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The effectiveness of using speech-to-text technology to support writing of students with learning disabilities

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**THE EFFECTIVENESS OF USING SPEECH-TO-TEXT TECHNOLOGY TO
SUPPORT WRITING OF STUDENTS WITH LEARNING DISABILITIES**

by

Jennifer Adams

A Thesis

Submitted to the
Department of Interdisciplinary and Inclusive Education
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In partial fulfillment of the requirement

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at

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Thesis Chair: S. Jay Kuder, Ed.D

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Dedication

In dedication to my family and friends for their unwavering support.

Acknowledgments

“It always seems impossible until it’s done” Nelson Mandela

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Abstract

Jennifer Adams

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SUPPORT WRITING OF STUDENTS WITH LEARNING DISABILITIES

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S. Jay Kuder, Ed.D

Master of Arts in Special Education

This study examined the effects of using Speech Recognition (SR) technology to create more cohesive writing for students with learning disabilities as compared to the use of paper and pencil. Six students with IEPs from general education classrooms, ages 7 years old to 9 years old, participated in this study.

Prior to the start of this study, the subjects completed a baseline assessment to measure their expressive writing abilities in response to a narrative prompt. The students were required to include a topic sentence, beginning, middle, and end, and demonstrate understanding of the conventions of writing. There was not a requirement for number of words or a time limit. The writing samples were graded on a grade-appropriate rubric (see Appendix) to measure for holistic quality, organization and cohesiveness, grammar, and mechanics of writing. The students participating in this study did not demonstrate a significant improvement in writing when utilizing the speech-to-text technology to compose narrative writing samples compared to paper and pencil transcription.

Implications and suggestions for future studies regarding utilizing SR technology to accommodate students with Learning Disabilities are discussed.

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Chapter 1

Introduction

Writing is no longer isolated to the subject area of Language Arts. All content areas require extensive and cohesive writing to express ideas and reasoning. As a result, students who once demonstrated a strength in mathematics or the humanities are slowly falling behind academically due to the level of writing that is necessary in these subject areas. The Partnership for Assessment of Readiness for College and Careers (PARCC) testing incorporates writing in all subject areas being assessed. Students are required to compose essays in response to reading passages, explain their mathematical strategies and reasoning, as well as express opinions and understanding of content in the subject areas of science and social studies. As the presence of written expression becomes more prevalent in our curriculum and assessments of school-aged children, the need to improve student development of writing has intensified.

As our education system moves towards preparing students for the 21st Century and the implementation of the Common Core State Standards (CCSS), writing expectations have become more rigorous and more prevalent across the curriculum. According to the CCSS website (2016), there are four anchor standards for writing for k-12 students; Text Types and Purpose, Production and Distribution of Writing, Research to Build and Present Knowledge, and Range of Writing. This research study will focus on two of the standards: Text Types and Purpose standard and Production and Distribution of Writing standard. The text Type and Purpose standard requires students to write a narrative essay to develop real or imagined experiences. The Production and Distribution of Writing standard requires students to develop their writing through the

approach of planning, organizing, revising, editing, and rewriting with the use of technology and collaboration.

Many school-aged students struggle to meet the expectations of writing set forth by the CCSS; such as applying the conventions of writing, implementing the writing process, and developing fluency. Students with learning disabilities are at a greater detriment in the process of writing due to a variety of factors. Some students understand the conventions of writing; but have trouble in expressing their ideas clearly in written format. Others can write expressively but lack focus or cohesiveness in their story line. For many students with learning disabilities, the task of writing is daunting and therefore they are unable to begin the process of writing. Writing is a skill that will affect the lives of all students beyond their educational career; therefore, effective instruction and application are crucial. Providing effective instruction for students with learning disabilities requires educators to access many of our technological advances to promote self-efficacy and student achievement.

Speech recognition technology was first introduced to the world in the 1950s with the ability to recognize digits and has since then progressed to recognizing over 230 billion words. Using speech recognition software for students with learning disabilities has many benefits for the process of writing in the classroom. Students with dyslexia, dysgraphia, vision impairments, physical disabilities, or other learning disabilities profit from this technology based on the potential for increased writing production, improvements in writing mechanics, increased independence in writing, and decreased anxiety towards writing. Speech recognition software enables the student to write more quickly and fluidly while eliminating the obstacle of transcribing thoughts while

brainstorming. Although speech recognition software has developed greatly over the past two decades, the student is still responsible for many of the writing aspects such as editing and revising. Students must monitor the words and sentence structures to edit and revise their work as it is transcribed to the computer, therefore developing their grammar and phonemic awareness. With the emergence of text-to-speech technology, students are able to hear their writing and make necessary edits independently. The use of speech recognition technology in the classroom will become more applicable for students with learning disabilities as the development of natural speech recognition is developed.

A majority of the research being conducted on writing instruction for students with LD focuses on the teacher's instruction, rather than the tools utilized by the students to practice the skill. The research question to be addressed in this study is, would the use of speech-to-text technology improve the composition of writing among 2nd and 3rd grade students with learning disabilities? My hypothesis is that 2nd and 3rd grade students with learning disabilities will create more cohesive writing using speech-to-text technology than if they were to use paper and pencil.

Reducing the individual's struggle to express their ideas through the use of speech-to-text technology will increase fluency and self-efficacy in writing among students with learning disabilities. Through a single-subject study, I hope to find that students with learning disabilities who perceive writing as an overwhelming task will develop a stronger sense of writing and cohesive expression when approaching and composing a narrative writing sample when provided speech-to-text accommodations. Students will compose a written response using the speech-to-text technology, allowing them to focus on their ideas rather than the physical task of writing with paper and pencil.

As the student progresses in their ability to communicate their ideas they will then develop editing and revising strategies to enhance their writing.

The implications of the research will influence students, schools, and society. If this method is successful, it has the potential to help students with LD to become stronger communicators in both written and oral aspects. The student with LD will have the ability to demonstrate their understanding of the writing process as well as their application and composition of writing cross-curricular. Since writing is a component of all subjects, students will be able to demonstrate their strengths in all content areas. In turn, students with LD will be able to showcase their strengths in subject areas such as math.

Teachers may find the use of speech-to-text software helpful to all students in the area of writing. Effectiveness of instruction may increase when students are encouraged to use technology to guide their writing process. Schools may experience an increase in formal assessment scores of students with LD in all content areas.

Writing skills are prevalent in our everyday lives. Individual's seeking employment are required to produce writing in one form or another while social media, emailing, and texting allows people to communicate with family, friends, and the world. Graham & Harris (2013) state that ... "students who are poor writers are at a serious disadvantage in succeeding at school, successfully pursuing some form of higher education, securing a job that pays a living wage, or participating fully in social and civic activities (29)." Students with LD are currently at a disadvantage in our education system due to the high demands of our standards without proper instruction or means to express their writing abilities. Incorporating speech-to-text technology as a tool for

students with LD to convey their creative thoughts through the use of the writing process will increase the student's quality of written expression.

Chapter 2

Literature Review

Writing is a process of communicating thoughts, ideas, and information through a combination of letters and symbols. Children begin writing as early as 2 years old through drawings, squiggly lines, and representation. As they continue through grade school, they learn how to properly form letters, symbols, and numbers; combine those symbols to create words; combine words to create sentences and cohesive thoughts; and develop expressive writing. Learning to write is a complex cognitive, linguistic, affective, and physical act that affects a student's academic successes, social interactions, and prospective employment.

