ease of using the VRS. Six of the 15 participants attempted to use the software (Brenda, Clay, Alicia, Richard, Ron, and Kim). Only one (Brenda) of the six indicated that it was easy to use. Even though Brenda indicated it was easy to use she also had difficulties with the program at times. Alicia stated that it was not as easy to use as she thought it would be, yet she continued to use it.

An emergent variable, from the theme ease of use, was that the software did not recognize non-standard English. In observing Clay it was obvious that his dialect was not recognized by the system. Another example is taken from Frank who during the initial training said the word fence and DNS typed the word friends. To hear him pronounce fence it was clear how the system could interpret it as friends.

**Personal issues.** Personal issues had an impact on the ongoing use of the VRS for at least six participants. Personal issues that arose from the data conveyed a large range from moving to another island, to having cancer. For the subjects who did not return phone calls and respond to attempted contact, personal issues may have been a reason.
Use of Standard English. The use of non-standard English impacted the ease of use of the software and thus the ongoing use. Examples of how some participant's dialects were translated by the computer were previously illustrated. These include things like pronouncing "three" like "tree", "clover" like "clova", "kind" like "kine", and "for" like "foc".

Disability. Of the six subjects who attempted to use the software only Brenda's learning disability is specific to writing. Frank's disability is also specific to written language but due to personal problems, as reported by the disability support officer, he withdrew from college.

Other compensatory strategies. Eight subjects (see table 5) mentioned the use of compensatory strategies already developed that are easier and quicker than trying to learn a new software program. For example Betty stated that she can type quickly so she did not have a need for the software. Bill indicated he could use other strategies (i.e. using a scanner to get text into electronic format, and using his wife for proofreading) to compensate for his limited writing abilities.

Acquisition of skill to fully utilize the software. The overarching theme that emerged from the data, was the necessity of the individual using VRS to acquire the skills necessary to use the software efficiently. All other emerging themes, to varying degrees, fall under the umbrella of acquisition.

Summary

The data collected, using the various data collection tools described in Chapter III, were presented in Chapter IV and are summarized in the following text. Fifteen research subjects were trained on the use of VRS. Out of the 15 initially trained, 7 attempted to
use the VRS, 5 did not use the software, and 3 did not respond to attempted follow-up contact. Of the 7 subjects who attempted to use the VRS, 2 continued. These 2 used the VRS to complete their written assignments for their assigned course work. The demographic data on each research subject was illustrated in table 4 while the emerging themes were presented in table 5. Chapter V follows with a discussion of the findings, implications, characteristics of an individual who may benefit from VRS, direction for future research, and limitations.
Chapter V: Discussion

The problems addressed in this study expand on the current literature base that investigates the use of VRS as a compensatory strategy for written language difficulties often experienced by postsecondary education students with learning disabilities. The current literature base, focused upon this specific issue, is limited, with one study (Higgins & Raskind, 1995) reporting findings. There are six other empirically based studies investigating the use of AT as a compensatory strategy for learning disabilities and or difficulties (see Table 2). These six studies do not focus on postsecondary education exclusively but investigate the use of AT over a range of grades and ages from early elementary to college. The findings from these studies show positive results for AT used as a compensatory strategy, except for Wetzel’s (1996). Likewise the study conducted by Higgins and Raskind (1995) found that VRS improves the holistic writing scores of individuals when compared with samples completed with a transcriber, and without assistance. While this finding is positive, many questions remain unanswered.

The research conducted for the study presented here investigated three such questions.

1. After being trained on VRS will persons, in postsecondary education, receiving services under the category of learning disabled, continue to use it to complete their academic course work? Will they further use the software for purposes other than academic study?

2. Does the ongoing use of VRS, by postsecondary education students receiving services under the category of learning disabled, improve their written performance when assessed with Fry’s Readability Graph?
3. What are the contributing variables that influence the continued use, or non-use, of VRS by postsecondary education students receiving services under the category of learning disabled?

The findings related to these questions were presented in Chapter IV. Chapter V presents a discussion of the findings beginning with their relationship to the research questions. This discussion includes specific recommendations and implications for various users and for those concerned with further study in this area. This discussion is followed by a presentation of the characteristics of candidates who may benefit from VRS. Next, implications for specific populations or persons concerned with the use of VRS are discussed. Chapter V concludes with a discussion of direction for future research and limitations of this study.

The discussion posed in Chapter V is based upon the findings from the analyzed data from 12 out of 15 research subjects who responded to follow-up contact by the researcher after their initial training. Discussion of the findings related to the 3 subjects who did not respond to follow-up contact is based upon data collected prior to and during their initial training.

Research Questions

The findings, as they relate to the research questions, are discussed in the following text.

Research Question 1

After being trained on VRS will persons, in postsecondary education, receiving services under the category of learning disabled, continue to use it to complete their
academic course work? Will they further use the software for purposes other than academic study?

The answer to this question was both yes and no. Two subjects (Brenda and Alicia) continued to use version 5.0 of DNS to complete their academic course work after being trained on it. A third subject (Clay) indicated that he intended to use version 6.0 as he tried it and it worked better for him than version 5.0.

While the use of DNS worked well for Brenda it was, to a lesser degree, beneficial to Alicia. Five other subjects (Clay, Jim, Richard, Ron, and Kim) attempted to use the software. Of these five, Clay, Richard, and Ron indicated they would try it again. Jim was not sure if he would try the software again as he was graduating from college with his Bachelor’s degree, thus his need was reduced. Bill did not attempt to use the software but said he would try it in the future, if he had more time and a computer at home, with a working version of the software.

