

**SMARTPEN TECHNOLOGY AND NOTE-TAKING STRATEGY  
ON ACHIEVEMENT FOR STUDENTS WITH DISABILITIES  
IN SECONDARY ENGLISH CLASSES**

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## ABSTRACT

This study was designed to evaluate the effects of a note-taking intervention using the Livescribe 4GB Echo Smartpen™ assistive technology on students' notes and lecture comprehension, with an emphasis on content, vocabulary skills, and total words written. Students both with and without disabilities, including Specific Learning Disability, in 9<sup>th</sup> grade English Language Arts classes participated in this study. Students with disabilities may struggle with slower processing speed and poor working memory skills, which reduces the quality of their notes. Students in the experimental group were instructed how to use a note-taking intervention in conjunction with the smartpen assistive technology. This note-taking intervention was designed to assist students with disabilities to focus on taking their notes using the smartpen assistive technology, identify vocabulary words and definitions, amend their notes for errors or missed information, and write a brief summary of the important content. Results from the data analysis found statistical significance with special education students in the experimental group; they recorded more words in their notes, as well as an increase in word count and vocabulary words on the Immediate Free Recall (IFR) assessment.

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## TABLE OF CONTENTS

	Page
ABSTRACT .....	iii
ACKNOWLEDGMENTS .....	iv
LIST OF FIGURES .....	viii
LIST OF TABLES .....	ix
CHAPTER	
1. INTRODUCTION .....	1
Context.....	1
Statement of Purpose .....	10
Research Questions.....	12
Research Question 1 .....	13
Hypothesis 1.....	14
Research Question 2 .....	14
Hypothesis 2.....	15
Research Question 3 .....	16
Hypothesis 3.....	17
Definition of Terms.....	17
Summary.....	20
2. REVIEW OF LITERATURE .....	22
Working Memory.....	22
Content Area Note-taking.....	25

Student Prompts During Lectures .....	31
Assistive Technology .....	34
3. METHOD .....	40
Introduction.....	40
Sample.....	41
Note-taking Intervention.....	42
Procedures.....	45
Measures .....	52
Materials .....	54
Data Analysis Plan.....	55
Pretreatment Comparison.....	56
Posttreatment Comparison .....	56
Correlation Between Measures .....	57
Interrater Reliability.....	58
Ethical Procedures .....	59
4. RESULTS .....	61
Analysis for Pretest and Posttest Multiple-Choice Scores.....	61
Analysis for Total Word Count in Notes .....	63
Analysis for Total Vocabulary in Notes .....	65
Analysis for Total Word Count in Immediate Free Recall.....	67
Analysis for Vocabulary in Immediate Free Recall.....	71
Analysis for Total Word Count in Delayed Free Recall.....	72
Analysis for Vocabulary in Delayed Free Recall .....	73

Experimental Group Analysis With Daily JIGSAW Practice .....	73
Analysis Between Measures .....	74
Social Validity Survey Responses .....	75
Interviews for Social Validity.....	77
Summary .....	79
5. DISCUSSION.....	81
REFERENCES CITED.....	92
APPENDICES	
A. PARENTAL LETTER AND CONSENT FORM .....	105
B. STUDENT LETTER AND ASSENT FORM.....	110
C. TEACHER LETTER AND CONSENT FORM .....	115
D. FIDELITY CHECKLIST.....	119
E. INTERVIEW QUESTIONS FOR SOCIAL VALIDITY .....	123
F. NOTE-TAKING STRATEGY STUDENT SURVEY.....	124
G. JIGSAW TRAINING WORKSHEET FOR STUDENTS.....	127
H. JIGSAW STUDENT CHECKLIST FOR NOTE-TAKING.....	128
I. JIGSAW STUDENT QUIZ.....	129
J. IDENTIFYING LECTURE POINTS: PRACTICE SHEET .....	130
K. MARK TWAIN SCRIPT.....	132
L. EDGAR ALLAN POE SCRIPT.....	141
M. MARK TWAIN QUIZ.....	150
N. EDGAR ALLAN POE QUIZ .....	156
O. PERCENTAGE CHANGE FOR TOTAL WORD COUNT ON IFR NOTES .....	162
P. SCHOOL DISTRICT LETTER OF SUPPORT.....	166

## LIST OF FIGURES

Figure	Page
1.1: Steps of the JIGSAW note-taking strategy.....	11
3.1: Analytic plan.....	56
4.1: Estimated Marginal Means of Posttest Immediate Free Recall Notes and Total Word Count.....	70

## LIST OF TABLES

Table	Page
4.1: Means and Standard Deviations (SD) for Pretest and Posttest Scores on the Multiple-Choice Assessment .....	62
4.2: ANCOVA Results for Pretest and Posttest Scores Tests of Between-Subjects Effects .....	62
4.3: Means and Standard Deviations (SD) for Pretest and Posttest Total Word Count (TWC) .....	63
4.4: ANCOVA Results for Pretest and Posttest Total Word Count Tests of Between-Subjects Effects .....	63
4.5: Paired Sample t-test Means for Pretest and Posttest Total Word Count in Notes .....	64
4.6: ANCOVA Results for Pretest and Posttest Total Word Count Tests of Between-Subjects Effects .....	66
4.7: ANCOVA Results for Pretest and Posttest Vocabulary Count in Notes Tests of Between-Subjects Effects .....	66
4.8: Paired Sample t-test Means for Pretest and Posttest Vocabulary Count in Notes .....	66
4.9: Means and Standard Deviations (SD) for Pretest and Posttest Total Word Count (TWC) in Immediate Free Recall (IFR) .....	68
4.10: ANCOVA Results for Pretest and Posttest Total Word Count (TWC) in Immediate Free Recall (IFR) .....	68
4.11: Paired Sample t-test Means for Pretest and Posttest Total Word Count in Immediate Free Recall .....	68
4.12: Means and Standard Deviations (SD) for Pretest and Posttest Vocabulary in Immediate Free Recall (IFR) .....	71
4.13: ANCOVA Results for Pretest and Posttest Vocabulary in Immediate Free Recall Tests of Between-Subjects Effects .....	71
4.14: ANOVA Results for Total Word Count in Delayed Free Recall (DFR) Tests of Between-Subjects Effects .....	72
4.15: Descriptive Statistic Results for Total Word Count in Delayed Free Recall .....	72
4.16: Descriptive Statistic Results for Vocabulary in Delayed Free Recall .....	73

4.17: ANOVA Results for Vocabulary in Delayed Free Recall Descriptive Statistics .....	73
4.18: Experimental Group Descriptive Statistics for Daily Practice JIGSAW Score.....	74
4.19: Analysis Between Measures Correlations .....	75
4.20: Descriptive Statistics for Social Validity Survey Question.....	76