Writing Expectations for Primary Grade Students

In 2010, the National Governors Association Center for Best Practices (NGA Center) and the Council of Chief State School Officers (CCSSO) initiated academic standards to improve the education system and expectations of students with the intent to increase student's preparedness for college and careers. The Common Core State Standards (CCSS) for writing place emphasis on a student's ability to compose expressive writing through critical thinking, metacognition, understanding writing purposes and genres, incorporating writing components, applying the features of text, and maintaining motivation (www.corestandards.org). While all students are upheld to the same expectations, the means in which they achieve that success differs greatly. Learners develop at different paces, through different modes, and with different degrees of self-efficacy.

The CCSS states that by the end of 3rd grade, all students will be able to: write opinion pieces supporting a point of view with reasons and support, linking words, and a concluding sentence; write an informative or explanatory text to examine, develop, and convey facts, information, or ideas using linking words, and a concluding sentence; and write narratives to develop real or imagined events through details, dialogue, and temporal words.

Writing is a multifaceted, integral part our education system requiring students to plan, organize, compose, revise, and edit to create a cohesive and legible writing sample, yet many students with learning disabilities struggle with written expression. Students with physical disabilities, vision impairments, dysgraphia, dyslexia, and other learning disabilities often struggle with transcription, the act of producing written words from thoughts, therefore impeding on their writing in a multitude of ways. A review of the research on the writing of students with learning disabilities (LD) by Graham, Collins, Rigby-Wills (2015) found that, when compared with their classmates encompasses students with learning disabilities: use fewer ideas; their writing is more poorly organized; lacks basic structural elements; involves less diverse vocabulary; is less legible; includes more errors involving spelling, grammar, and usage; and is of poorer overall quality. There has been an increasing focus on understanding why students with learning disabilities struggle with written expression, the impact it has on their education, and accommodations to support writing among this population of students.

Transcription Difficulties for Students with Learning Disabilities

Students with LD experience handwriting difficulties, producing letters at a rate significantly below their more fluent peers, and generating papers that are considerably less legible and of a lower quality (MacArthur and Graham, 1987; Weintraub and Graham, 1998; Baker, Gersten, & Graham, 2003; Santangelo, 2014). Understanding the basic struggles that students with LD face in regard to written expression empowers educators to support the development of writing in a manner that is least restrictive for the student.

MacArthur and Graham (1987) investigated the effectiveness of three different methods of text production: handwriting, word processing, and dictation, among students with LD. Fifth and sixth grade students with LD were asked to compose stories in response to pictures using each method of composing. MacArthur and Graham concluded that there were no significant differences in the paper and pencil or word processor compositions; however, the dictated stories were longer, contained fewer grammatical errors, and were of a higher quality. The findings for poorer pencil and paper and word processing compositions were attributed to two factors: a slow rate of production and difficulties with mechanics. Reducing or eliminating the use of paper and pencil or word processors during the writing process enabled students with LD to demonstrate their ability to develop a composition without the struggles of transcription; therefore, improving the quality of writing.

Baker et al. (2003) conducted a review of experimental studies to present research-based examples of effective instructional approaches and interventions to

improve expressive writing among students with LD. Baker et al. noted that explicit instruction on the processes of writing was crucial for the development of written expression; however, spelling and handwriting difficulties interfered with the production of expressive writing among these students. Contributing factors included: fatigue due to underdeveloped motor skills and muscle fatigue, avoidance of the task due to the demand of focus on spelling and handwriting, a discrepancy between the thought process and the rate of transcription, and an interruption in the thought process or planning of writing. Dictation of compositions yielded longer and better text than when writing by hand via paper and pencil or typing on a word processor (Baker et al., 2003).

In 2014, Santangelo conducted a narrative review of current research to analyze the difficulties that students with LD experience regarding writing. The article focused on the influence of strategic behaviors, knowledge of the writing process, transcription, and motivational factors on the production of writing among students with LD. Santangelo reported that students with LD have difficulties planning or generating ideas for writing due to the effort required to retrieve relevant information for the task, having limited knowledge about the genres of writing, organizing, and executing the planning strategies necessary for writing.

In Santangelo's article, generating linguistic ideas and transcribing are noted as two primary elements that contribute to the impediment that students with LD experience in written expression. Neatness and legibility were found to significantly impact the ratings of student writing. Samples that were written more neatly and legibly were viewed as higher in overall quality. Handwriting and spelling skills accounted for 25% and 46% in compositional quality at the primary and intermediate grades, and 66% and

41% in compositional fluency, at these same grade levels (Graham, Berninger, Abbot, Abbot, & Whitaker, 1997). Having such a substantial influence on the viewed quality of writing; transcription, neatness, and legibility are key factors to improving the overall performance of writing among students with LD. Santangelo contributed the difficulty with text production among students with LD to the motor and cognitive aspects of handwriting. The dysfluency of transcribing and the generation of ideas limits the composition of written expression among students with LD. Students with LD experience handwriting difficulties, producing letters at a rate significantly below their more fluent peers, and generating papers that are considerably less legible and of a lower quality (Weintraub and Graham, 1998; and Santangelo, 2014).

While transcription interferes with the physical act of composing written expression, affecting spelling, grammar, fluency, and the generation of ideas; other stages of the writing process are hindered as a result of students struggling with transcription. Revising is a critical step in the writing process and typically develops writing on a deeper more cohesive level. Students with LD are less likely to revise their writing beyond spelling, punctuation, and neatness (Santangelo, 2014). Difficulties with handwriting were found to negatively impact the revising stages of the writing process due to students omitting sections of their writing when composing a second or final draft. Furthermore, the struggle with transcribing either limits the amount of time a student has to revise their composition on a timed project or necessitates more time and focus for students with LD who are granted additional time to complete their writing. The final influencing factor reviewed by Santangelo was motivation and perception of value. Most students view writing as useful in achieving academic and vocational goals;

however, students who struggle with composing do not demonstrate the same views on the purpose of writing. Santangelo reported that students with LD who struggled with written expression perceived it as having nominal relevance or value.

Overall, Santangelo and Baker et al.'s research review concluded that students with LD face many challenges in writing: planning and generating ideas, text production, revising, and motivation. Difficulties with text production and transcribing interfere with the automaticity and fluency of written expression, impacting the readability, length, and structure of the writing as well as the ability to plan and revise. Focusing on the lower-level skills of text production, such as letter formation, spelling, and grammar may interrupt the author's plan and progression of writing; therefore, hindering the performance of their higher-level skills.

Students with Learning Disabilities Dictating Writing

Dictating to a scribe has been a commonly used accommodation for struggling writers throughout the years. Past practice of dictation required a student to speak their writing to a teacher, paraprofessional or aide, who then recorded the words via paper and pencil or word processor. Dictation to a scribe proved to be beneficial for struggling writers; however, the feasibility and availability of a scribe for each student is limited.