Brenda and Alicia, the two subjects who continued to use the VRS used it for different purposes as presented in the narrative of Chapter IV. Through data analysis the researcher concluded that they used the software in different ways because of their individual needs, both personally and in relationship to their learning disabilities. Brenda used the software for all commands that are usually performed with a mouse, as well as for word processing. When observed, Brenda appeared to feel very comfortable using her voice. From the data collected, in particular the conversations held with Brenda, this researcher concluded that this is because of the years of frustration Brenda faced trying to write in the traditional pen and paper or typing format. Being that Brenda’s writing skills were so poor it was a relief for her to be taken out of the “alpha-numeric” realm and into
an auditory one. The software utilized her strong verbal abilities and minimized the use of her weak, traditional pen and paper, writing abilities. Brenda used the VRS for purposes other than academics. Again the researcher concludes that this is because of her strong verbal abilities.

In contrast to Brenda, Alicia used the VRS to get her thoughts onto paper for completion of her academic coursework. Alicia also has strong verbal abilities with a weaknesses in organization and processing. The software utilized her strong verbal abilities while compensating for her weaknesses thus serving her purpose for using it. Alicia did not use the software for purposes other than academics.

Why Brenda and Alicia continued to use the software and why the other participants did not can only be hypothesized. Variables that may have influenced ongoing use are discussed in response to research question number three.

Research Question 2

Does the ongoing use of VRS, by postsecondary education students receiving services under the category of learning disabled, improve their written performance when assessed with Fry's Readability Graph? Brenda's writing samples, completed with the use of VRS, had a higher grade level equivalency, as determined using Fry's Readability Graph, than her sample submitted without the use of the VRS. In reviewing Brenda's records and her first submitted writing sample it is clear that she has difficulty with written composition. Her first writing sample, completed without the use of VRS, had a grade level equivalency of 4.5. The two samples completed using VRS had a grade level equivalency of 6.5. Even with the use of VRS Brenda exhibits a large discrepancy between her written performance at grade level equivalency 6.5, and her status as a
college student, which implies she should be writing at a college grade level equivalency. With such a large discrepancy it is apparent that she has a great need for a compensatory strategy to assist her in writing.

Based on the data analysis the researcher concluded that Brenda had a greater need than 11 of the other research subjects while three others (Rhonda, Brent, and Frank) exhibited a need similar to Brenda's. This conclusion is based on record reviews, observations made during the initial training of the VRS, and the first writing samples submitted. Rhonda and Frank submitted writing samples that were completed without the use of the VRS and analyzed with Fry's Readability Graph. Rhonda's sample had a grade level equivalency of 3.5 and Frank's had grade level equivalency of 6.5. Frank told the researcher that he had been assisted in completing the sample, thus it is not necessarily an accurate depiction of his actual writing performance. Brent did not submit any writing samples but based on his self-report of dyslexia, his reading performance, and data collected from the disability support officer the researcher concluded that his need of a written language compensatory strategy was similar to Brenda's, Rhonda's, and Frank's.

Of the three subjects with a need similar to Brenda's, Rhonda was enrolled in a certificate program (non-degree) that required very little writing. Thus, Rhonda was not highly motivated to learn the software. Also, Rhonda did not express a desire to continue her education after receiving her certificate.

Likewise, Brent was enrolled in remedial classes at the beginning of the semester and planning to get a degree in agriculture. Again, minimal writing was required in his program of study. Brent was diagnosed with cancer and left college the semester he
participated in the study. Brent did express a desire to use the VRS to complete reports required for his job as a campus security officer thus his motivation for using the VRS may have been outside of the academic arena. Also, because he left college, the researcher is not clear about his intentions to continue to use the software. As of last contact, he was not using the software.

The third subject, Frank, who had a need similar to Brenda’s, was enrolled in remedial classes and planning on getting a degree in social work. At the time he participated in this research he was employed as a sanitation professional but said that he wanted to change professions. While obtaining a degree in social work would require ample writing, working as a sanitation professional would not. Frank dropped out of college during the semester he participated in this study so it is not clear if he will continue to pursue a degree nor is it clear if he is using the VRS. His need for a written composition compensatory strategy is also not clear but if he is not attending college then his need is probably minimal.

At the time of this study, of the four subjects with the poorest writing performance, Brenda demonstrated the greatest desire for advancement in postsecondary education. While participating in the study, Brenda was completing her AA degree and planning on continuing her education and getting a BA in criminal justice. She also spoke to the researcher about getting her Master’s degree. Her desire for advanced academic achievement leaves her highly motivated to develop compensatory strategies for her written language difficulties. Based upon this information Brenda had the greatest need for a written composition compensatory strategy. Brenda’s goals were clear and her need was great. The software did appear to improve her written composition
performance. High need, coupled with high motivation, appear to be key variables for the ongoing or continued use of VRS.

In contrast to Brenda, Alicia continued to use the software but the use of the software did not show an improvement in her written composition performance. Alicia’s writing samples were at the college grade level equivalency. Alicia used the software, as self reported, to get her thoughts onto paper. While participating in the study Alicia was working on her Master’s Degree in Public Administration. Like Brenda, Alicia has a high need in that her goal is to go to law school. Alicia recently called the researcher and inquired into the use of the latest version of DNS (7.0), because she got accepted into law school and wants to continue to use the software. Alicia is highly motivated but her learning disability interferes with her ability to express herself in writing, as reported in her evaluation. While her written performance grade level equivalency, as assessed with Fry’s Readability Graph, is high, her organization and flow are hindered by her learning disability. VRS appears to assist in this area of need. Although Alicia’s needs are different from Brenda’s both have high aspirations for success in postsecondary education as well as a high need for compensatory strategies to assist in the limitations posed by their learning disabilities. Again, high need, coupled with high motivation, appear to be key variables effecting the ongoing use of the VRS.

