# SPEECH RECOGNITION FOR STUDENTS WITH DISABILITIES IN WRITING

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## ABSTRACT

*The role of technology in education is ever increasing. This article looks at students with disabilities and the problem of writing independently. Speech recognition technology offers an option, or solution, for students who have physical and/or learning disabilities and for students who cannot access and use computer keyboards or switches. Classroom use of the speech recognition software program packaged within most personal computers is suggested.*

The act of composing and writing occurs naturally for most students, but a disability in written language expression can present a significant stumbling block to student academic success (Bernstein & Luttinger, 2006). Students with physical disabilities, learning disabilities, or learning and physical disabilities may struggle in written language expression. The purpose of this article is to encourage speech recognition use with students who may have physical disabilities, learning disabilities, and/or a combination of both physical and learning disabilities in order to facilitate independent writing.

Students with poor motor skills may experience significant problems writing and communicating when using written language. According to Curtain and Clark (2005), Hemmingson and Borell (2002), and Llewellyn (2000), students with physical disabilities encounter barriers in the physical environment which hinder their ability to fully participate in and benefit from the inclusive general education classroom environment. Those who have difficulty using their hands may experience additional problems manipulating the standard computer mouse and keyboard. They may suffer mental

or physical fatigue more easily. The student may become fatigued by gathering resources such as reference materials for classroom assignments and not be up to completing the writing process. Students with specific learning disabilities in written expression may also have physical disabilities that will hamper the writing process. Limited research has been conducted in the area of written expression for students with specific learning disabilities, but empirical research conducted in the area of written expression for students with physical disabilities is scarce.

## STUDENTS WITH DISABILITIES IN WRITTEN EXPRESSION

Many factors may contribute to a disability in written expression. A student's ability to express thoughts via written expression may be affected by impairments in motor, language processing, or cognitive skills (Manasse, Hux, & Rankin-Erickson, 2000). Students with problems in word retrieval, grammar, or syntax, along with impaired physical ability may experience such frustration that they have difficulty putting thoughts into words.

Lack of fluency may inhibit written expression. Less fluent writers may be embarrassed by the appearance of their writing due to brevity of sentence or paragraph length, illegibility of handwriting, and/or misspelled words (Quinlan, 2004). These students may misbehave or attempt to create a distraction to avoid writing activities in class. Inhibited working memory capacity may affect the planning process in organizing thoughts, or the ability to translate thoughts into words. When translating thoughts into words, students with reduced working memories may not be able to coordinate higher level processes. In the revising and editing process, students may take so long to remember how to spell a word that they forget, or lose, the thought.

According to MacArthur (1999), a student with a learning disability in written expression may report greater concern with the mechanics of writing rather than the substance of what is written. Anxiety about mechanics may interfere with the ability to compose. Quantity and quality of writing are easily affected by whether the student is handwriting or typing, having problems with spelling, capitalization, or punctuation, and formatting text on the computer (MacArthur, 1999). A student with a learning disability in writing may become more concerned with how to form letters or where a particular key is located on the keyboard than with the substance of writing. Writing may be an unpleasant chore for students with mechanics problems. They often focus on the lowest levels of criteria for good writing such as forming letters or spelling of words. Mechanics problems may limit the learning of content, organization or of style (MacArthur, 1999). The text production of students

with learning disabilities was found to be inferior to that of students without learning disabilities according to Quinlan (2004). In text production, students with learning disabilities used shorter sentences and paragraphs, and more misspelled words were noted. Various mechanical problems noted by Quinlan included confusion with capitalization, punctuation, and noun-verb agreement. Poor handwriting skill limited the student's writing performance.

Bernstein and Luttinger (2006) and MacArthur and Cavalier (2004) identified many problems that students with learning disabilities in written expression encountered when using word processing programs. Bernstein and Luttinger found that writing with a computer word processor "helpful" for certain students but an additional burden for others. Word processing programs provide an additional stressor to some students when attempting to write.