## CHAPTER 1

### INTRODUCTION

#### Context

Students experiencing a classroom lecture are expected to successfully obtain and record pertinent information, which they can later review to facilitate retention and learning. Recording information provided through lectures is crucial for students so that they can return to their notes to review and prepare for upcoming assessments, and has been linked to positive test performance (Armbruster, 2000). Teachers evaluate student performance based on these class assessments. Yet a main concern with note-taking is that many students demonstrate poor note-taking efficiency; researchers have found students record between 20 and 40% of main concepts and vocabulary during a typical lecture (Kiewra, 1985). Note-taking has been used for years to keep track of information presented during a variety of content-based lectures. With the advent of technology, the importance of taking notes has been questioned by students. Students now can receive printed and electronic copies of lecture notes; the lecture notes may have more content than students' records. Students also can record audio notes of an entire lecture and transcribe them later. However, the act of note-taking itself has been suggested to increase student recall and understanding through encoding of knowledge (Kiewra et al., 1991). This is especially true when the notes encourage cognitive processing and connecting of ideas (Huxham, 2010). One benefit of writing down what is being said in a lecture is called *the generation effect* (Rabinowitz & Craik, 1986). The generation effect suggests that information is remembered more clearly when physically recorded by the student using handwritten notes. The act of note-taking, therefore, helps students to recall

the information heard in the lecture as opposed to simply hearing the information. Due to increased recall, students who take notes and use them for review perform better on assessments than students who do not (Kiewra et al., 1991; Titsworth & Kiewra, 2004). Furthermore, Klein (1999) stated that handwriting facilitates learning by promoting structured thinking through semantic and syntactic choices. These choices create a permanent product that can be reviewed, encouraging the writer to connect ideas, and thereby aiding the writer in modifying notes based on the content.

While attending a lecture, students who take notes take part in selective listening—they must listen specifically for the key information and the main idea, while also attempting to connect that information to the overall lesson (Suritsky & Hughes, 1996). For students to attend a lecture and create meaningful notes, they must have accurate reception of auditory signals, literal processing of those symbols into meaning, and reflective processing of the pertinent information (Hauser & Hughes, 1988). According to Peeverly et al. (2007), students who are experts in note-taking attribute that skill to three variables: “transcription fluency, working memory, and the higher level processes needed to identify important information in lecture” (p. 168). Therefore, students who fail at any one of these three variables may not be able to prepare adequate lecture notes. For students with Specific Learning Disability (SLD), a slow transcription speed could challenge their working memory capacity and cause them to lose some of the information presented in the lecture; they may struggle with retaining information from the lecture in long-term memory (Piolat, Olive, & Kellogg, 2005). A decrease in working memory can also affect students’ abilities to take notes, specifically with transcription speed while handwriting. This slower writing speed can cause students to miss much of

the lecture information. Students with slower processing speed struggle with higher level processes used to identify key content pieces.

Taking lecture notes requires students to simultaneously monitor the relationship among listening to the lecture, determining gradations of importance in information, recording information on paper or computer while continuing to monitor the lecture and inhibiting distractions. (Peeverly, Garner, & Vekaria, 2014, p. 7)

Students with disabilities are expected to follow along with lectures and find ways to obtain and retain the content presented. Yet traditional note-taking methods are not beneficial for all students, especially students with special education needs (Englert, et al., 2009). One study found that students with disabilities scored much lower in the areas of organization, content, reduction (ability to summarize or paraphrase ideas), and usefulness, when compared to students without disabilities (Englert, et al., 2009).

Students with special education needs, such as SLD and Other Health Impairment (OHI), may struggle with working memory skills, especially given a classroom setting.

According to the National Joint Committee on Learning Disabilities (1991), students with learning disabilities are defined as those having significant difficulty with obtaining and using skills and knowledge related to specific tasks, including reading and vocabulary.

Students with learning disabilities may also demonstrate developmental delays in memory, perception, or motor abilities (NJCLD, 2006). According to the U.S.

Department of Education, *specific learning disability* refers to a “disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written... which can manifest in the imperfect ability to listen, think, speak, read, write, spell,” etc. (2016; IDEA, 2004b). These deficits can result in difficulties with basic literacy skills, including vocabulary and phonological awareness (Shamir, Korat, &

Fellah, 2012). Secondary-level students with SLD are found to typically be several years behind their school peers in both reading levels and standardized achievement test scores (Deshler, Schumaker, Alley, Warner, & Clark, 1982). Students with SLD can experience difficulty in taking notes from lectures or reading materials (Hughes & Suritsky, 1994). These students can experience increasing difficulty in secondary school block scheduling with classes lasting 90 minutes instead of the average 42 minutes.

It is important to focus on the classroom environment for students of varying disabilities, because the number of students with disabilities placed in general education or inclusive classrooms in secondary-level content classes has risen over the past decade. The U.S. Department of Education states that more than 61% of students with disabilities are placed in the general education classroom for 80% or more of the school day (NCES, 2015). The amended Individuals with Disabilities Education Act (IDEA, 2004a) emphasized that students with disabilities should be placed in general education classes to have access to the general education curriculum (Cortiella & Burnette, 2006; Schumaker et al., 2005). Furthermore, to comply with the Every Student Succeeds Act (ESSA, 2015), students with SLD may be required to meet the minimum academic standards, which include passing state standards in assessments of specific content areas, such as English Language Arts (ELA). As students enter the secondary school setting, teachers are increasingly using a lecture format to present and provide information to students in the classroom (Putnam, Deshler & Schumaker, 1993; Suritsky & Hughes, 1996). Students should be autonomous learners to be successful in high school and college. Researchers have found that 99% of college students use note-taking during lectures (Palmatier & Bennet, 1974), and other research has shown that 94% of U.S. college

students believe note-taking is crucial to obtaining important lecture content (Dunkel & Davy, 1989). Students with disabilities require note-taking skills, yet struggle with the note-taking process.

It is important for students to use note-taking to enhance learning and achievement. Moreover, note-taking skills are increasingly required as students move from the secondary school setting to the postsecondary and college setting, where they continue to require effective note-taking and listening skills (Suritsky & Hughes, 1996). Most professors in the college setting use lectures to present course content to students (Carrier, Williams, & Dalgaard, 1988; Westendorf, Cape, & Skrtic, 1982), and note-taking is the main method for students to comprehend and record the information (Palmatier & Bennett, 1974; Suritsky & Hughes, 1996). In content-area classes at the secondary level, lectures comprise a major portion of a student's day. An observational study found that in seventh- and 10th-grade ELA classes, teachers lectured an average of nearly 44% of the time (Putnam et al., 1993). One study found that teachers who devote more time to present class content with a lecture style led to students learning more information (Schwerdt & Wuppermann, 2011). Lecture formats are found to be one of the most common among teaching formats, which establishes the locus of control with the teacher (Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2003). Moin, Magiera, and Zigmund (2008) observed 53 lessons in science-content classrooms; their results showed that 45% of the total lessons consisted of whole class direct instruction focusing on lectures and note-taking, with 34% and 21% on small and individual group work, respectively. With almost half of the time spent providing verbal information in a

secondary school ELA lesson, students are required to obtain information through their own methods.

Handwritten note-taking is a commonly used strategy for recording information (Suritsky & Hughes, 1996). To be successful in these content classes, students need effective listening and note-taking skills to learn and to review lecture content. Unfortunately, some students, particularly students with disabilities, perform poorly at recording critical lecture content (Boyle, 2010a). When these students are left to their own note-taking strategies, they demonstrate poor note-taking skills and record only approximately 30% of the lecture idea units for future referencing (Kiewra, Benton, Kim, Risch, & Christensen, 1995). Good note-takers possess multiple skill sets used simultaneously, including the ability to record and organize notes accurately, monitor and assess note-taking strategies, and revisit notes to amend any missing or inaccurately recorded information (Boyle, Forchelli, & Cariss, 2015). Despite today's technology, students still benefit from taking handwritten notes, because it assists with the act of encoding and enables students to better retain the content. Studies have shown that although students may demonstrate fast transcription skills with typing, they do not retain the information presented 24 hours later (Buim, Myerson, & Hale, 2013). Mueller and Oppenheimer (2014) suggested that students who attempt to take notes on a computer as opposed to handwriting may use reduced encoding abilities, which leads to less content being retained by the student.