In 2014, Gillespie and Graham conducted a meta-analysis of experimental, quasi-experimental, and within-subject design studies to determine the effectiveness of writing interventions on the quality of writing produced by students with learning disabilities. Their research found that dictation resulted in statistically significant improvements in the writing quality of students with LD. One particular study in their review focused on

the maintenance of effects, which concluded that the students in the dictation group continued to outperform students in comparison conditions two weeks post intervention.

MacArthur and Cavalier (2004) conducted a repeated measures group designed study of 31 high school students: 21 students with LD and 10 students without LD, to measure the feasibility and validity of speech recognition software and dictation to a scribe. Their results indicated that dictating to a scribe yielded higher overall scores than dictating to speech recognition; however, dictation in both forms produced higher levels of writing than handwritten essays. While MacArthur and Cavalier found dictating to a scribe to be the most beneficial means of transcription for students with LD, that option is not always available to students. MacArthur and Cavalier (2004) concluded that speech recognition is valuable in providing a valid assessment of a student's ability to generate and organize ideas, use coherent sentences, and revise content.

Students who dictated their composition produced a higher quality of writing compared to those who wrote via paper and pencil (Baker et al., 2003; Gillespie and Graham, 2014; MacArthur and Cavalier, 2004). Dictation accommodations traditionally required struggling writers to verbally speak their writing to a teacher or paraprofessional. Although the accommodation of dictating to a scribe proved beneficial to the struggling writer in the production of written expression, it was time consuming and forced the student to be dependent on the adult for written expression. With the emergence of new technology, such as speech recognition, students are able to generate expressive writing independently, with fewer errors and more ease.

Speech Recognition Technology and Students with Learning Disabilities

In more recent years, there has been an increased interest on the effectiveness of technological accommodations for students with LD. With the understanding that struggling writers and students with LD experience difficulties with transcription, research has begun to focus on the benefits of speech recognition (SR) technology.

Gardner (2008) conducted a review of research and studies to examine the benefits of SR technology for students and educators. His research indicated that with increased use and practice of SR technology, the student's level of comfort and ease of access improved. The more a student or individual interacts with the technology, the more familiar they become with the application of the program for their needs. Speech recognition technology reduces the demands on the teacher, paraprofessional, or aide to support the writing process; enabling the teachers and paraprofessionals more working time to spend with all students in the classroom. Likewise, the individual student gains a sense of independence in their writing, by decreasing the reliance on the teacher or paraprofessional. Gardner reported that struggling writers who used SR were less focused on the mechanics of writing and therefore increased their quality of writing. Speech recognition software reduces the focus on the lower-level skills of written expression, permitting the student to focus on the structure of their ideas and authoring.

Quinlan (2004) conducted a between-subject, repeated measures design study that encompassed 41 children between the ages 11-14 years, to investigate how planning support and speech recognition affected writing performance on less fluent writers. For the purposes of his study, Quinlan identified less fluent writers as students who exhibited

a discrepancy between verbal and written expression. Students were first instructed on how to use the speech recognition software as well as a graphic organizer. SR competency was measured via a probe task establishing the accuracy rate of words recognized by the SR software. A minimum accuracy rate of 80% was demonstrated by all participants prior to proceeding with the experiment. The participants then composed four narratives under four different conditions: handwriting with advanced planning, SR with advanced planning, handwriting without advanced planning, and SR without advanced planning. The writing task was presented in picture prompts to compensate for poor reading skills among the participants. The narratives were analyzed for number of words, holistic quality, surface errors, and t-unit length.

Quinlan found that less-fluent writers produced longer narratives with fewer surface errors, and a higher quality through the use of SR compared to handwriting. Removing the constraints of paper and pencil writing, students with LD are able to expand and express their ideas with fewer errors.

Forgave (2002), De Le Plaz (1999), and MacArthur (2009), reported that students using SR technology dictated longer, more complex, and higher quality writing with fewer spelling and grammatical errors. Speech recognition technology has the capability to support writers in developing their writing; however, students are responsible to plan, organize, compose, and revise their writing when using SR technology. Assistive technology programs exist that support students in developing and organizing their ideas, generating the written expression, and revising the work and should be used in conjunction with direct instruction to achieve maximum results.

Forgave (2002) reviewed studies in the areas of speech synthesis programs, organizational software, and voice recognition software to examine the advantages and limitations of each form of assistive technology. One form of speech recognition software known as speech-to-text, was noted as positively affecting remedial writing and reading skills among students with LD when used in conjunction to direct instruction. It was presumed that speech-to-text software enabled students to render their ideas in written format before they were forgotten, circumventing their difficulties with lower-level writing skills such as transcription. As a result, some studies reviewed by Forgave indicated that struggling writers increased their self-esteem and motivation to learn and create written expression.

Peterson-Karlan, Hourcade, & Parette, (2008) conducted a literature review of assistive technologies to support students with physical and learning disabilities in the development of writing. As students move through grade school, the demands of writing increase at a rapid rate. By second grade, students are required to perform complex and higher-level writing tasks such as planning, organizing, editing, and revising written compositions. Peterson-Karlan et al. explained that students with physical and learning disabilities may become exceedingly cognizant in their attempts to produce legible handwriting and error-free spelling. As a result of the hyperawareness of these tasks, the student's writing becomes limited and of poorer quality. The authors suggested that the assistive technology should support a variety of related functions, including: a) readability or legibility of print production; b) speed of the transcription; c) accuracy of the transcription; d) length of the composition; and e) quality of the composition (p19). Peterson-Karlan et al. reported that students who use speech recognition apply more

advanced vocabulary, focus less on spelling errors, and give greater attention to text and the generation of ideas.

According to De La Plaz's (1999) review of five studies, speech recognition technology did not affect the quality of a student's written expression independently. De La Plaz observed that instruction of planning and organization of ideas was influential in the expressive writing produced by students with LD. When students were instructed on the process of planning in combination with using SR technology, their writing significantly improved compared to students who did not receive direct instruction and wrote using paper and pencil. Based on the studies reviewed by De La Plaz, there was little evidence that SR technology alone increased writing quality; however, the benefits of SR were noted in the article. Through the use of supportive technology, De La Plaz noted that struggling writers were able to develop increased motivation and self-efficacy in regard to the writing process.

In 2009, MacArthur conducted a research review focusing on the use of technology to support the writing of students with learning disabilities. The primary focus was directed to the use of word processors, word prediction and speech recognition software, and concept-mapping technology. Each form of supportive technology aided in the development of quality writing when used in combination with strategy instruction for the writing process. MacArthur found that in more recent studies, word processing instruction and its application during the writing process indicated a larger effect size among low-achieving writers. Students who used word processing software were more apt to revise their writing for quality and quantity when using a word processor. This is fundamental to the application of speech recognition technology since SR presents the

student's writing through word processing software. MacArthur deduced that research shows that students with LD and other struggling writers using speech recognition generally produce longer and higher quality essays than by handwriting or word processing. The use of concept-mapping technology enables students to develop, organize and revise their ideas during the planning stage of writing with more ease than paper and pencil. The electronic maps can also be converted to outlines more easily due to the design of the software. MacArthur concluded that papers written with online support were of higher quantity, better organized, contained more relevant content, and were higher in overall quality when compared to papers written using a paper and pencil approach with an organizer.