## STUDENTS WITH PHYSICAL DISABILITIES

The research available for individuals with physical disabilities is focused primarily on adult subjects, not children and adolescents. Koester (2001) reviewed the literature regarding the use of speech recognition technology with adult subjects with physical disabilities and of those with normal speech patterns. Koester found a lack of data regarding the use of speech recognition systems by individuals with physical disabilities, a satisfaction with speech recognition systems among users who have physical disabilities and normal speech patterns, and continued skill development among those users. No research was reported regarding training methods and procedures for children and adolescents with physical disabilities. In a later study, Koester (2004) surveyed adult subjects whose physical disabilities hindered their use of the computer keyboard. She assessed user satisfaction with the performance measures of speed and accuracy, and participant usage and satisfaction with speech recognition systems. Results of the survey indicated a general satisfaction with speech recognition. Input via speech was reported less painful and fatiguing than manual keyboard input for the users with physical disabilities and Koester also suggested that more experienced users with physical disabilities were more tolerant of shortcomings in the speech recognition system than those with less experience. She hypothesized that an individual's need for a speech input system may increase the user's perceptions of satisfaction with their speech recognition technology.

Kotler and Tam (2002) examined text generation speed, recognition accuracy, and perceptions of the disadvantages of use of speech recognition software by adult subjects with physical disabilities and normal speech pat-

terns. Among the disadvantages reported by users, low levels of text generation speed were attributed to the computer's misrecognitions of an individual's speech. General fatigue and vocal fatigue were reported due to the need for constant vigilance to monitor for errors, or misrecognitions, and to make necessary corrections. For users unable to use the keyboard to write, however, Kotler and Tam found speech recognition systems an effective means for writing, despite the disadvantages reported by subjects in the study.

The act of writing requires physical stamina. Depending upon the individual's health, a student with impaired motor skills may experience fatigue due to the muscle control and/or concentration required when writing. Weakened muscles, early signs of arthritis, or tension headaches may also lead to student fatigue (Hux, Rankin-Erickson, Manasse, and Lauritzen, 2000; Manasse, Hux, and Rankin-Erickson, 2000). A student with physical disabilities and impaired cognitive ability may experience problems in organization, planning, and monitoring for errors (e.g., when writing in the narrative, the student may experience difficulty putting events in order). These may be problems describing the qualities of items including shape, size, or color (Manasse, Hux, and Rankin-Erickson, 2000). All of these may be compounded by lack of physical endurance to manually transcribe one's thoughts.

## SPEECH RECOGNITION TECHNOLOGY

For students with physical and/or learning disabilities in written expression, assistive technology, including computers, word processors, and spelling and grammar checkers, provides an alternative strategy, or intervention, to assist students with written work. One of the goals of educators is to adapt technology into the classroom curriculum (Dyrli & Kinnaman, 1994). The classroom computer can serve as any other classroom instructional tool to promote student productivity, in this case, written communication for students with physical and/or learning disabilities who may experience difficulty recording their thoughts on paper.

To meet the writing needs of students who experience difficulty recording their thoughts on paper, speech recognition software programs, or the speech recognition engine packaged within most classroom computers will allow students to dictate and to give the computer commands into a headset or microphone, instead of typing manually. The speech recognition software converts students' voices into text as they speak. MacArthur and Cavalier (2004) and Quinlan (2004) examined word processing programs which feature dictation as a method of compensation for students with learning disabilities in the area of written expression. However, little research has been

conducted on the effectiveness of this type of assistance specific to students with physical disabilities. Speech recognition software may provide many students with physical disabilities a powerful tool that will allow them to access and manipulate the computer to record their ideas quickly and independently with relative ease (Alliance for Technology Access, 2000).

## BENEFITS OF SPEECH RECOGNITION TECHNOLOGY

The speech recognition program can be accessed by students with limited bodily skills or physical problems. Speech recognition software can be used as a means, or option, for independently completing assignments involving written expression. Speech recognition is valuable in providing a valid assessment of the ability to generate ideas, organize ideas, use coherent sentences, and revise content (MacArthur & Cavalier, 2004).

### EASE OF ACCESS
As students become more familiar with speech recognition technology and its limitations, they are able to attain greater success and more consistent benefits (Koester, 2004). Experienced users expressed higher rates of satisfactions and were more tolerant regarding limitations. According to Koester, for students with physical disabilities who required hands free access to the computer, speech recognition technology was a much more attractive alternative in comparison to other options, such as mouthstick typing.