The act of note-taking requires functions of encoding and storage for effective results (Kiewra, 1987), as well as the ability to review accurate notes. To be effective in encoding and storage, students need to take notes and review them later. However, most

students are generally poor note-takers and record less than half of the critical ideas presented in the lecture (Rahmani & Sadeghi, 2011). Students who take incomplete notes and attempt to study from recorded content inevitably miss out on the reviewing function.

Domain- or skill-specific basic skills (e.g., the processes that underlie word recognition) must be executed with an acceptable degree of fluency or automaticity, so that most, if not all, of the available space in working memory can be used for the application of the higher level cognitive skills (e.g., language ability) needed to produce successful outcomes (e.g., good comprehension). (Peverely, Ramaswamy, Brown, Sumowski, & Alidoost, 2007, p. 167)

Students who lack basic skills such as word recognition with fluency, comprehension skills, or cognitive abilities will experience deficits in their note-taking skills. The basic skills for note-taking must be applied automatically for successful notes to be obtained. Researchers have found that the skill of transcription fluency (with handwriting) relates directly to the quality of notes, with faster transcription speeds enabling students to record more content and higher quality notes (Peverely et al., 2007). Traditional note-taking strategies require students to have a specific outline, format, or system to use consistently across educational settings. If students are not recording the important lecture points, there is less information for these students to connect to higher-level thinking, structured thought, and later review.

Some teachers provide strategies to assist students with note-taking during lectures, such as guided notes, skeletal notes, or PowerPoint printouts with a notes section. These aids identify key terms and meanings during the presentations. Rahmani and Sadeghi (2011) found that students who were provided with note-taking instruction and graphic organizers performed better on specific recall and comprehension compared with students who studied their conventional notes. Researchers found that skeletal notes,

which provide incomplete outlines with 50% or less of the key lecture details, resulted in increased recall compared with students using traditional note-taking methods (Cornelius & Owen-DeSchryver, 2008). However, when an entire class is required to complete skeletal notes (instead of traditional note-taking measures), the lecturers are required to pause and wait during their presentation to allow time for students to complete notes. Larson (2009) argued that this wait time could be better used to describe further examples and continue to emphasize key points to connect to the overall lesson objective. Furthermore, Crook (2000) found that students individually create more exploratory and creative notes compared with handouts given by the lecturer.

Guided notes are handouts with specific blank spaces that correspond to a PowerPoint presentation with the missing content provided. Each blank space requires students to write only two to three words (Konrad, Joseph, & Itoi, 2011). With guided notes, students focus on writing down the key words and may not be listening to the meaning associated to the key words in their notes. However, Huxham (2010) found that students who were presented with PowerPoint slides and a statement cue recorded the brief information, but only 22% of students expanded on the information in the slides to contextualize it or further explain it.

If students do not apprehend those structures or rhetorical devices implicitly . . . note-taking in effect turns into a mere recording exercise, rather than an active process of information processing and making sense of lecturers' intended meanings and arguments. (Van der Meer, 2013, p. 14)

Additionally, student-taken notes are recalled more easily for students compared with the notes provided by the instructor (Kiewra, 1985). A meta-analysis study was conducted on peer-reviewed research that provided direct instruction in a guided notes intervention, yet

the study concluded that it is unclear as to whether or not using guided notes helps students to take better notes on their own or if it promotes student engagement during the lecture (Konrad, Joseph, & Eveleigh, 2009; Neef et al., 2006).

Researchers found that students had a difficult time distinguishing important information from unimportant information when they took notes; without a systematic approach, they remembered the information arbitrarily (Hebert, Graham, Rigby-Willis, & Ganson, 2014). Notes that provide meaning are derived from carefully listening to the lecture and simultaneously fighting distractions, not from writing and random selection (O'Hair, O'Hair, & Wooden, 1988). When students with SLD struggle with maintaining attention in the classroom, they are less likely to comprehend and retain the information presented in a lecture format by the teacher. Boyle (2010a) found that secondary students with SLD failed to record as many important lecture points and total lecture points as peers without SLD. His results also showed that students with SLD recorded fewer notes and therefore received lower scores on associated assessments, with 47% of notes recorded for the SLD group and 67% of notes recorded for the group of students without SLD.

Recent developments in traditional note-taking strategies have provided promising results as a way for students in both secondary and college settings to obtain key points and track information during a lecture. One study found that students provided with specific instruction and practice in taking notes showed higher scores than those who did not receive instruction (Faber, Morris, & Lieberman, 2000). Studies on note-taking strategies have found that students who are able to attend to cues and specific facts have more developed note-taking skills (Adkins & McKean, 1983).

Assistive technology is increasingly used within classrooms due to its ubiquity and potential to assist students to learn more effectively (Stover & Pendegraft, 2005; Huang, 1997). For example, it has become standard to see computers as a technology in education (Wood et al., 2011; Weaver & Nilson, 2005). Furthermore, federal legislation currently enacted requires school districts to provide the supplementary aids and services listed in Individualized Education Plans for special education students, including assistive technology such as laptops or iPads for taking notes (Watson & Johnston, 2007). However, studies have shown that despite some technologies promise to enhance educational achievement, (i.e., computers and laptops) they can actually lead to impaired performance due to lack of engagement in the lesson an overall distraction (Wood et al., 2011; Wainer et al., 2008; Kraushaar, & Novak, 2010). Other forms of assistive technology can include digital or tape recorders to obtain lecture (Watson & Johnston, 2007). Yet these types of technology do not provide students with the same form of encoding that can be obtained from handwritten notes and selecting specific key words and information. Overall, there is a lack of research in the area of assistive technology, strategic note-taking methods, and handwritten notes from lectures, especially for students in high school. Furthermore, the smartpen assistive technology, created by Livescribe in 2007, has limited research about its uses in a classroom or lecture setting.

#### Statement of Purpose

Although the literature provides a promising start in the research of note-taking with assistive technology, each study represents a separate part—note-taking strategies, the use of assistive technology, or social validity surveys from students. No one study combines all of these aspects. Overall, note-taking is a viable option for students. Note-

taking was addressed in this study due to the effects of encoding that occur during handwritten transcription of notes, which thereby processes information into working memory and assists note-takers in retaining the information from the lecture. The purpose of this study was to evaluate the assistive technology of the Livescribe 4GB Echo Smartpen™ in the areas of achievement, recall, and note-taking, in conjunction with a researcher-created note-taking intervention (JIGSAW) using quantitative measures. The purpose of the smartpen technology is to provide students with the ability to easily identify missed information and playback audio from the lecture to amend their notes. The JIGSAW strategy is specifically designed for note-taking with the assistive technology of the smartpen, to assist students in capturing vocabulary and important content during note-taking (see Figure 1). The smartpen is an electronic pen with a microcamera that records both text written by the pen and audio from a lecture. The goal of this study was to determine if there is a difference with the combined intervention on note-taking skills as measured by Total Word Count (TWC) in notes, total vocabulary in notes, and a multiple-choice assessment measure in ELA classes. Understanding was measured by the TWC and total vocabulary recorded in the immediate free recall (IFR) with a comparison among the pretest and posttest between experimental and control groups. Within this study, it is also important to gain social validity to identify a diversity of opinions on the intervention within a given population (Jansen, 2010).