Research Question 3

What are the contributing variables that influence the continued use, or non-use, of VRS by postsecondary education students receiving services under the category of learning disabled?
As presented in Chapter IV numerous variables that influenced the ongoing use of the VRS arose from the research data. While distinct themes emerged from the data there were also overlapping variables within these themes. For example, time was a consideration related to the subjects’ perception that they had enough time to learn the VRS while keeping up with their coursework. Time was also a variable associated with ease of use. That is, if the software were easier to use then it would not take a lot of time to learn how to use it. Even though numerous variables emerged within multiple themes the researcher will discuss each theme, and associated variables, independently in the following text.

Time. The participants’ perception that they did not have enough time to learn a new software program was a large inhibitor to subjects attempting to use the software. If individuals had the strategies in place, to compensate for their written language difficulties, they stated they did not have enough time to learn a new software program. For Brenda the VRS served as a compensatory strategy as she did not have strategies in place to deal with her poor writing skills. Thus, using the VRS decreased the length of time it took her to complete written assignments. For Brenda the use of the VRS was a time-related advantage. For Alicia, the VRS was used as a compensatory tool to allow her to get her thoughts into text format. Alicia found the VRS to be a beneficial tool when used for this purpose. As self reported the VRS did decrease the length of time and improve her ability to get her thoughts into writing. Alicia did state that she did not have enough time to learn all the aspects of DNS but using it was a time advantage.

Eight subjects (see Table 5) stated or implied that they did not have enough time to learn a new program. They chose to "get by" with the strategies they already had in
place. Thus, the conclusion is drawn that to use VRS would have been counterproductive for them during the semester they participated in the study. If they had used the software it may have influenced the completion of their coursework in a negative manner. For example, taking the time to continue to learn the software while attempting to keep up with their coursework and having the software not work seamlessly could cause frustration. Based on this frustration the individual may quit using the software so the time they spent trying to learn it could have been used to complete the assignments with the strategies they already had in place. Also, the stress involved in “trying something new” may also cause frustration and lead to the same end.

The time of year when the initial training took place may have been a contributing variable to the ongoing use of VRS by the study participants. For example, Jim indicated that he did not have enough time to keep up with his coursework, and other life issues, while attempting to learn a new program. The researcher concludes that if the participants were trained on the software during a time when other demands on their time were minimal they may be more apt to use the software and reap the benefits.

Subjects reported that the VRS was more time consuming to use than they had originally thought it would be. Based on the data analysis this researcher concludes that the subjects in this study thought they could sit down and use the software with little effort and minimal training and that the software would perfectly recognize everything they said. The reality is such, that the software requires ongoing training. The software also picks up extraneous sounds such as sighs, or “umms”, uttered by the person using it. As the software continues to improve some of the current issues may be eliminated but as it stands now the VRS does require ongoing training, which can be time consuming. For
individuals with other compensatory strategies in place, attempting to use the VRS may be a hindrance to completing their academic tasks. But, as exhibited by Brenda and Alicia, the use of the software by individuals who do not have other strategies in place serves to save time in the writing process.

**Personal computer.** Three subjects (Richard, Bill, and Ron) stated that not having a computer, conveniently available, influenced their use of the VRS. These subjects stated that they probably would have used the software if they had personal computers. Additional research should take place to see if the availability of a personal computer would contribute to different findings (i.e., the likelihood that persons will use the software if they have their own computer). The convenience of a personal computer is also associated with time. For instance, Bill stated that he did not have the time to use the computers on campus. He said that if he had one at home he may have used the software.

**Ease of use.** An emergent theme, from the category ease of use, was that the software did not recognize non-standard English. The researcher observed Clay and it was obvious that the software did not recognize the words he spoke because of his dialect. The researcher observed and concluded that one reason for this was that many words pronounced by Clay were not substantially distinct from one another. A similar example can be drawn from Frank, another subject who speaks Pidgin. During training Frank said the word fence and DNS typed the word friends. To hear him pronounce fence it was clear how the system could interpret it as friends. As the software continues to improve additional research should take place to see if the software becomes easier to use for persons who speak non Standard English.
Personal Issues. The data collected indicated that subjects’ personal issues influenced the use of the VRS. The personal issues experienced and expressed during data collection included planning a wedding, being diagnosed with cancer, and moving. Again these personal issues are also associated with time (i.e., time needed to try to use the VRS). The personal dispositions of the subjects may have also influenced use. When the researcher observed Brenda she was very patient and had a high tolerance for word recognition mistakes. Brenda is the only research subject who found the VRS easy to use. Brenda exhibited strong verbal skills. When the researcher observed Brenda the VRS did not recognize all the words she spoke but she did not appear to let this frustrate her. Based on the data analysis this researcher concluded that Brenda’s lack of frustration is related to her high need and perhaps disposition. Even with the misinterpretations by the VRS it was still easier for Brenda to use the software than it would be to type or use paper and pencil.

Of the seven participants who tried to use the software (see Table 5) Brenda had the most difficulty with written composition. For Brenda, using the VRS, even with frustrations, was better than her writing without it. Clay, on the other hand, got very irritated. His frustration was visible in his body language and words. Clay is also diagnosed as ADHD and indicated problems concentrating. The researcher concludes that the individual’s disposition, coupled with their need, impacted their use of the software.

As expressed previously the use of AT is an individualistic endeavor. A general conclusion drawn by Raskind (1998) states that what works for one person may actually be counterproductive for another. Based on observations of Clay and Brenda this
appeared to be the case. If Clay had been forced to use the software his frustration may have interfered with his productivity and the quality of his written performance. In addition, the researcher came to the conclusion that persons who have compensatory strategies in place, to assist with their written language difficulties, may find the use of the VRS counterproductive. In contrast, the use of the VRS by Brenda had a positive impact on her writing performance and on her perception of writing as indicated in her statement that she could use “words, big words,” that she could not use previously because she could not spell them.