Current research has maintained that SR technology positively impacts the written expression of struggling students and students with LD by eliminating the burden of transcription, however, questions remain to be answered. For example, Gardner (2008) and Peterson-Karlan et al. (2008) concluded that struggling writers who used SR technology were less focused on the mechanics of writing and therefore increased their quality of writing. Conversely, MacArthur (2009) and Quinlan (2004), found that struggling writers produced better quality writing as a result of seeing the emerging text. They contributed the improvement to the students' ability to reread, plan, and remain focused throughout the composition. The research reviews of Forgave (2002), De La Plaz (1999), and MacArthur (2009) discuss the incorporation of various technological advances and their application in the realm of writing. Collectively, their findings support the notion that speech recognition, when applied with strategy and direct instruction of the writing process, support written expression among struggling writers

and students with LD. The purpose of speech recognition technology is not to replace instruction but rather to support instruction and provide a tool for students with LD to demonstrate their higher-order thinking processes of writing. De La Plaz (1999) stated that speech recognition technology allows students to write at a faster rate than paper and pencil transcription. People speak at an average rate of 125 to 165 words per minute (De La Plaz, 1999). Handwriting slows the process of communicating thoughts due to the slower rate of transcription. Add to that the struggles of a student with LD to transcribe and the thought process is significantly interrupted composing via paper and pencil. Speech Recognition (SR) technology may not be able to convert spoken language to written text as quickly as verbal language is processed, however, it is faster than transcribing.

The reauthorization of the Individuals with Disabilities Education Act requires students with disabilities to have access to the general curriculum with supportive and adaptive instruction to ensure a quality education. There is an emphasis on integrating assistive technology to support instruction and student work in the classroom. Since many students with learning disabilities struggle with writing, the utilization and demand for assistive technology for writing is increasing. Unfortunately, there is a limited amount of research regarding the effectiveness and utilization of SR in the classroom to support students with written expression.

Based on the current research of SR technology and written expression, my study combined evidence-based instructional practices with speech recognition technology. Strategy usage and direct instruction are essential to developing writing skills among young learners and continued to be the focus of instruction. The incorporation of SR

technology served the purpose of providing students with LD a tool to exhibit their writing abilities without the interruption or struggle with transcription. Students received instruction and guidance for planning and organizing their ideas, formulating a cohesive narrative writing, and revising their work to develop a writing composition of higher quality. Through my study, I hoped to identify the applicability and utility of SR for struggling writers.

Chapter 3

Methodology

School

This study took place in Field Street Elementary School, part of the Penns Grove Carney's Point Regional School District located in Penns Grove, New Jersey. Field Street School encompasses first, second, and third grade students with a student enrollment of 551 students. The building supports 3 self-contained special education classrooms and 5 inclusion classrooms across the three grade levels. Seventy-one percent of the students enrolled in the school are documented as coming from economically disadvantaged households, 13% of enrolled students are classified as Students with Disabilities, and 20% of enrolled students are English Language Learners.

Classroom

Students with IEPs from two inclusion classrooms participated in this study. The 2nd grade inclusion classroom participating in this study includes a general education teacher and a special education teacher who remain with the students during instructional time. The classroom has 24 students, with 6 students having an IEP. The class is departmentalized, with one teacher for reading and language arts and a different teacher for math and humanities. The special education teacher accompanies the students when they change classrooms. The 3rd grade inclusion classroom participating in this study is departmentalized as well. The classroom consists of a general education and special education teacher. The classroom has 22 students with 5 students having an IEP.

Subjects

Six students from general education classrooms, ages 7 years old to 9 years old with IEPs, participated in the Speech-to-Text study. The participants were determined because they have an IEP, are enrolled in a general education classroom at Field Street Elementary School, and their parents provided consent for them to participate in the study. Three 2nd grade students with an average age of 7 years 10-months-old and three 3rd grade students with an average age of 8 years 9-months-old participated in the study. Two students were African American, two students were Hispanic, and two students were Caucasian. All the students participating in the study struggle with writing. Four of the six students struggle with transcription while two of the students struggle with sentence structure.

Student A. Student A is a 7 year and 9-month-old African-American female student in a 2nd grade general education classroom setting. Student A was found eligible for special education and related services in December 2016 under the classification Specific Learning Disability. Per her IEP, Student A has good ideas for written narratives, but her writing is sometimes difficult to read due to spelling errors. She can sequence ideas using temporal words, but needs support to write in clear, concise language that includes openings, key details that elaborate the main idea, and a closing. Student A needs support to complete a written narrative that is written with an opening, supporting details that explain the main idea, and a closing. She requires support to use decoding skills for spelling the words she uses in her written assignments.

Student B. Student B is a 7 year and 10-month-old Hispanic male student in a 2nd grade general education classroom setting. Student B was found eligible for special education and related services in May 2012 under the classification Communication Impaired. Per his IEP, Student B struggles with his expressive language skills as well as his language structure. This can impact his ability to produce written and verbal responses to questions in the classroom. Student B can give a written response to a question, but does need support with spelling and sentence structure. He can verbalize the rules for capitalization and punctuation, but does not always carry that over in his writing. Student B has been working on revising and editing, to check for errors and expand on ideas. Student B has a difficult time with written expressive language and language structure. He needs support to give a written response that includes an opening, key details from the text, and a closing.

Student C. Student C is a 7 year and 11-month-old Hispanic male student in a 2nd grade general education classroom setting. Student C was found eligible for special education and related services in April 2012 under the classification Communication Impaired. Per his IEP, Student C can write a written response, but gives a minimal amount of effort. He can state that a sentence requires a capital letter and a punctuation mark, but needs support to revise and edit his work for mistakes. He needs support to integrate his knowledge and ideas into a clear, concise written piece with an opening and a closing.

Student D. Student D is an 8 year 7-month-old Caucasian male student in a 3rd grade general education classroom setting. Student D was found eligible for special education and related services in October 2015 under the classification Multiply

Disabled. Per his IEP, Student D is able to use his eyes to guide his hands for fine motor tasks. He becomes frustrated when presented with a writing task and engaged in avoidance behaviors. Student D can compose several sentences in response to a prompt with assistance in revising and editing. He currently uses a graphic organizer to plan writing with a beginning, middle, and end. Currently, Student D includes narrative elements such as characters, problem, and solution in his writing. He understands the purpose of temporal words in writing, but needs assistance incorporating them into his compositions. His transcript is light and often difficult to read due to spelling and grammatical errors. Student D uses a word processor to produce legible writing compositions. He needs to add details to show thoughts, feelings, and actions of character as well as a closing.

Student E. Student E is an 8 year 7-month-old Caucasian male in a 3rd grade student in a general education classroom. Student E was found eligible for special education and related services in August 2011 under the classification Other Health Impaired. Student E has a diagnosis of Klinefelter syndrome which affects his motor development and academic progress. His reading and writing abilities are directly affected by this diagnosis. Student E also has a diagnosis of hypotonia which impacts his speech due to muscle tone. He receives speech therapy once a week. Per his IEP, Student E can compose a narrative paragraph with assistance in revising and editing. He currently uses a graphic organizer to plan writing that includes narrative elements such as character, problem, and solution. His writing often loses focus and direction. Student E needs to include details to express thoughts, feelings, actions, and a closing in his writing.