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J	=	Jump to record
I	=	Initiate notes
G	=	Grab vocabulary, content, and lecture cues
S	=	Scan for missing information
A	=	Amend notes
W	=	Write a brief summary

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*Figure 1.1* Steps of the JIGSAW note-taking strategy.

This smartpen technology was chosen based on its ability to capture audio from a lecture and quickly identify a selected point by tapping the pen tip to any written note on the page. The smartpen allows the user to capture information they may have otherwise missed due to the quick pace of the lecture, slow writing, or poor note-taking skills. While the smartpen alone is a helpful tool, it cannot replace the act of note-taking, which requires the student to engage, identify, and process key information from a lecture. Therefore, one goal was to determine the effectiveness of combining the smartpen assistive technology with a note-taking strategy, JIGSAW, which I created to aid students with SLD, OHI, and other special education needs to improve their comprehension and quality of notes from lectures.

One key aspect of successful note-taking requires students to be engaged in the task. To measure student engagement, students were provided with a survey to identify their own opinions of the use of the note-taking strategy and the use of the assistive technology in the classroom. The purpose of the social validity aspect of the study was to determine students' perception of the pen and its accessibility to new users.

### Research Questions

The following research questions were used to identify the note-taking needs for students with disabilities, as well as the skills required for note-taking during lectures at the secondary level. These research questions addressed the skills and adaptive technology available to assist students with disabilities to become autonomous learners and therefore be successful in note-taking. These research questions also addressed students' preference of the technology and its ease of use in note-taking tasks. This study addressed the following research questions and hypotheses.

### *Research Question 1*

Does the use of a specific note-taking strategy in conjunction with the smartpen technology improve the note-taking skills of students with and without disabilities?

Studies on providing training in note-taking strategies have shown promising results. Tsai and Wu (2010) identified that students who received direct instruction with note-taking strategies demonstrated retention in short-term memory of lecture content and recorded more information. Suritsky (1992) found that providing explicit instruction to students with a note-taking strategy led to an increase of information recorded during lectures. Further studies have identified that students who were provided with instruction in note-taking resulted in a better understanding of lecture content (Boyle, 2012). While these studies demonstrated promising results in the area of note-taking strategy, they lacked the piece on simultaneously providing students with assistive technology. This study bridges that gap by providing students with direct instruction in a note-taking strategy (JIGSAW) that is used in conjunction with the smartpen assistive technology.

The smartpen technology works by recording all verbal information and therefore provided the students with the ability to review missed points and amend their notes. Students using the smartpen were able to focus on obtaining lecture cues and key vocabulary words without rushing to write down the definitions or meanings. At the end of the lecture, students were able to amend their notes by tapping words with the pen tip on the paper, which immediately played back definitions spoken at each point in the lecture. Students could then rewrite any significant information that they may have missed in the lecture. This assisted students who had slower handwriting speeds and allowed them to focus on the important cues and vocabulary words in the lecture.

### *Hypothesis 1*

It was hypothesized that the smartpen technology in conjunction with the JIGSAW strategy, used by the experimental group, would result in significant improvement in student notes recorded during the posttest compared with the pretest notes, with an increased TWC and vocabulary words recorded. This measurement was used to demonstrate an improvement in skilled note-taking. The use of the smartpen technology provided students with the opportunity to select and review specific audio bites from the lecture and amend their notes. It was hypothesized that this JIGSAW strategy would assist students with recording an increased amount of information from the lecture while using their working memory and assisting in the enhancement of their encoding skills.

### *Research Question 2*

To what degree does the proposed note-taking intervention assist with retaining vocabulary and content, both for students with and without disabilities?

Researchers have studied the impact of providing explicit instruction of note-taking strategies to enhance students recorded vocabulary and content. Berry (1999) provided a specific note-taking strategy to students with special education needs and found that students who received explicit instruction in the strategy increased the vocabulary words recorded when compared to pretest scores. Boyle and Joyce (2017) provided the intervention of a note-taking strategy with assistive technology and found that students recorded more notes and scored higher comprehension on multiple-choice measures compared to pretest measures. While these studies demonstrate positive results in enhancing vocabulary and content recorded, they do not address student's memory of

the content with short-term and long-term measures. Furthermore, these studies fail to address the aspect of social validity by gaining student input of the intervention.

This study addresses short-term memory of vocabulary and content using the Immediate Free Recall (IFR) measure, and long-term memory using the Delayed Free Recall (DFR) measure, each timed for three minutes. The IFR measure allowed students to demonstrate information they remembered after the lecture. Students were tested on the same information as the posttest to assess the long-term effects of the study in a Delayed Free Recall (DFR) measure. DFR was measured using TWC and vocabulary words recorded. At the conclusion of the study, students who received the intervention were provided with a survey form to identify their opinions regarding the use of the smartpen technology. This survey was a student self-evaluation of the smartpen and the JIGSAW note-taking strategy focusing on note-taking difficulty, satisfaction of the product, and ease of the note-taking strategy. Students were required to identify their meta-cognitive judgments based on their confidence levels of success on different topics of note-taking.

### *Hypothesis 2*

It was hypothesized that students in the experimental group, both with and without disabilities, would score higher on the posttests in the area of vocabulary knowledge than those in the control group. It was also hypothesized that students with disabilities in the experimental group would demonstrate significant improvement when comparing their vocabulary pretests and posttests. Furthermore, students who were in the experimental group were expected to retain more of the information from the initial posttest compared with students in the control group.

### *Research Question 3*

Is there a correlation between notes recorded (TWC and Vocabulary) and achievement measures (multiple-choice posttest)?

Minimal research has analyzed a correlation between a note-taking intervention and achievement measures for students with SLD. Researchers Tsai and Wu (2010) provided direct instruction on a strategic note-taking intervention and identified a correlation between students who received the intervention and achievement measures. However, this study does not specifically address an intervention for students with SLD.

It is necessary to identify if students who receive the intervention demonstrate the act of encoding and use of working memory. First, the act of encoding facilitates the writer's long-term memory and therefore produces greater idea generation during the writing process (Faber et al., 2000). When encoding occurs, it promotes an increased comprehension of the material (Budd & Alexander, 1997). Students who take notes are involved in the act of handwriting and encoding by using language and comprehension skills. Second, students who take notes use their working memory to determine and hold the information deemed important to write down in their notes (Kiewra & Benton, 1988). Kiewra and Benton (1988) and McIntyre (1992) found that working memory applies significantly to note-taking during lectures. For students who are taking notes, the process of working memory allows them to absorb the information being presented while simultaneously retaining selected information.

It is necessary to determine if a correlation exists between student notes, including TWC and vocabulary, and the multiple-choice posttest assessment measure to determine the effectiveness of the intervention and student's ability to apply the content knowledge

on multiple-choice assessments, using encoding skills and working memory. Identifying TWC and vocabulary words in notes indicates that lecture content has been retained in working memory. Students participated in the measures by writing content and vocabulary from the lecture. The data were quantified by using information in students notes recorded, including TWC and vocabulary words.