*Use of Standard English.* The fact that VRS did not recognize the users voice to the accuracy level predicted by the makers may be due to the dialectical differences of the participants in the study when compared to people who speak Standard English. In the state where the study took place Pidgin is the primary language. Use of non-standard English appeared to negatively influence the accuracy of the VRS. This may also have influenced frustrations expressed by Clay and Kim in that the program did not recognize the words they spoke. DNS also did not appear to recognize the dialectical differences of many of the participants thus resulting in frustration.

Dialectical differences observed in the language patterns of Brenda and Alicia may have influenced the VRS recognition of their words also. This is supported by Higgins and Raskind (1995) in that the phonetic model to which the speaker is matching his or her vocabulary (when training and using VRS) is in standard GLAD (Great Lakes Area Dialect; Davis, 1949 as cited in Higgins & Raskind, 1995) apparently spoken by a male in his late twenties. While Brenda and Alicia were not male, their voice patterns were more closely matched to GLAD than the Pidgin speaking individuals in the study.
In the research performed by Higgins and Raskind (1995) they noted that the training of the VRS took longer for females, older students, and students with strong regional dialects. Both Brenda and Alicia have strong verbal skills and speak Standard English but with dialectical differences when compared to GLAD (Davis, 1949 as cited in Higgins & Raskind, 1995). While not male, both Brenda and Alicia enunciated clearly. Based on this and their speaking of Standard English both found the VRS easier to use than their Pidgin speaking counterparts in this study but still had difficulties which may have been because of their dialectical differences as well.

Disability (area effected). In reviewing institutional records, Brenda, the subject who continues to benefit the most from the VRS, is performing in the normal range in nonverbal reasoning but has below average achievement in written language and reading. Alicia, who also continues to use the software, has a learning disability related to processing and organizing. The range of diagnosis for other subjects varied. While the research findings presented here can not state a direct correlation between written language deficits and beneficial use of VRS the researcher does believe that this correlation exists. Severity of disability alone may not be a predictor of ongoing use and benefit of VRS but severity, coupled with goals and purpose for writing may be directly and highly correlated. Based on this the researcher recommends that a degree of need be established up front and prior to recommending the use of VRS.

Other compensatory strategies  The use of compensatory strategies already in place to assist with written language difficulties emerged from the data as reason for not using the VRS. For example, Jim and Ernest were close to finishing their Bachelor degrees. Both indicated that they did not have enough time to learn a new software
program while keeping up with their academic demands. While neither Jim nor Ernest submitted writing samples, that could have been scored for grade level equivalency, they both self reported as having difficulty with written composition. Being that they were nearing the end of their Bachelor's degree programs and had "made it this far" one conclusion is that they had compensatory strategies in place to assist them with their written language difficulties. The researcher believes that both Jim and Ernest would have benefited from the use of VRS if they had been presented with the option earlier in their postsecondary education careers.

In contrast to Jim and Ernest, Brenda was in the early stages of her postsecondary education career. Brenda has dysgraphia and a high need for a compensatory strategy to overcome her written language deficiencies. A possible result of this is that her need drove her desire to use the software. Likewise, Alicia was in the later stages of her postsecondary education career but wanted to continue her education although she still struggled with getting her thoughts onto paper. She had not found an effective strategy for doing this prior to the use of the VRS. Thus, even though she had succeeded in postsecondary education she still had a need that the VRS could fill. While other subjects may have had difficulty with written language many expressed that they used other compensatory strategies to overcome their difficulty. Thus, perhaps, their need was not as great as Brenda's and Alicia's.

The researcher concludes that if individuals with learning disabilities and other difficulties have compensatory strategies in place that allow them to perform at a college level then the use of VRS may not be beneficial. For those individuals who do not have
compensatory strategies in place VRS affords them the opportunity to compensate for their written language difficulties, in effect the use of VRS may level the playing field.

*Acquisition of skill to fully utilize the software.* The overarching theme that emerged from the data was the necessity of the individual using VRS to acquire the skills necessary to use the software efficiently. If the skills, needed to use the software efficiently, were readily acquired the other variables that influenced ongoing use of the software would not have been as influential. For example, Ron attempted to use the software but his computer was not working well. If he had installed the software, trained it, and the first time he used it there were no problems (i.e., everything he said was translated to text without error; plus, if the software did not recognize extraneous sounds) he may have continued to use the VRS.

Likewise, if the skills necessary to use the software were easily acquired then the issue of time would not have been a concern. Subjects could have used the software with minimal training time required. Acquisition of skills necessary to use the software as a variable contributing to the ongoing use of VRS is a two-fold problem in that the software is not perfect. Thus, the user has to be proficient.

Many of the variables discussed as influencing the use of VRS can not be controlled. Thus, it is important for persons who may see potential in the use of VRS to evaluate their situations, prior to attempting to learn the VRS. This also holds true for individuals working with people with disabilities in that personal issues should be considered prior to making a recommendation for an individual with a disability to use VRS.

*Characteristics of an Individual who may Benefit from VRS*
Based upon the findings from this study the researcher has "drawn up" an image of the "ideal" candidate who would most benefit from the use of VRS. While this candidate is hypothetical the characteristics that a person may possess, that would maximize their benefit from the use of VRS, are drawn from the data analysis. This information is valuable to many individuals including persons with disabilities; persons working with those with disabilities including DVR counselors, disability support officers, high school teachers and counselors; parents of students with disabilities and difficulties; and the manufacturer of VRS and those who sell and promote the software.

Given the findings of this study, data indicate that VRS usage would be most advantageous to individuals with disabilities who possess the following characteristics.