### TEACHER TIME
Use of speech recognition technology for students in the classroom also helps with the teacher, aide, or paraprofessional's time spent working one-to-one with an individual student. Teachers and paraprofessionals often act as transcribers for students with physical disabilities who require additional teacher time completing assignments involving written communication (MacArthur, 1999). With little, or limited, assistance from the teacher or aide, students work at their own rate without feeling pressured, or rushed, to perform.

### INDEPENDENCE
Level of training and amount of training in the optimal use of speech recognition technology affects satisfactory ability to use the program (Hux, Rankin-Erickson, Manasse, and Lauritzen, 2000; Kotler and Tam, 2002). Speech recognition technology also decreases reliance on the teacher, in turn increasing student ability to function independently (MacArthur, 1999).

According to Hux, Rankin-Erickson, Manasse, and Lauritzen (2000), individual accuracy levels vary and continued use should yield continued improvement. Continued use and improvement should result in increased functioning and independence.

## STANDARDIZED WRITING ASSESSMENTS

The computer becomes a tool to measure the acquisition of student communication, or more specifically, student writing skill, and as a tool for measuring specific writing skill goals and objectives. Within this framework, a speech recognition program can be implemented to measure specific performance by a student with a physical and/or learning disability as he or she participates in standardized assessments of writing (MacArthur & Cavalier, 2004) including descriptive, narrative, expository, and persuasive modes of writing skill. The student is then able to focus on the mode of writing and not on the physical act, or effort, and, is not dependent on an adult scribe.

## IMPROVED GENERATION OF IDEAS

Students with writing problems who use speech recognition are found to be less focused on mechanics. They report that speech recognition is faster than handwriting, typing, and dictation to a teacher or scribe. Poor writers are able to dictate papers that are more complete, longer, and of better quality (MacArthur, 1999). Students who use speech recognition evidence more advanced vocabulary, focus less on spelling errors, and give greater attention to text and idea generation (Manasse, Hux and Rankin-Erickson, 2000). Fewer word errors were made by students with learning disabilities on essays with speech recognition than with handwriting. The continued use of speech recognition technology resulted in greater accuracy and the use of speech recognition required students to focus on speaking clearly and monitoring their writing for errors (MacArthur & Cavalier, 2004). According to Regan (1998), when using training software, the more you train, the better the computer will understand your speech, including personal inflections and speech patterns.

## PROBLEMS WITH SPEECH RECOGNITION TECHNOLOGY

Koester (2001) found that many individuals held unrealistic expectations of perfect accuracy from their speech recognition systems. The most critical problems identified included formal assessment issues, error recognition and correction, irregular speech patterns, individual ability to problem solve, and

access issues. Vocal stress was identified as a human factor issue, or barrier, to user comfort.

### INDIVIDUALS WITH DYSARTHRIC SPEECH

The accuracy of individuals with dysarthric speech using three different speech recognition systems was examined by Hux, Rankin-Erickson, Manasse, and Lauritzen (2000). The accuracy rate of an individual with normal speech patterns was compared to the accuracy rate of an individual with dysarthric speech. Results indicated that each system was more accurate in reading the speech pattern of the individual with normal speech patterns than of the individual with dysarthric speech. Koester's (2001) research affirmed that human factors, such as cognitive disabilities or voice problems, decreased the effectiveness of the speech recognition system. Hux, Rankin-Erickson, Manasse, and Lauritzen (2000) found the process of selecting an appropriate speech recognition system highly personalized for individuals with dysarthria. The computer's ability to read speech patterns of individuals with dysarthria, along with reading level and motivation were identified as issues related to the accuracy of each system examined.

### FORMAL ASSESSMENT MODIFICATION

Problems using speech recognition technology may occur during formal assessment. Speech recognition technology may not be an acceptable modification or accommodation for students according to test manufacturers (MacArthur & Cavalier, 2004). When assessing written expression skill, the use of speech recognition technology may affect test validity. If the mechanics of writing are being assessed, the assessment of student ability to write in manuscript or cursive handwriting, spelling, punctuation, and capitalization may also be affected.

Another problem identified by students who use speech recognition technology (Regan, 1998), was the difference between the language used in "talking" to individuals in an informal environment versus the language used in formal "writing" required for assessment purposes. Writing requires a more formal language (e.g. writing a letter) than speaking (e.g., talking on the telephone). For many students, dictation feels unnatural, as in dictation of punctuation or commanding a new line.