### *Hypothesis 3*

It was hypothesized that there would be a direct correlation between TWC and vocabulary words recorded compared with overall achievement on the multiple-choice posttest measure. It was hypothesized that students in the experimental group would record more words, lecture points, and vocabulary and that these would be reflected in higher posttest scores.

### Definition of Terms

*Cognitive task analysis:* Cognitive task analysis requires students taking notes to comprehend verbal material by using background knowledge and language comprehension skills (Kobayashi 2005). Then students are tasked to temporarily store the data gained in their verbal working memory, determine the important information from the unimportant, and transcribe the important information before it is forgotten. Students simultaneously complete these tasks while attending the lecture for sustained periods of time to identify new data to analyze. Piolat and colleagues (2005) found that cognitive task analysis is required to create high-quality notes. The act of writing and taking notes requires the brain to use cognitive task analysis (Kobayashi, 2005).

*Cuing:* Cuing refers to any method used to increase the salience of some feature of a stimulus (Scerbo, Warm, Dember, & Grasha, 1992). Lecturers will often provide a

verbal cue by providing implicit statements such as “This is important,” or “You will need to know this for the exam.” Cues are also referred to as “importance makers” (Lynch, 2004), which are defined as lexicogrammatical devices that mark the importance or relevance and significance of points presented visually or verbally in the lecture. These researchers found that there are three common purposes of cuing: (a) stimulating student interest, (b) signaling the organization of ideas, and (c) signaling the importance of topics. The effects of cuing were studied by Jersild (1929) and confirmed by Ehrensberger (1945). Both researchers agreed that the cuing is one of the most effective methods for ensuring recall of a statement. The spoken cue acts as a signal, which alerts the student to pay attention to the upcoming information (Scerbo et al., 1992). In addition, cuing can be presented nonverbally by providing information on a PowerPoint slide. Huxham (2010) found that 98% of the notes recorded by students in his study were information presented on a slide during the lecture, and a large amount of the students recorded the lecturer’s words spoken in correlation to the slide. This demonstrates that students in Huxham’s study understood a slide as a cue for note-taking. Furthermore, researchers found that students recorded written cues more frequently during lectures and were able to retain this information better than spoken cues (Scerbo et al., 1992). Titsworth and Kiewra (2004) found that providing student cues with organization points during the lecture resulted in an increased amount of note-taking, as well as increased academic achievement.

*Executive function:* Executive function is the act of the cognitive processes being carried out in the prefrontal areas of the frontal lobes. Executive function includes the functions of working memory, planning, attention, self-monitoring, and initiation

(Goldstein & Naglieri, 2014). Executive function is crucial to handwritten note-taking because it directly corresponds with working memory, which allows students to hold information in their minds for brief periods of time and manipulate the knowledge into a useful format, especially while participating in complex cognitive tasks (Goldstein & Naglieri, 2014).

*Encoding function:* Encoding function is the process of taking notes during the lecture, converting the information, and applying it to memory. Encoding occurs during note-taking when students identify the important information from the unimportant, which requires them to focus their attention, organize, and interpret the information from the lecture. Di Vesta and Gray (1972) compared learning outcomes in recall and academic achievement from students who took notes versus those who did not take notes. They found that students who participated in encoding demonstrated higher learning outcomes. The task of taking notes assists with encoding of knowledge—even more so when the notes encourage generative processing, which requires the student to actively identify relations among the parts of the learning material, or between the learning materials and the individual's prior knowledge (Kiewra, 1985; Kiewra, et al., 1991).

*External storage function:* External storage function is the student's final product, which is applicable for students who take notes to have them available later for review, and it provides benefits for learning (Di Vesta & Gray, 1972). The external storage function is a complete and comprehensive set of notes (a final product), which can assist students in review and positively affect academic achievement. The external storage function is used during note-taking and is based on the assumption that notes are recorded and then referenced in the future (Faber et al., 2000). With this function, notes are written

and then stored in a place where the students are able to use the information for a later reference. The external storage function has been found to increase comprehension when used with note-taking (Ganske, 1981).

*Meta-cognition:* Meta-cognition is the ability for students to regulate their own learning. This skill allows for students to recognize their mistakes and monitor their understanding (Mynlieff, Manogaran, St. Maurice, & Eddinger, 2014).

*Working memory:* Working memory is the system that maintains information in the mind while performing complicated and multistep tasks, such as reasoning, learning, and comprehension (Baddeley, 2010). Working memory is defined as the mental workspace that allows ongoing processes to be stored, organized, and integrated into demanding activities (Just & Carpenter, 1992). Working memory is the limited amount of information that can be retained at a time and the limited number of operations that an individual can perform, based on that information (Sweller & Chandler, 1994). An individual's operation of working memory directly relates to his or her functioning executive process (Daneman & Carpenter, 1980). Working memory requires individuals to simultaneously combine the act of processing information and storing learned information, such as reading sentences and remembering the last word in each sentence for subsequent immediate recall (Baddeley, 2003). Working memory is associated with increased capabilities in complex cognitive skills, including learning how to operate electronics or improving reading comprehension (Baddeley, 2003).

### Summary

In this study, students were provided with training on the use of a specific note-taking strategy in combination with the assistive technology of the smartpen. This study

aimed to enhance student's note-taking skills and to increase the number of words written, vocabulary words identified, and vocabulary words defined.

## CHAPTER 2

### REVIEW OF THE LITERATURE

Researchers have been analyzing students' note-taking habits and behaviors since the late 1960s. This chapter summarizes the literature related to working memory, content-area note-taking, student prompts during lectures, and assistive technology. This literature review lays the groundwork for the methodology presented in Chapter 3.

#### Working Memory

Throughout secondary classrooms, teachers use lectures to present key information, including vocabulary words, categorical information, and key concepts. Carrier and Titus (1979) found that note-taking increases students' attention process and leads to greater concentration on material. Note-taking can also encourage students to process the material on a deeper level and assist in the activation of prior knowledge (Carrier & Titus, 1979). Note-taking requires students to access working memory—the mental workspace that allows ongoing processes to be stored, organized, and integrated into demanding activities (Just & Carpenter, 1992). Working memory tasks include remembering step-by-step directions while completing a task, retaining information while taking notes, or comprehending instructions (Dehn, 2014). Furthermore, students using their working memory are attempting to encode important information into their long-term memory and therefore push their working memory capacity (Dehn, 2014).

Teachers encourage students to take notes. Students are accountable for obtaining information from the lecture or presentation, and their performance is evaluated on class exams and quizzes (Konrad, Joseph, & Eveleigh, 2009). However, this process is not always perfect. For example, during note-taking, some students attempt to record all of

the information heard and have no clear differentiation of key lecture points, vocabulary words, and definitions. Some students may fail to translate the information being presented from the lectures due to difficulties listening to the lecture and simultaneously attempting to write information (Barbetta & Skaruppa, 1995). Hartley and Cameron (1967) and Maddox and Hoole (1975) found that student's record only about 50% of what the lecturer perceived to be key information. Furthermore, when students with Specific Learning Disability (SLD) attempt to take notes, they often find that the lectures occur at a fast past, and they are not able to take complete notes (Putnam et al., 1993). Kline, Schumaker, and Deshler (1991) found that only half of the sentences in the notes of secondary students with SLD are complete; sentences that are complete tend to be simple sentences.