- an ability to use a computer
- poor written language abilities
- a high need (be it poor written language abilities, difficulty processing information, or difficulty organizing their thoughts and putting them into writing
- speak standard English (or close to it)
- a disposition that can tolerate high degrees of ambiguity and potential frustrations
- limited compensatory strategies in place to deal with written language problems
- motivation (to get a degree, to become a better writer, to use the VRS in a work setting)
- a perception that they have the time to learn a new software program
- a perception that they can benefit from learning the program

While these characteristics provide a framework of variables to consider prior to using VRS it may not be necessary for an individual to possess all of them in order to
benefit from the use of VRS. These are characteristics that came out of the data collected and analyzed and are important to consider for those who are interested in using or recommending VRS. For instance, if people do not perceive that they have enough time to learn a new software program there is a good chance they will not take the time to learn it. This ties into having other compensatory strategies in place as well as having a high degree of need. If individuals have compensatory strategies in place, to assist with their written language difficulties, then taking the time to learn a new program may not be the most efficient use of time. In contrast, a high need is important and an individual exhibiting high need may actually save time by using the VRS.

**Directions for Future Research**

Two out of 15 research subjects in this study continued to use DNS version 5.0 after the provision of initial training. A third subject indicated that he tried version 6.0, that it worked well for him and that he was going to attempt to use it. Due to the small number of participants in the study, statistical significance cannot be determined but the fact that two persons continue to benefit from use of the software, with indication that a third person may, shows that it can be useful to persons with learning disabilities and difficulties. As the software continues to improve additional research should take place to evaluate its continued usage by subjects.

Higgins & Raskind, (1995) indicated that VRS did improve written performance in a controlled setting. Additional research was required to see if the results would transfer to real life situations, as their study did not indicate if any participants used the software outside of the controlled study. The present study investigated this as a next step in building the research base on the use of AT as a compensatory strategy. In
addition, this researcher intends to follow-up with the participants of this study over the next three years to determine if the two participants (Brenda and Alicia) who used the software continue to use it and if they transfer its use to a work setting. Also, the researcher believes that several other study participants may use the software in the future. The researcher will attempt to ascertain this use through follow-up surveys mailed annually for three years.

In addition to follow-up by this researcher it would be sensible to investigate the current use of VRS by persons with learning disabilities in the current workforce. This research should seek to determine how many individuals are using the software as well as its effectiveness. This could be done through the use of surveys. The premise of this research would be to investigate whether or not the variables that influenced the use of VRS in the present research would apply to persons using the software in a work setting.

Voice recognition software may be beneficial to individuals with disabilities other than learning, including, quadriplegia, visual tracking problems, vision loss, arthritis, fine motor control problems, muscular sclerosis, and cerebral palsy. Additional research is needed to document effective and ineffective strategies across all disability categories. The technology, as it continues to improve, should be incorporated into daily instructional lessons throughout the educational arena and within work settings for those individuals who choose to utilize it and those who may benefit from using it.

Future research should replicate the current study in multiple settings to determine if the results generalize. This may include a sample with a larger mix of ethnicity, and gender. Replicating this study with students with learning disabilities and difficulties in secondary schools would also be beneficial. The researcher believes that
future research may determine that the earlier an individual learns to use VRS the more benefit they will reap. Please note that earlier intervention should be implemented with caution and either after remedial approaches have been exhausted or in conjunction with remediation.

Another possible research study is one designed in the same manner as the current study but with ongoing training required so that the subjects would meet a predetermined level of proficiency in using the software prior to using it to complete writing samples. This study should also include the submission of writing samples, by the subjects, that are uniform (i.e., written to similar topics to allow for better direct comparisons).

Another direction for future research would be to study what actually occurs in disability support offices regarding the training and usage of the software. For example, the research participants in this study were attending institutions where, if they had inquired into the use of VRS, would have been shown where the computers were located. They would, more than likely, be given access to the user manual. They would be given very little if any support beyond this. The premise of such a study would be to determine how many students continue to use the VRS under these conditions and the variables that influence this use.

Additional research should take place with a study that establishes the need of subjects prior to their participating in the research. This need could be based on their written language performance (including severity of dysgraphia) and academic and professional goals. The study would be designed to validate the findings from the current study by determining if there is a correlation between need and ongoing use of VRS.
Likewise, a study could be designed to compare the use of VRS by subjects diagnosed with dysgraphia to those diagnosed with learning disabilities/not otherwise specified. The premise of this is that those with the most severe dysgraphia would have the greatest need for a written composition compensatory strategy. Thus, they would be the most likely to use VRS in an ongoing manner and to benefit from it. This could include subjects who perform below a predetermined level in their written performance prior to taking part in the study.

Future research should also investigate the use of VRS by persons with varied dialectical differences. The findings obtained from such a study would not only have implications for persons with disabilities but could also assist the software developer in creating better software.

Studying the use of VRS with individuals diagnosed with specific cognitive and achievement deficits; as well as those with various disabilities could serve to determine if there is a correlation between disability type and ongoing use of the software and whether or not this is related to severity of the disability, thus need.

*Implications for Specific Populations*

This study was conducted with individuals with learning disabilities and difficulties attending postsecondary education institutions. Although the findings are drawn from this group, the findings have implications for a wider audience including: persons with many types of disabilities; parents of children with disabilities; children of parents with disabilities; and professionals working with people with disabilities including DVR counselors, disability support personnel at postsecondary education institutions, and secondary school personnel working with youth with disabilities.
Persons with Various Types of Disabilities

Raskind, (1998) indicates that the difficulties experienced by persons with learning disabilities in secondary school continue to pose problems for the individuals in postsecondary education. VRS may be seen by many as a panacea for all individuals with written composition deficiencies. The research findings, from the study presented here, clearly indicate that VRS is not for everyone. Whether or not individuals continued to use the software was contingent upon their individual characteristics. Persons with disabilities should be aware of the variables that influenced the use of the software in this study, prior to their using the software, in order to maximize their efforts.