Student F. Student F is a 9 year 4-month-old African American female in a 3rd grade general education classroom setting. Student F was found eligible for special education and related services in January 2016 under the classification Specific Learning Disability. Per her IEP, Student F can compose 3-5 sentences in response to a narrative prompt with assistance in revising and editing. She uses a graphic organizer to plan writing with a beginning, middle, and end. Student F understands the use of temporal words, but needs assistance incorporating them into her writing. Her writing can be difficult to read due to improper letter formation, size, and word spacing. Student F utilizes a space stick for her writing to be legible. She needs to add details to show thoughts, actions and feelings and include a closing.

Method

All students needed access to a Google Chromebook[®] with speech recognition software and a word processor to conduct their writing. The writing samples were graded on a grade-appropriate rubric (see Appendix A) to measure for holistic quality, organization and cohesiveness, grammar, and mechanics of writing. The materials necessary to conduct this study included a Chromebook, pencil and paper, and a writing rubric.

Procedure

Prior to the start of this study, the subjects completed a baseline assessment to measure their expressive writing abilities in response to the narrative prompt: *Write about a time when someone made you feel special. What did he or she say to you?* The students are required to include a topic sentence; beginning, middle, and end; and demonstrate

understanding of the conventions of writing. There was not a requirement for number of words or a time limit.

The assessment was scored according to the grade-level appropriate rubric. (see Appendix A) Following the baseline assessment, the participants participated in two 30-minute sessions of training to learn how to properly and effectively use the speech-to-text software on the Chromebooks. Training included the functions, proper annunciation, and manipulation of the SR software to create a word document on the Chromebook. The participants used the Speech Recognition technology software routinely in their classroom instruction to establish a comfortability with the use and application of the programs. Students interacted with the software during instruction for a period of 30 minutes a week. Writing, grammar, and phonics instruction from the classroom teacher continued per the school district curriculum for the four (4) weeks of the study. Once a week students were assessed on their expressive writing in response to a narrative prompt using the speech-to-text software (intervention) and paper and pencil (control) mode. The students were monitored while composing their writing to reduce interruptions and ensure reliability of participant involvement. Two professionals in the school blindly scored each writing sample according to the appropriate grade-level rubric. The scores were averaged to establish an average score for each participant's writing sample. Data was recorded for each writing sample to monitor growth, areas of improvement, and weaknesses among the participants.

Research Design and Data Analysis

The study utilized a single subject design. Student subjects baseline performance was assessed based on the average of 3 narrative writing samples using paper and pencil.

During the intervention, students were assessed on their writing once a week, utilizing both paper and pencil (control) and speech-to-text (intervention) for a total of 8 writing samples. Students' writing performance with the intervention was compared to the baseline and control writing samples. The growth in scores from the student's performance of the speech-to-text writing samples were compared to those of the paper and pencil writing samples.

Chapter 4

Results

The effects of utilizing Speech Recognition (SR) Technology to support students in the composition of narrative writing was studied. Six special needs students from second and third grade general education classrooms participated in the study. Writing instruction was conducted as typical per the Common Core Content Standards and the school district's curriculum. Students participating in the study used Speech-to-Text technology as an intervention while composing narrative writing. The intervention writing samples were compared to compositions transcribed using paper and pencil. Student scores were analyzed on a single-subject design, determining the degree of growth in their writing samples via paper and pencil and using SR technology.

The research question addressed in this study was: Would the use of speech-to-text technology improve the composition of writing among 2nd and 3rd grade students with learning disabilities?

Participating students composed 3 narrative writing samples using paper and pencil to establish a baseline score. Following the baseline assessment, the participants received two 30-minute sessions of training to learn how to properly and effectively use the speech-to-text software on the Chromebooks. Training included the functions, proper annunciation, pacing, and manipulation of the SR software to create a word document on the Chromebook. The participants used the Speech Recognition technology software routinely in their classroom instruction to establish a comfortability with the use and application of the programs. Students interacted with the software during instruction for a

period of 30 minutes a week. Once a week for four weeks, each student composed two narrative writing sample one via paper and pencil as well as one using the speech-to-text intervention. Two teachers scored each writing composition using the same narrative writing rubric. The narrative compositions were scored to measure planning and implementation; use of genre characteristics; and grammar, usage, and mechanics. The two scores were then averaged to measure the score for planning and implementation; use of genre characteristics; grammar, usage, and mechanics; and overall score.

Student Data

Student A. Figure 1 shows the growth trends of the baseline assessments (paper and pencil), and the intervention (SR technology) writing samples for Student A. The scores were calculated by averaging the two scores for each writing sample using a rubric for narrative writing. Student A maintained a score of 5-points during the baseline course of the study. As narrative writing instruction continued in the classroom, the control writing sample had an average score of 6.75-points. The intervention writing, using SR technology, had an average score of 7.25-points. Overall, the intervention of SR technology demonstrated a 0.50-point difference for Student A between the average of the intervention writing samples when compared to the paper & pencil writing samples.

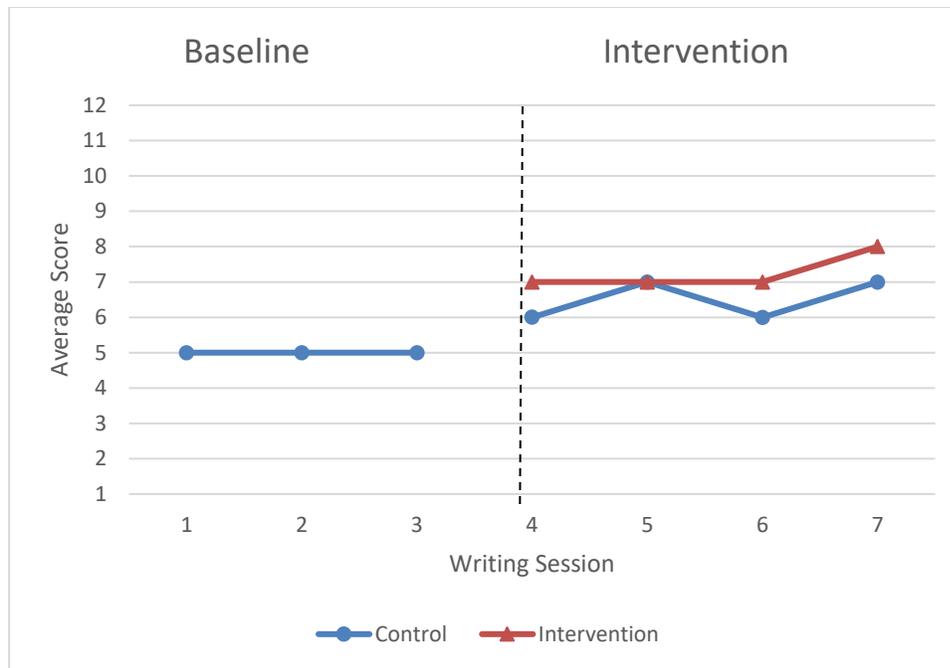


Figure 1. Results for Student A

Student A demonstrated minimal difference in growth between the average scores of the control and intervention writing samples in the writing elements of planning and implementation as well as genre characteristics. The participant's greatest growth was in the element of grammar, usage and mechanics with a 0.50-point difference between the control writing samples and the intervention writing samples.