During a lecture presented to students at the secondary level, students are required to focus on a variety of processes at the same time. Students must be able to use skills such as processing, listening, and writing. These skills require developed executive functioning skills, including attention and working memory. While students are taking notes, they must demonstrate focus, process the main lecture points, retain the information in their working memory, use a strategy for recording their notes, and write down lecture points at a quick pace while simultaneously listening to subsequent lecture information (Suritsky & Hughes, 1996). Teachers assume that students who reach adolescence have already developed the executive functioning skills required for working memory to achieve success in a school environment; however, their ability to demonstrate these skills is often inconsistent (Goldstein & Naglieri, 2014). Baddeley (1992) found that students could hold about seven items in their working memory at a

time. However, Van Merriënboer, and Sweller (2005) found that when a person is actually required to process the items, working memory is limited to about three items. Attempting to retain excessive amounts of data simultaneously can lead to cognitive overload and deter learning. Cognitive overload may be prevented if students work with an external representation of their previous knowledge by taking notes (Wetzels, Kester, van Merriënboer, & Broers, 2011). Note-taking allows students to organize their thoughts into a framework and frees up their working memory by acting as an external storage function (Hartley, 1983; Huxham, 2010; Kiewra et al., 1991).

Individual students differ in their working memory capacity; this can result in differences in ability to effectively use the execution processes of working memory and can result in a disparity in skills (Baddeley, 2001). Working memory capacity is directly correlated with note-taking. However, note-taking results also differ based on individual differences among students, both in their skill level and style of recording information, which can result in a diversity of note-taking strategies (Carrier & Titus, 1981). Without direct instruction on note-taking expectations before the lecture, students may choose note-taking strategies that vary and lead to unclear notes (Bui, Myerson, & Hale, 2013). One reason students' notes vary compared with their peers may be individual differences in limited working memory capacity.

During note-taking, students must decide which lecture points are important and worth recording, then select lecture points to record from working memory, followed by writing the information quickly and simultaneously attempting to listen to new lecture content (Boyle, 2010a; Kobayashi, 2005). Working memory allows students to process information and retain it to apply later to other content knowledge (Baddeley, 2003).

Students who are weak in working memory and other executive functioning skills, such as students with SLD, struggle in keeping up with the lecture pace while attempting to apply the information that they have learned to previous knowledge and also trying to write it in a note-taking format at the same time. With challenging secondary level material, teachers begin lectures with content-rich material, yet students with SLD have trouble with keeping pace due to their slower cognitive processing speed (Kennedy & Ihle, 2012). In studies evaluating note-taking skills for students with SLD at the college level, the most common problems that students with SLD experience include writing fast enough, maintaining focus, comprehending the information, and determining which information is important enough to record (Suritsky, 1992a).

#### Content Area Note-taking

Note-taking is one of the most common methods that students use to assist their learning and obtain information from content-area lectures, such as English Language Arts (ELA), history, or science (Scruggs, Mastropieri, & Okolo, 2008). One content area in which students with disabilities often lag behind is in ELA classes. In ELA classes, Klassen (2006) reported adolescents with SLD significantly overestimated their writing (52%) and spelling abilities (19%), whereas students without SLD were generally accurate in their performance estimations. The result of students' overestimation of their abilities can be poor performance in these classes. In one study focusing on secondary students from grades 9 through 12, students identified as SLD had significantly lower scores in ELA compared with their peers without SLD (Hampton & Mason, 2002). Among students with SLD, reading comprehension and vocabulary tend to present hurdles that can stifle their academic growth and understanding of information presented

in the classroom. In addition to reading information, students with SLD often experience reading difficulties and are below grade level in their writing. On average, SLD students continue to write on a fourth-grade level throughout secondary school (Deshler & Schumaker, 2009). Students with a large gap in their reading and writing level struggle with direct verbal instruction of key concepts and ideas, especially when they are required to take notes. With the amount of time spent presenting ELA content through lectures, students with SLD often struggle to take notes due to the complex cognitive nature of note-taking. Note-taking during lectures requires students to listen, process, organize, and write, all at the same time and while hearing continuous new information presented in the lecture. This skill is unlike other academic tasks, which periodically allow students to pause and catch their thoughts (e.g., reading a book or composing an essay); recording notes during lectures makes it difficult for students to slow down, because this may cause them to miss the following lecture points (Piolat et al., 2005). Without the use of note-taking strategies, students both with and without disabilities perform poorly when recording critical lecture content into their notes. Boyle and Weishaar (2001) found that trained students outperformed conventional note-taking participants on recall measures, test performance, and total number of words in recorded notes.

Students in an inclusive secondary ELA classroom experience strenuous vocabulary and requirements as they progress through school (Kobayashi, 2005). The percentage of students with disabilities who receive their education in inclusive or general education classrooms rose quickly in the 1990s from 33% in 1990 to 45% by 1995 (Sack, 1998). The goal of placing special education students in inclusive classes is

to expose them to the general education curriculum and class setting with their same-aged peers. For some special education students, the application of a general education curriculum can cause them to experience an academic gap, which continues to widen as they progress the secondary levels. “Students with learning disabilities and other low-achieving students have deficits related to the demands of the settings in which they are required to participate and be successful” (Putnam et al., 1993, p. 331). For example, Deshler and colleagues (2004) found that students with disabilities in inclusive secondary school settings performed considerably poorer than their counterparts who were considered normally achieving or at risk: 51.3% had grade point averages reflecting D or F work. All students in the ELA classroom must be able to determine and record key parts of a lecture at a quick pace. Inclusive ELA classrooms require students with SLD to learn the same content and keep up with the grading expectations and assignments (Schumm et al., 1995). Often, teachers do not realize that the information of the lecture is being provided too quickly for students to take accurate and meaningful notes.

In addition, the act of note-taking becomes more complex at the secondary level as the content intricacy increases, levels of expectations increase, and directions become more complex (Suritsky & Hughes, 1996). Note-taking at this level involves more vocabulary, material, and key topics. Teachers of inclusive classes increase expectations for students to use critical listening and note-taking skills during instruction (Suritsky & Hughes, 1996). Furthermore, standards in the secondary school setting are often difficult for students with SLD, and lectures require students to retain large amounts of information and repeat it for assessments and assignments (Deshler et al., 2004). Students in general education secondary school classrooms face heavy demands on their ability to

listen to the lecture, comprehend the information, and retain it for assessments. Struggling with note-taking can negatively affect students' understanding of the coursework and assessments and can negatively affect their grades and cause their academic confidence to suffer (Deshler et al., 2004).

Students with disabilities struggle to identify and use appropriate skills and strategies for note-taking during lectures (Kennedy & Ihle, 2012). Some students with SLD struggle with a slower processing speed. Difficulty with note-taking is amplified by their slower cognitive processing speed (Kennedy & Ihle, 2012). These students have difficulty with the verbal speed of lecture, and they are unable to keep up with teachers' presentation (Johnson, Humphrey, Mellard, Woods, & Swanson, 2010). For example, when a teacher is presenting a vocabulary word and writes it on the board, the student may be inclined to write down the word in his or her notes. However, students with SLD while handwriting may block out portions of the verbal lecture information that is presented after the vocabulary term, which often includes the meaning of the vocabulary word, its appropriate usage, and its connection to the lesson.