Many individuals with learning disabilities have spent years being frustrated by ineffective remedial attempts and strategies. It is important that using VRS does not become another frustration. If individuals consider the variables that influenced the use of the software, as explored in this study, and weigh them against their own characteristics they may be able minimize frustration and maximize benefit. The variables associated with use or non-use of the VRS in this study should be used as a framework from which to assess possible success. This is not to say that individuals who possess characteristics other than those associated with successful VRS use in this study will not benefit from the software. It is saying however, that the findings from this study should be used as a guide and with caution.

Parents of Children with Disabilities

The findings from this research also have implications for parents of children with disabilities. Parents should be aware of the findings from this study and provided with the findings as a framework from which to determine if their child might benefit from the
use of VRS. It is important to note that the parents should be informed of the negatives of using an AT intervention in place of remedial interventions when remediation may still be successful.

*Children and Significant others of Adults with Disabilities*

Many people, as they age, acquire disabling conditions. One example is macular degeneration, a condition that causes impaired vision and can lead to blindness. As people with macular degeneration lose their vision they may be able to operate a computer with their voice. VRS also allows the text that is entered with one's voice to be “read” back to the individual in his or her own voice or in a synthesized computerized voice. For people who are visually impaired, the option of having text read back to them is one method of verifying what they have “typed”. As people age, their children or other support people may take on the role of an information resource provider. These individuals should have access to the findings of this study so they can better determine the potential benefits of VRS.

*Professionals Including DVR Counselors, Disability Support Coordinators, Teachers, and Others Who May be in a Position to Make Recommendations for AT*

It would be advantageous for professionals working with individuals with various disabilities to consider the research findings presented in this study prior to recommending VRS as a possible strategy to compensate for individual’s disabilities or difficulties. While these research findings may not be generalizable in a traditional quantitative manner it is logical to conclude that the variables that influenced the use of the software, by study participants, would also influence the use of the software by persons with other disabilities.
The use of the findings from this research can be applied as a framework for predetermining the possibility of whether or not an individual will benefit from the software. By considering the variables that influenced the use of the VRS, in this study, professionals can make a better determination as to who may or may not benefit from the software thus reducing frustration, this also serves to eliminate unnecessary purchasing of the software, thus reduces expenditures.

Based on the finding that time was a key variable that influenced the ongoing use of the VRS the researcher recommends that training on the use of VRS be offered as a college course. For students with written composition difficulties who are entering postsecondary education, offering VRS training, as a credit course, would minimize the amount of time required outside of the classroom to learn the software. The researcher believes that a higher percentage of students would find the software beneficial under this condition. Also, offering the course when students are first entering postsecondary education may improve retention rates as the frustrations often accompanied by poor writing performance may be alleviated. In addition, if, as indicated in the findings from Raskind and Higgins (1995), VRS improves written performance when compared to composing with a transcriber or without assistance then the academic performance for students using the VRS should improve.

The researcher concludes that the findings from this study can be used as a guide to assess the potential benefit of using VRS for people with many types of disabilities including spinal cord injuries, carpal tunnel syndrome, arthritis, traumatic brain injury, and muscular sclerosis. One way for this to occur would be to develop a handbook for individuals with disabilities. The handbook could outline variables to be considered prior
to individuals attempting to use VRS. The handbook could be distributed through HEATH and NCSPES. Copies should be distributed to people with disabilities, professionals working in the disability field, and secondary and postsecondary counselors.

Limitations

This research study has numerous limitations. While there are numerous limitations, the findings are important as they build upon the existing research base on the use of VRS as a compensatory strategy for written composition difficulties.

One limitation of the study is the small sample size. Attempts were made to recruit students over the period of 2 semesters. The original goal of 30 subject was not met. Extensive attempts to recruit subjects, as indicated in chapter III, yielded 15 who were enrolled in a postsecondary education institution and receiving services under the category of learning disabled. While the number of study participants is small the findings are considered important for the reasons described previously. While generalizability is reduced, because of the small sample size, the findings may be applicable to persons with disabilities other than those related to learning but they should be applied with caution.

Another limitation of this research is that it was based on the use of a single speech recognition system, DNS. Other VRS programs may have produced different outcomes based upon their ease of use. Two aspects related to ease of use, that may have influenced the findings in this study, are the user interface and the capacity of the program to recognize varied dialectical patterns. Persons with learning disabilities exhibit a wide range of difficulties. One difficulty is in processing information. If a
computer program's user interface is complicated or simply not presented in a manner that is intrinsically accessible to an individual then they may experience difficulties using the program. Thus, VRS programs other than DNS, may have produced different outcomes. Also, another VRS program may have recognized the dialectical variances of the study participants better than DNS thus producing outcomes different from those found in this study.

Another limitation of this study is that there is not one standard, acceptable definition of learning disabled. While all subjects were receiving services from their institutions under the category of learning disabled there was a wide range of diagnoses and learning difficulties indicated in the subjects institutional records and observed by the researcher. This wide range, though typical of individuals with learning disabilities, limits comparisons across individuals. While this is a limitation it is also “real to life” thus making the findings more applicable to real life situations as opposed to a controlled setting where all subjects exhibit similar learning difficulties.

An additional limitation is that the writing samples, requested from the participants, were not uniform in content. The researcher provided subjects with a list of possible topics (Appendix H) that they could address in their writing samples. The researcher also told participants they could submit assignments from their coursework upon prior approval from the researcher. The lack of uniformity posed a problem in evaluating writing samples across the two conditions. For example, Brenda’s first writing sample was a narrative on her weekend. Her second and third writing samples were coursework assignments. Her coursework assignments required vocabulary that
was different from the vocabulary she used to describe her weekend. Thus, the lack of consistency in writing topics may have skewed the findings.