Student B. Figure 2 shows the growth trends of the baseline assessments (paper and pencil) and the intervention (SR technology) writing samples for Student B. The scores were calculated by averaging the two scores for each writing sample using a rubric for narrative writing. Student B obtained an average score of 7.33-points during the baseline course of the study. As narrative writing instruction continued in the classroom, the control writing sample had an average score of 8.25-points. The intervention writing,

using SR technology, had an average score of 9-points. Overall, the intervention of SR technology demonstrated a 0.75-point difference for Student B between the average of the intervention writing samples when compared to the paper & pencil writing samples.

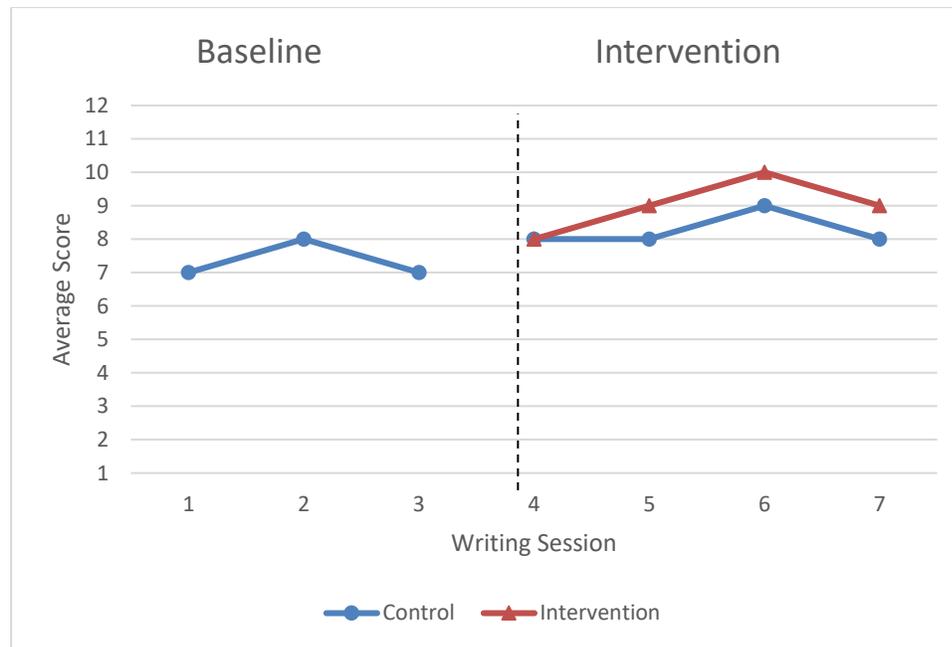


Figure 2. Results for Student B

Student B demonstrated minimal difference in growth between the average scores of the control and intervention writing samples in the writing elements of planning and implementation as well as genre characteristics. The participant's greatest growth was in the element of grammar, usage and mechanics with a 1.11-point difference between the control writing samples and the intervention writing samples.

Student C. Figure 3 shows the growth trends of the baseline assessments (paper and pencil) and the intervention (SR technology) writing samples for Student C. The scores were calculated by averaging the two scores for each writing sample using a rubric

for narrative writing. Student C obtained an average score of 7.67-points during the baseline course of the study. As narrative writing instruction continued in the classroom, the control writing sample had an average score of 8.50-points. The intervention writing, using SR technology, had an average score of 9.50-points. Overall, the intervention of SR technology demonstrated a 1.00-point difference for Student C between the average of the intervention writing samples when compared to the paper & pencil writing samples.

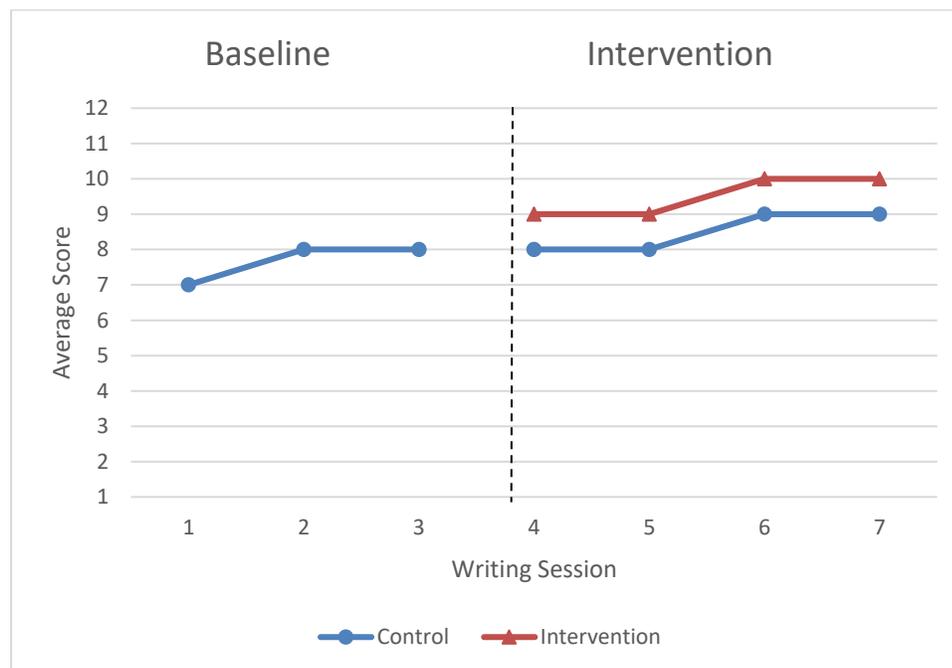


Figure 3. Results for Student C

Student C demonstrated minimal difference in growth between the average scores of the control and intervention writing samples in the writing elements of planning and implementation as well as genre characteristics. The participant's greatest growth was in

the element of grammar, usage and mechanics with a 0.86-point difference between the control writing samples and the intervention writing samples.

Student D. Figure 4 shows the growth trends of the baseline assessments (paper and pencil) and the intervention (SR technology) writing samples for Student D. The scores were calculated by averaging the two scores for each writing sample using a rubric for narrative writing. Student D obtained an average score of 7.33-points during the baseline course of the study. As narrative writing instruction continued in the classroom, the control writing sample had an average score of 8.75-points. The intervention writing, using SR technology, had an average score of 9.25-points. Overall, the intervention of SR technology demonstrated a 0.50-point difference for Student D between the average of the intervention writing samples when compared to the paper & pencil writing samples.