Students who enter the secondary grades are required to enter the classroom with a variety of literacy strategies and skills in their tool kits. These include the ability to prewrite, draft, revise, edit, proofread, state main ideas, compare and contrast ideas, and provide supportive details. Students with SLD in the secondary school ELA setting are typically several grade levels behind in reading and writing abilities and may not have mastered the expected literacy skills (Deschler & Schumaker, 2009). During note-taking, they are required to combine their literacy skills with listening skills of main lecture points, vocabulary, and order of events. Moreover, teachers typically provide rhetorical

devices by stating transition words and giving signals to structure their lectures; if students do not understand what these structures imply, they are missing the lecturer's cues (Van der Meer, 2012). Educators are often concerned about students' listening to the lesson, yet they expect students to develop high-quality listening skills without direct instruction in specific strategies (Suritsky & Hughes, 1996).

Recent research has shown that when students with LD are taught strategies under typical general education conditions, opportunities for multiple practice attempts are not provided . . . mastery is not required, so students do not learn the writing strategies at a socially significant level. (Deshler & Schumaker, 2009, p. 90)

Tsai and Wu (2010) found that students who received training on strategic note-taking scored significantly higher and with a larger effect size on recording pertinent information from short conversations and long lectures. Students who received training also were found to have more capability to store the content externally and with better recall. Therefore, students who are provided with explicit and direct instruction in a strategic note-taking strategy are more likely to experience benefits; these benefits include better retention of lecture content in short-term memory and more detailed and organized notes. While this study identifies a correlation of a note-taking strategy and achievement measures, it does not specifically address an intervention for students with SLD.

With the purpose of helping students identify key concepts in their handwritten note-taking, Suritsky created a note-taking strategy in her dissertation called the AWARE strategy (1992b). This five-step note-taking strategy requires students to *Arrange* to take notes, *Write* quickly using shorthand procedures, *Attend* to cues, *Review* notes as soon as possible, and *Edit* notes. Results from this study found that nine SLD participants who

used the note-taking strategy increased the percentage of information recorded from a baseline of 34% to 60% (Suritsky, 1992).

Berry created two specific content area note-taking strategies with SLD and non-SLD students in 1999 referred to as LOTS and GRADE. LOTS is a strategy designed for taking notes. LOTS stands for *Listen* and set goals, *Observe* cues, *Telegraph* information, and *Sort* main ideas and details. In this same study, she created the acronym GRADE as a strategy for students to use while reviewing and studying their notes. This stands for *Gather* the missing information, *Reread* and highlight, *Ask* yourself questions, *Draw* and organize, and *Engage* in positive self-talk. Her research study on 13 college students found that after four hours of instruction with the two note-taking strategies, the average percentage of lecture content recorded with students with SLD actually exceeded the average percentage of students without SLD, compared with previous studies. Overall, the students using the note-taking strategy increased scores on their lecture vocabulary from a mean of 49% to 68.8% (Berry, 1999).

While Berry and Suritsky's studies address a specific note-taking strategy by hand, later studies have gone further to tie in note-taking strategies with assistive technology. One example is the TARGET note-taking strategy, developed by Boyle and Joyce (2017). TARGET is a mnemonic device to assist students with and without SLD in taking accurate notes with the assistive technology of the smartpen. The acronym stands for *Tap* on the record button; then *Activate* notes by writing the date, topic, and name on the paper; followed by *Record* lecture points on the dashed lines. Then, students would *Grab* vocabulary words by writing the words and its definition and *End* the notes by tapping the stop button. Lastly, *Touch* up notes by listening to specific parts of the lecture

(Boyle & Joyce, 2017). Boyle and Joyce found that students who used this note-taking strategy recorded more notes and scored higher on the comprehension posttest compared with students in the control group who used conventional note-taking strategies.

#### Student Prompts During Lectures

Locke (1977) found that when students were prompted or cued to take notes with key concepts and words written on the board, on average, students recorded 88% of the material. Titsworth and Kiewra (2004) found that providing students with spoken organizational cues led to students' recording four times the organizational points and twice the details in their notes compared with students who took notes in a non-cued lecture. Students who were provided with spoken organizational cues recorded 60% of the lecture points. "Prompting students during note-taking (as opposed to during study or at testing) encourages them to monitor not only during information collection, but also helps them to filter information from multiple sources of information during learning" (Kauffman, Zhao, & Yang, 2011, p. 321).

In addition, researchers have found that middle school students with SLD who were not provided with strategic note-taking skills recorded only 13% of the total noncued lecture points presented, whereas students without SLD recorded 25% of noncued lecture points. Yet when students were provided with cued lecture points, students were found to record more lecture points: at 18% with SLD and 43% without SLD (Boyle, 2010a). Furthermore, providing students with prompting or cues or marking the important parts of lectures helps students identify and discern the main concept of the lesson while processing the complex lecture message during their continual note-taking (Deroey, 2015).

A main concern is making sure that students are aware of the importance of the cues being presented. It is crucial that students easily identify important lecture points and that “the processing effort involved in their interpretation and the identification of the evaluated entity” is simplistic and recognizable (Deroey, 2015, p. 69). If students are not able to identify the cues, they are missing key concepts that are therefore absent in their note-taking. According to Kiewra and Benton (1988), students who were provided with a free recall opportunity rather than a cued-recall lecture did not produce efficient notes. Therefore, the best means for enhancing a students’ encoding function is to provide cues to increase recall.

Cues provided during a lecture can be divided into three categories: organizational cues, importance cues, and written cues. Organizational cues require the lecturer to provide information in a list or outline format. For example, the teacher may say to the class, “There are five main types of English literature. These are . . .” The teacher then provides a list of the different types and goes into detail regarding each item listed. An importance cue occurs when the teacher is providing a verbal or nonverbal signal to the class, indicating that it is a key concept for the lesson. For example, the teacher may say, “It is important to remember the term *melancholy* for the symbolism section of your upcoming assessment.” This type of cue calls students’ attention to the specific term and provides them with the association for its importance. The written cue occurs when the lecturer writes information on the board, such as key points or vocabulary words. The act of writing information on a large presentation board indicates that it is necessary information from the lecture and signals to students that they should record the information in their own notes. Regardless of the type of lecture cues, the use

of cues promotes students to record main concepts and ideas into their notes and ultimately increase achievement and comprehension (Boyle, 2010a; Titsworth & Kiewra, 2004).

When teachers present students with SLD with direct instruction in strategic note-taking or guided notes, researchers observed that students had improved notes and demonstrated a better understanding of the lecture content (Boyle, 2012). Boyle (2010b) found that students who used strategic note-taking to identify cues performed better than students in the control group in the area of achievement on assessments, even without the use of their notes as a study aid. The students in the experimental group recalled more cued lecture points (almost 50% more) than the students in the control group. Furthermore, researchers compared experimental groups with control groups and found higher performance results when students used typical note-taking skills. In this case, students in the experimental groups' demonstrated stronger skills with long-term recall, immediate free recall, quiz performance, and total recorded notes (Boyle, 2010a; Boyle & Weishaar, 2001). Providing strategic note-taking skills and techniques to assist students with disabilities in understanding lecture content and recording more lecture-based information has yielded positive results. Teaching these skills may be time-consuming, but it provides promising results, which enable students to function more independently in the classroom and help them to progress throughout higher education as well.