Another possible limitation of this research is that the five subjects who attempted to use the software and the two who continued to use it did so on computers with varied capacities. This was true for all subjects, other than Brenda and Clay, who used computers on the campus of their attending institution that had the same type of processor. The use of computers with varied capacities may have influenced the word recognition of the software, as the software should perform better with a higher quality central processing unit (CPU) in the computer. Again, the use of computers with varied capacities is "real to life" thus was appropriate for the conditions set in this study. Future research may seek to control this variable.

Summary

The findings from this research add to the current literature base as this is the first study investigating the use of VRS by persons with learning disabilities and difficulties outside of a controlled setting. The findings provide a framework of variables that influence the continued use of the software that, if applied to persons with disabilities may assist in identifying individuals who are most likely to benefit from the use of VRS.

Being that research on the use of AT as a compensatory strategy for persons with disabilities is at the infant stages the findings from this dissertation study assist in developing a foundation on which to build future research. Not only do the findings assist in building a research base they also have implications for persons with disabilities and those working in the disability field.
The findings from this study should be published and widely disseminated to individuals with disabilities, their support persons, and those working in disability related fields. Providing individuals with a sense of what to consider, prior to initiating VRS training, will be advantageous in that it will reduce frustrations experienced by persons when they attempt to use the software and do not find it beneficial. The findings also provide insight into the variables that influence the ongoing use of VRS. The study provides valuable information on these variables that may be utilized to determine who can most benefit from the use of VRS.
Appendix A

Fry's Readability Graph

Directions for Use

- Randomly select three 100-word passages from a book or an article.
- Plot the average number of syllables and the average number of sentences per 100 words on the graph to determine the grade level of the material.
- Choose more passages per book if great variability is observed and conclude that the book has uneven readability.
- Few books will fall into the solid black area, but when they do, grade level scores are invalid.

Additional Directions for Working Readability Graph

- Randomly select three sample passages and count exactly 100 words beginning with the beginning of a sentence. Don't count numbers. Do count proper nouns.
- Count the number of sentences in the hundred words, estimating length of the fraction of the last sentence to the nearest 1/10th.
- Count the total number of syllables in the 100-word passage. If you don't have a hand counter available, an easy way is to simply put a mark above every syllable over one in each word, then, when you get to the end of the passage, count the number of marks and add 100.
- Enter graph with average sentence length and number of syllables; plot dot where the two lines intersect. Area where dot is plotted will give you the approximate grade level.
- If a great deal of variability is found, putting more sample counts into the average is desirable.
Fry Graph for estimating Reading Ages (grade level)

Average number of SENTENCES per 100 words

Average number of SYLLABLES per 100 words

long sentences

long words

College
Appendix B
Recruitment Flyer

Students With Learning Disabilities

- Special opportunity to improve your **writing skills**
  - Use your **voice** to type into the **computer**
  - Complete better papers by talking to the computer

- A UH Manoa Graduate student is looking for UH students to take part in a study
  - The study is on a computer program called **Dragon Naturally Speaking** which recognizes your voice
    - Study participants will be trained on Dragon Naturally Speaking
    - If you have a documented learning disability, are taking a course that requires a lot of writing, and would like to participate please contact
      - Kelly Roberts at 255-2101 or
      - robertsk@hawaii.edu
Appendix C

Agreement to Participate in the Research Study:
A Compensatory Strategy for Students with Learning Disabilities in Postsecondary Education and in Their Subsequent Employment

Aloha, my name is Kelly Roberts. I am doctoral student at the University of Hawai‘i, Manoa. I am conducting a research study that will investigate the use of voice recognition software by persons with learning disabilities. I can be reached at 255-2101 or robertsk@hawaii.edu.

Dr. Robert Stodden, Director of the Center on Disability Studies, and Professor of Special Education, is my faculty advisor. He will oversee this research study and can be reached at 956-9199 or stodden@hawaii.edu.

Over the period of two semesters, approximately 15 postsecondary students with learning disabilities will be trained on the use of voice recognition software. These students will be recruited from 3 different postsecondary educational institutions. The study will follow the participants for 4 years after the initial year to determine the long-term effects of the use of voice recognition software.

Participants will be trained on the voice recognition software by the State of Hawai‘i representative for Lemout & Hauspie, the maker of Dragon Naturally Speaking. Training will take place at a computer lab in Honolulu. Continued training and support will be available upon request. These additional hours will not be mandatory but will be noted as a possible cause for variance in the outcomes.

As a participant in this study you are asked to do the following during the period of one academic semester: (1) be trained on the use of VRS and use it to complete assignments in appropriate courses (the estimated time involved with the writing assignments will be determined by your course instructor); (2) submit three writing
samples, one at the beginning of the semester, one mid-semester, and one near the end of
the semester, each will take approximately 1 hour to complete; (3) complete a survey at
the beginning of the semester, this will take about thirty minutes (the survey will ask
questions pertaining to your high school education, family history, current educational
status, computer experience, and disabilities; (4) attend a focus group meeting or
interview to discuss your experience with the software, this should take about one hour;
and (5) allow your postsecondary educational records to be reviewed. The review of
your records will look at your file that is in the disability support office. This review will
verify your disability classification. The researcher will also look at your complete file.
It is anticipated that this should include reading your evaluation and other materials in
your file. You will also be asked to complete a survey on a yearly basis for the 4 years
following your participation in the study. Each survey should take about thirty minutes
to complete.

Information collected will be kept confidential to the full extent allowed by law.
Outcomes will be reported in such a way that no identifiable information will be reported.
You may withdraw from the research project at anytime.