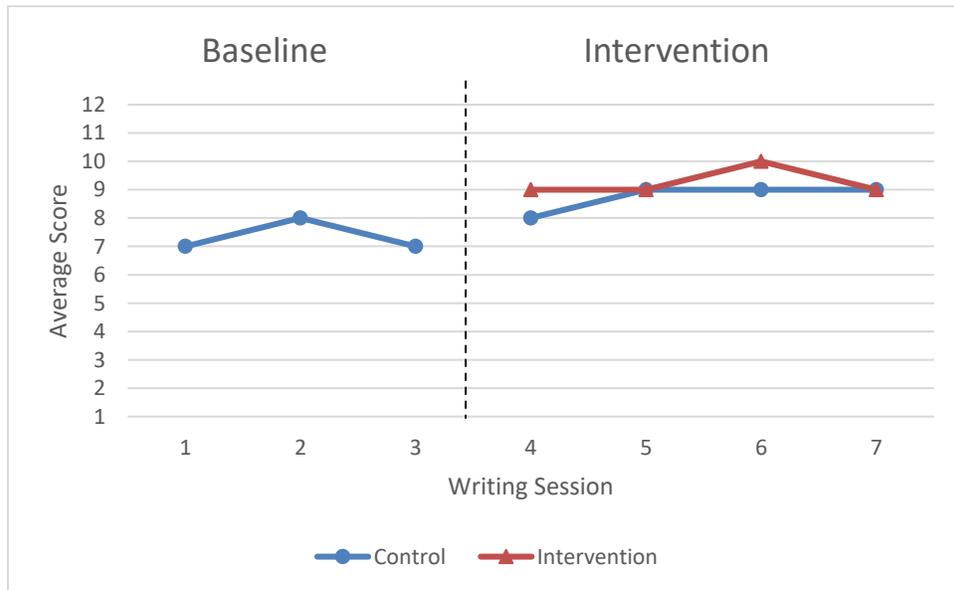


Figure 4. Results for Student D

Student D demonstrated minimal difference in growth between the average scores of the control and intervention writing samples in the writing elements of planning and implementation as well as genre characteristics. The participant's greatest growth was in the element of grammar, usage and mechanics with a 0.82-point difference between the control writing samples and the intervention writing samples.

Student E. Figure 5 shows the growth trends of the baseline assessments (paper and pencil) and the intervention (SR technology) writing samples for Student E. The scores were calculated by averaging the two scores for each writing sample using a rubric for narrative writing. Student E obtained an average score of 7-points during the baseline course of the study. As narrative writing instruction continued in the classroom, the control writing sample had an average score of 8.25-points. The intervention writing, using SR technology, had an average score of 8.75-points. Overall, the intervention of SR technology demonstrated a 0.50-point difference for Student E between the average of the intervention writing samples when compared to the paper & pencil writing samples.

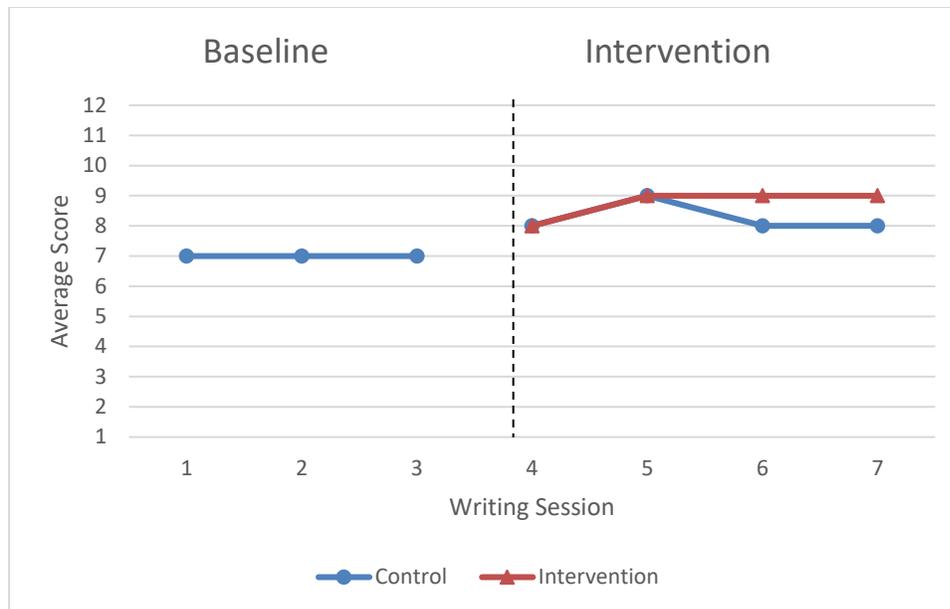


Figure 5. Results for Student E

Student E demonstrated a 0.57-point growth between the average scores of the control and intervention writing samples in the writing elements of planning and implementation. The participant did not show a difference in scores between the control or intervention writing samples in the writing element of genre characteristics. The participant's greatest growth was in the element of grammar, usage and mechanics with a 0.61-point difference between the control writing samples and the intervention writing samples.

Student F. Figure 6 shows the growth trends of the baseline assessments (paper and pencil) and the intervention (SR technology) writing samples for Student F. The scores were calculated by averaging the two scores for each writing sample using a rubric for narrative writing. Student F obtained an average score of 6.67-points during the baseline course of the study. As narrative writing instruction continued in the classroom, the control writing sample had an average score of 7.75-points. The intervention writing,

using SR technology, had an average score of 8.75-points. Overall, the intervention of SR technology demonstrated a 1-point difference for Student F between the average of the intervention writing samples when compared to the paper & pencil writing samples.

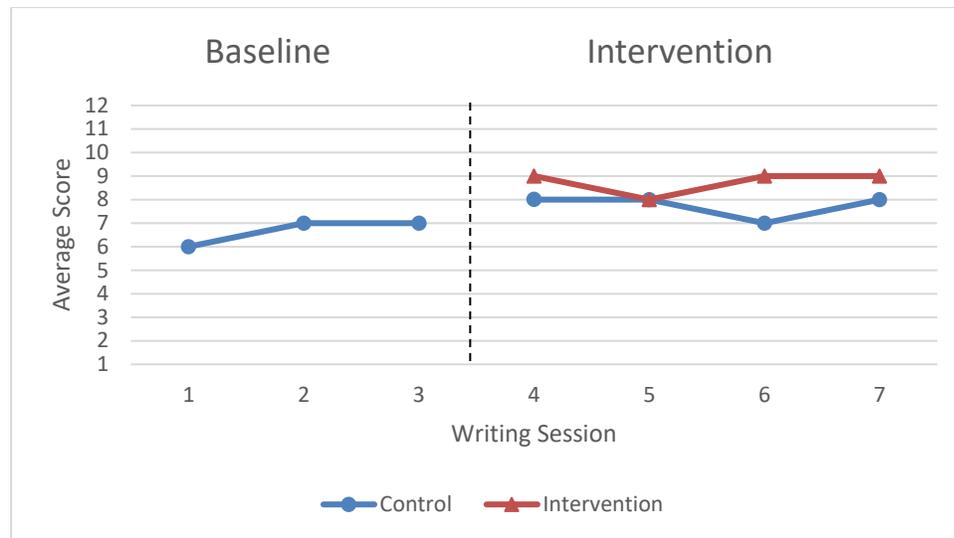


Figure 6. Results for Student F

Student F demonstrated minimal difference in growth between the average scores of the control and intervention writing samples in the writing elements of planning and implementation as well as genre characteristics. The participant's greatest growth was in the element of grammar, usage and mechanics with a 1-point difference between the control writing samples and the intervention writing samples.

Chapter 5

Discussion

This study examined the effects of using speech recognition (SR) technology to create more cohesive writing for students with disabilities than if they were to use paper and pencil. The six participants in the study were students with learning disabilities and IEPs in Field Street Elementary School general education classrooms. The students were determined eligible for special education services under the classifications: Specific Learning Disability, Communication Impaired, Multiply Disabled, and Other Health Impaired. All the students participating in the study struggle with writing. Four of the six students struggle with transcription while two of the students struggle with sentence structure.