### ERROR RECOGNITION

Speech recognition software requires reading skill and ability to recognize errors (MacArthur, 1999). The computer's ability to accurately recognize speech is limited when using speech recognition software. Students must

have the ability to monitor writing processes, and detect and correct spelling and/or grammar errors. For experienced writers, speech recognition may interfere with, or inhibit, the writing process. Computer based writing requires fewer strategies for planning, rereading, and editing work according to Leijten and Waes (2005). They identified problems encountered by users which included the computer misrecognizing single words, the word appearing differently from what is intended, the computer misrecognizing a series of words or commands, the individual hums or coughs, or the computer misrecognizing the individual's speech pattern were among the problems identified.

### ERROR CORRECTION

Error correction is another problem identified by students who use speech recognition technology. Speech recognition software is very sensitive to sounds. Vocalizations or heavy breathing are picked up by the computer and recorded as environmental noise (Regan, 1998; MacArthur, 1999). MacArthur (1999) found ability to detect errors to be a problem for students with disabilities. Accuracy with speech recognition is limited and requires the student to monitor and correct errors. In order to do this, the student must possess reading skills and the ability to recognize errors.

### PROBLEM SOLVING SKILLS

Student reported reasons for not using speech recognition technology include lack of time to learn a new program, and a lack of computer access. A disability in an area other than the area of written composition was reported by some for not using speech recognition. Students who used other compensatory strategies (e.g. teachers or parents as scribes) did not need speech recognition (Roberts & Stodden, 2005). Roberts and Stodden reported that those who use speech recognition technology must display patience and tolerance for word recognition mistakes, possess the ability to concentrate, and the individual must have a high tolerance for frustration. The individual must possess the ability to speak Standard English.

### COMPUTER ACCESS

Technology is only effective if it enhances the educational program and supports student learning (Jones, Valdez, Nowakowski, & Rasmussen, 1995). It is expensive, so for classroom use it must be cost effective and easily accessible to students. Students with disabilities must also have opportunity to access and use current technology programs as part of the daily curriculum. According to Jones et al., technology may yield positive results not detected

by standardized testing and should not be rejected based on those findings. They suggested measuring the technology against more specific outcomes, such as access, operability, organization, ability to engage students, ease of use, and functionality. Jones et al. also identified several policy issues that affect schools' use of technology: providing technology access to all students, developing standards for technology use and assessing those standards, locating funding, coordinating services for students beyond the classroom into the home and workplace, and collaborating with parents.

## DISCUSSION

Students with disabilities are being increasingly asked to meet standards for written expression that demonstrate proficiency. Using speech recognition technology applications to enhance the writing skills of students with physical and/or learning disabilities in written expression is an effective means for improving independence in written expression. By configuring the speech recognition software packaged in most classroom computers, students who experience problems writing will have an inexpensive and easy method for writing. The lack of physical ability, or stamina, will not interfere with ability to participate in classroom writing assignments. Classroom teachers can determine the student's ability to utilize the program based upon student ability to read paragraphs provided during the configuration process. Additional information should be gathered prior to use by determining the student's oral reading level and voice.

In addition to providing students with physical and/or learning disabilities in written expression with a means for writing, speech recognition has the capacity facilitate independent writing for these students. The additional teacher time required to transcribe the student's dictation is no longer required. The student will have the opportunity to interact with technology independently. Students may find it easier to express ideas through technology rather than through using the teacher as a scribe.

## SUGGESTIONS FOR FUTURE RESEARCH

Given the lack of empirical literature addressing the use of speech recognition software programs for students with physical disabilities, additional research is needed to evaluate this program. Investigations must be conducted to establish speech recognition software as a valid, evidence-based practice to develop written expression skills for students with physical and/or

learning disabilities. This includes an evaluation of the impact of speech recognition software on student learning for students with physical disabilities and students with physical and learning disabilities. Data should be gathered to determine if the systematic use of speech recognition results in improved student outcomes in the areas of written expression for these populations. Teachers and students can be questioned about their perceptions of the effectiveness of speech recognition. With limited teacher time to write as a student dictates, it is important to understand whether speech recognition is perceived as being more, less, or as useful as more expensive dictation programs for students with physical and/or learning disabilities. A time of "universal access" (Alliance for Technology Access, 2000) for all students with disabilities in written expression can be realized.

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