Benefits of participation may include free training on the use of voice recognition
software, knowledge that you have assisted in determining the effectiveness of VRS use
by persons with learning disabilities, improved writing, and $20.00 at the end of the
semester. You will also receive $5.00 for every yearly survey returned.

Results of the research on the voice recognition software intervention will be
available to you by January 2003. The results of the 4-year follow-up study; will be
available to you by August 2006.
I certify that I have read and that I understand the foregoing, that I have been given satisfactory answers to my inquiries concerning project procedures and other matters, and that I have been advised that I am free to withdraw my consent and to discontinue participation in the project or activity at any time without prejudice.

I hereby give my consent to participate in this project with the understanding that such consent does not waive any of my legal rights, nor does it release the Principal Investigator from liability for negligence.

__________________________________________
Signature of individual participant

__________________________________________
Date

If you cannot obtain satisfactory answers to your questions or have comments or complaints about your treatment in this study, contact: Committee on Human Studies, University of Hawaii, 2540 Maile Way, Honolulu, Hawaii 96822. Phone: (808) 956-5007.

c: Signed copy to subject
Appendix D
Training Protocol
Provided by Krysler Consulting

Creating a User
Controlling the Microphone
Dictating Text and Punctuation Marks
The Dragon NaturallySpeaking User's Guide
The Accuracy Center
Online Help
The Sample Command Windows
Correcting Recognition Errors in Your Dictated Text
  Correcting in the Spell Dialog box
  Using Playback to Aid Correction
Saving Recorded Dictation
Deleting Recorded Dictation Files
Editing Your Document
  Navigation Commands
  Selection Commands
  Replacing Text
Formatting Your Document
Controlling Your Computer Desktop and Applications
  Starting and Closing Applications by Voice
  Switching between Applications by Voice
  "Clicking" Menus, Submenus by Voice
  "Clicking" Dialogbox Controls by Voice
Dictating Numbers, Special Text & Spell Mode
Customizing Your Vocabulary
  Adding a Word to Your Vocabulary
  Adding a Short Phrase to Your Vocabulary
  Adding He Spoke Informed to Your Vocabulary
  Importing a List of Word
Training for Improved Accuracy
Copying User Files between Computers
Using Dictation Shortcuts
Appendix E

Interview Protocol

Welcome and thank-you for agreeing to take some time to discuss your experience with Dragon Naturally Speaking. The reason for this study was to find out if people would continue to use Dragon Naturally Speaking after they were initially trained on it. I also hope to find out some of the things that impacted your use of the software. I will ask a few questions. Please respond openly and honestly. Do you have any questions before we begin?

Possible questions:

1. What was it like for you using the software?
2. What did you like about the software?
3. What did you not like about the software?
4. Will you continue to use the software?
5. What are the reasons you used the software?
6. What are the reasons you did not use the software?
7. Do you think you will try to use the software again?
Appendix F

Focus Group Protocol

Welcome and thank-you for taking the time to meet. You agreed to be here today to discuss your experience with Dragon Naturally Speaking. The reason for this study was to find out if people would continue to use Dragon Naturally Speaking after they were initially trained on it. I also hope to find out some of the things that impacted your use of the software. I will ask a few questions. Please respond openly and honestly.

Possible questions.

1. What was it like for you using the software?
2. What did you like about the software?
3. What did you not like about the software?
4. Will you continue to use the software?
5. What are the reasons you used the software?
6. What are the reasons you did not use the software?
7. Do you think you will try to use the software again?
Appendix G
Survey

Class Section

Please provide a short answer.

1. What is your major area of study?

2. What is your minor area of study?

Please place a check in the appropriate box.

3. Do you have a high school [ ] Diploma [ ] Certificate of Completion, or [ ] GED?

4. What was your high school grade point average (GPA)?

[ ] 0-1.0 [ ] 1.1-1.5 [ ] 1.6-2.0 [ ] 2.1-2.5 [ ] 2.6-3.0 [ ] 3.1-3.5 [ ] 3.6-4.0

5. Are you the first person in your family to attend college (postsecondary education)? [ ] Yes [ ] No

6. How many credits are you taking this semester? [ ] 0-3 [ ] 4-6 [ ] 7-9 [ ] 9-12 [ ] 13-15 [ ] 6+

7. How would you rate your computer skills? [ ] Very good [ ] Good [ ] Average [ ] Below Average [ ] Poor

8. How would you rate your writing skills? [ ] Very good [ ] Good [ ] Average [ ] Below Average [ ] Poor

9. If you have a disability please check the box that you would use to describe your disability, if you don't have a disability check the box labeled none.

[ ] Speech/Language [ ] Orthopedic [ ] Visual Impairment [ ] Learning Disability [ ] Health-related

[ ] Hearing Impairment [ ] Psychological/Psychiatric [ ] Other [ ] none


11. Have you ever used voice recognition software? [ ] Yes [ ] No

If you would like to participate in the study please write your name, phone number and e-mail address. I will contact you within the week. If you do not want to indicate your desire to participate on this paper please call me at 255-2101. Thank-you. Kelly Roberts
Appendix H

Writing Sample Topics

Plan and write an essay on one of the topics listed below. You will probably find it best to spend a little time considering the topic and organizing your thoughts before you begin writing.

An essay question is given in order for you to demonstrate how well you write. You should, therefore, take care to write clearly and effectively, using specific examples where appropriate.

1. Describe an invention you think would benefit humanity. Be sure to explain why and how the benefits would result.

2. Describe your favorite past time and why you like it. Include when, where, how, why, who, and feelings if appropriate.

3. Describe a memorable childhood experience. Include when, where, how, why, and who if appropriate.

4. What is your view of violence on television and or in video games? Explain why you feel the way you do. Indicate any personal experiences you may have had.
References