The students participating in this study did not demonstrate a significant improvement in writing when utilizing the speech-to-text technology to compose narrative writing samples compared to paper and pencil transcription. The expectations for this study were that students would demonstrate more cohesive writing using speech-to-text technology when compared to paper and pencil writing samples. The narrative writing samples were scored using a 12-point rubric to measure Planning and Implementation; Genre Characteristics; and Grammar, Usage, and Mechanics. Each student's growth was measured to compare their writing samples using paper and pencil (control) and speech-to-text technology (intervention). Two participants in the study (students C & D) demonstrated a writing score 1-point above their control writing sample when utilizing SR technology; one participant (student B) demonstrated a writing score

0.75-point above their control writing samples when utilizing SR technology, and three participants (students A, D, & E) demonstrated a writing score 0.50-point above their control writing samples when utilizing SR technology.

Upon analyzing student improvement within the three elements of writing measured by the rubric, five of the six students showed improvement in the element of grammar, usage, and mechanics using the intervention when compared to their average scores of the control writing samples. Three participants demonstrated improvement in the element of planning and implementation using the intervention when compared to their control writing sample average scores. In regard to the element of genre characteristics, three students demonstrated a small improvement writing with the intervention when compared to the control writing sample average scores. Although it was not a focus of this study, it was observed that students composed at a faster rate using the speech-to-text technology than transcribing with paper and pencil.

Previous Research

In 2014, Santangelo conducted a narrative review of current research to analyze the difficulties that students with LD experience in regard to writing. In Santangelo's article, generating linguistic ideas and transcribing are noted as two primary elements that contribute to the impediment that students with LD experience in written expression. Neatness and legibility were found to significantly impact the ratings of student writing. While the writing samples generated using the speech-to-text technology were more legible and comprehensible, the overall improvement in their writing scores did not reflect a significant change.

Gardner (2008) conducted a review of research and studies to examine the benefits of SR technology for students and educators. His research indicated that with increased use and practice of SR technology, the student's level of comfort and ease of access improved. The more a student or individual interacts with the technology, the more familiar they become with the application of the program for their needs. Due to the time restraints of this study, the students did not become familiar with SR technology and word processors. One participant of this study was familiar with navigating a word processor prior to the study and therefore composed, revised, and edited their writing more frequently than the other participants. During the span of this study, schedules and routines of classroom instruction and the implementation of the intervention were interrupted due to assemblies, MAP testing schedules, school cancelations, attendance, and a day in attendance without power.

Limitations

The low number of participants served as a limitation to this study. Less than 50% of the 2nd and 3rd grade students with learning disabilities in general education classrooms at Field Street Elementary School participated in this study. The participants in this study did not represent various socio-economic groups. Future attempts to conduct this study should consider a larger sample size from a more diverse population to yield data that is representative to the general population of students with learning disabilities. The limitation of time for conducting this study may have prevented the participants from developing a level of comfortability with the SR technology and therefore limiting their potential growth. If the research was conducted with a longer amount of time for the students to interact with SR technology, there is a likelihood that

the growth rate may have been more significant. The student growth data gathered from this study indicated a positive trend in scores over the 4 weeks of this study.

Practical Implications

Speech recognition technology is continuing to advance and develop for the purposes of education. With adequate training, ample time to familiarize oneself with the functions of the technology, and routine use, students could benefit from the tools to develop and strengthen their writing. Speech-to-text accommodations could benefit students with learning disabilities when taking state assessments. As state assessments become more computer-based, familiarity in navigating a word processor is crucial for all students. Speech-to-text technology could allow students to compose, edit, and revise their writing more comfortably and in a shorter amount of time. This accommodation would not be beneficial to students with speech disorders, as the program is sensitive to pronunciation.

The technology and materials necessary to conduct this study were available to the students without additional cost. Acquiring the technology, training, and staff to implement the use of SR technology daily could become costly to a school district. For this reason, speech-to-text interventions are not readily available to all students with learning disabilities in education. Familiarizing students and teachers with the procedures, features, and proper use of speech-to-text software is time consuming. It can take weeks or months to thoroughly train someone in all aspects of the software.

During the study, there were times that the speech-to-text software inserted words or phrases from other students in the classroom. To prevent interruptions in the use of

the SR technology, students had to compose their writing samples in a quiet location. This environment is not always feasible for classroom teachers.

Future Studies

Future research should study the effectiveness of SR technology on word count; vocabulary use, and/or planning and implementing writing among students with learning disabilities from a larger more diverse sample size. Measuring and comparing the length of the compositions in conjunction with vocabulary strength may provide more insight as to the benefits of speech-to-text technology. Utilizing a rubric that focuses on a specific element of writing and is tailored to more accurately measure the expectations within that element would provide more detailed and goal centered results.

Conclusion

In this study, I hoped to identify the applicability and utility of SR for struggling writers. The research question addressed in this study was: Would the use of speech-to-text technology improve the composition of writing among 2nd and 3rd grade students with learning disabilities? The data revealed that there was no significant difference between the control writing samples and those composed using speech-to-text technology. While the students earned slightly higher scores in the elements of grammar, usage, and mechanics, the increased score was not significant in the study overall. However, several students did show improvement, suggesting that this method may be useful for some students with disabilities.

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Appendix

Narrative Evaluation Rubric

Student _____ Grade _____

Teacher _____ Date _____

Directions: Use the rubric to evaluate your student’s completed narrative. To receive an exemplary score (4), a student’s work should reflect the criteria described below.

Score	Traits
<p style="text-align: center;">___4</p> <p style="text-align: center;">___3</p> <p style="text-align: center;">___2</p> <p style="text-align: center;">___1</p>	<p>Planning and Implementation</p> <p>The writer’s ideas are clear, well organized, and well developed.</p> <p>The narrative . . .</p> <ul style="list-style-type: none"> • is logically sequenced. • contains sequence words such as first, later, next, and finally. • includes descriptive words, including adjectives and adverbs, that “show, not tell.” • begins with a strong lead that grabs readers’ attention. • has a strong ending that makes the reader think about the author’s ideas.
<p style="text-align: center;">___4</p> <p style="text-align: center;">___3</p> <p style="text-align: center;">___2</p> <p style="text-align: center;">___1</p>	<p>Evidence of Genre Characteristics</p> <p>The narrative . . .</p> <ul style="list-style-type: none"> • focuses on one particular incident. • includes specific details about the time, place, and people involved. • includes thoughts and feelings as well as the actual event.
<p style="text-align: center;">___4</p> <p style="text-align: center;">___3</p> <p style="text-align: center;">___2</p> <p style="text-align: center;">___1</p>	<p>Grammar, Usage, and Mechanics</p> <p>The writing has . . .</p> <ul style="list-style-type: none"> • no run-on sentences. • no sentence fragments. • correct subject/verb agreement. • correct punctuation (commas in a series). • correct capitalization (proper nouns). • correct spelling (contractions). • indented paragraphs.
<p>Key:</p> <p>1-Beginning</p> <p>2-Developing</p> <p>4-Exemplary</p>	<p style="text-align: center;">Comments:</p>