Recording vocabulary words and definitions is crucial in note-taking because secondary students are consistently using new and old vocabulary words throughout their high school years (Bryant, Ugel, Thompson, & Hamff, 1999). Bryant and colleagues (1999) stated that secondary students acquire approximately 3000 new vocabulary words

each year and are expected to have encountered more than 88,500 word families by the time that they graduate secondary school. Students who demonstrate strong vocabulary skills often demonstrate strong comprehension, reading, and listening skills (Polloway, Smith, & Miller, 2003). Students with SLD tend to have poor and limited vocabularies due to a lack of involvement in reading activities, including significantly lower abilities than their peers with cognitive reading tasks, such as word recognition, vocabulary, phonemic awareness, and comprehension (Bryant et al., 1999; Simmons & Kame'enui, 1990). This gap tends to increase as students advance to each new grade. Vocabulary knowledge requires secondary students to comprehend the information and use it for other processing tasks (Roberts, Torgesen, Boardman, & Scammacca, 2008). Effective students must be able to understand the context and the multiple meanings of the words to use the vocabulary during higher-level reading (Kennedy, Deshler, & Lloyd, 2015).

#### Assistive Technology

The use of assistive technology in the classroom setting has been a continuous venture. The availability of portable and new technologies that connect to the Internet and allow individuals to have access anytime and anywhere has increased since the 1990s. With this advancement in technology, students have begun to use iPads, computers, and tape/voice recorders to collect and record their notes or the entire verbal selection of the lecture (Stover & Pendegraft, 2005; Huang, 1997; Watson & Johnston, 2007). One study found that college students who use a computer to take notes record and recall more of the lecture compared with college students who take notes by hand (Bui et al., 2013). Bui and colleagues found that students who used a computer to transcribe a lecture led to

the most notes and the best performance on both the free recall and short answer tests, with performance not only exceeding that of those who took organized notes with a computer but also that of those who used either handwritten note strategy. (Bui et al., 2013, p. 302)

In this age of advanced technology, more and more students have become fluent with keyboarding skills and may be inclined to attempt to transcribe lecture information into a document format on a computer. However, despite the fact that transcription of notes with a computer may prove to be an advantage for immediate free recall, a second experiment in the same study found that students who did not review their notes failed to remember the information 24 hours later (Bui et al., 2013). The study found that those who took organized notes performed significantly better on staggered assessments. In addition, despite the fact that students are able to immediately transcribe the lecture, they may be impairing the encoding benefits that other studies have reported as significant with handwritten note-taking (Mueller & Oppenheimer, 2014).

Researchers have raised additional concerns with using assistive technology in the classroom. Kay and Lauricella (2014, p. 3) found that when students use laptops during lectures, “five main problem areas emerged including being distracted by other students’ use of laptops, social networking, entertainment, surfing the web, and learning performance.” Laptop use in classrooms can cause distraction among peers in the room; the two most often cited reasons were student curiosity about what was on the other student’s computer screen and the distraction of the tapping keyboard (Boborne, 2009). In higher education classroom settings, nearly three-quarters of students used laptops in nonacademic ways during on-going lectures (Kay & Lauricella, 2014). The use of computers in the classroom may entice students to engage in multitasking between note-

taking and social networking by having various applications running simultaneously (Kay & Lauricella, 2014). Rubinstein, Meyer, and Evans (2001) found that individuals who engaged in multitasking required more time to complete both tasks than it would have taken if they had completed each task one at a time. As such, students who are attempting to take notes with computers and multitasking with other applications require additional time to complete their notes and may even be unable to take adequate notes when attempting to multitask.

Another type of technology in the classroom is the use of tape/voice recorders. With this technology, students are able to revert to the audio version of the lecture. However, it may take a considerable amount of time to identify a specific point during a long lecture. Previous publications have suggested tape recorders for students with disabilities to use to record only short tasks, such as directions or messages (Riviere, 1996).

The mechanical demands of note-taking by hand can put restrictions on the encoding effect (Kobayashi, 2005). This includes the acts of monitoring one's hand movements, the time required for writing, and the labor involved. Therefore, the lecturer's presentation speed, amount of information, and length of lecture affect the process of taking notes (Kobayashi, 2005). To alleviate the difficulties with note-taking that special education students experience in the ELA classroom, the use of the Livescribe 4GB Echo Smartpen offers an alternative with assistive technology. This device can help students compensate for deficits in working memory when used with strategic note-taking skills. The Livescribe Company was founded in 2007 and currently sells three different smartpen products: Echo, Sky Wi-Fi, and Livescribe 3. Each device

serves the purpose of assisting students to amend their notes with ease, as well as converting handwritten notes and audio into digital formats. The device itself consists of a standard size pen, fitted with a micro camera that records both verbal and visual information during a lecture.

The Echo smartpen requires the use of special dot paper, which identifies the location of the pen on the paper with the use of the pen's micro camera. While writing, the pen takes 72 snapshots per second, which captures a visual screenshot of the writing. The pen uses software that decodes the screenshot by providing an  $(x, y)$  coordinate pair, telling the smartpen precisely where the pen tip is on any given page and syncing these coordinate pairs with the audio recording. For example, if a student is able to write only a vocabulary term (e.g., *metaphor*) on the dot paper, after the lecture ends, the student puts the pen tip on the vocabulary term and the precise audio portion of the lecture will be played (e.g., *a metaphor is a comparison of two unlike things, without using like or as*), providing the students with the opportunity to amend his or her lecture notes by adding to or correcting the information. This assistive technology allows students time to process information while recoding partial or fewer notes, because they can later replay portions of the lesson through the syncing of the audio with their own written notes (Hannon, 2008). In addition to its note-taking capabilities, the smartpen also allows users to upload their notes in a digital version that includes both visual (notes) and audio recordings of the lecture.

Researchers have conducted limited studies on the various uses available for the Livescribe smartpens. Bogard and McMackin (2012) performed a qualitative study in a third-grade classroom using the Livescribe Pulse smartpen and focusing on literary skills.

The students had a goal to create written personal narratives. They created drafts by drawing scenes from their story while verbally narrating the story and capturing the audio on the pen for students to review. When Bogard and McMackin interviewed the participants, the students reported that they found the pen useful. “By telling his story orally before drafting, he was able to revise with ease and avoid the angst he had been experiencing when beginning a piece of writing” (p. 317). Other studies have used the smartpen as a discreet device for recording group conversations (Wood, Galloway, Hardy, & Sinclair, 2014) but no authors have researched and published on the effects of the smartpen in correlation with a note-taking strategy to enhance specific skills such as vocabulary content, cued lecture points, total word count and recall ability. Moore, Van Schaack, and Groves (2010) presented positive results with the use of the smartpen device as an alternative to other electronic solutions, such as tablet PCs. Using the smartpen can assist students by allowing them to quickly draw information from the lecture, such as graphs or diagrams, which can be difficult and time-consuming to create on a laptop or iPad device. Van Schaack suggested that students with SLD might benefit from the use of the smartpen device due to the increased opportunity for repeated listening to selected sections of the lecture (Van Schaack, 2009).

Overall, researchers have conducted limited studies on the use of smartpen technology in conjunction with research-based note-taking strategies. The current literature is lacking in the area of examining the effect of the smartpen on notes and academic achievement. In addition, the current literature does not address the use of the smartpen with a note-taking strategy that provides students with the recognition needed to identify key vocabulary, content, and organizational information. Furthermore, the

research that has been conducted has not aligned the use of the smartpen with a learning support curriculum. In addition, it has not combined the use of the technology with the use of a specific note-taking strategy—one designed to instruct students in the act of listening, identifying, and recording meaningful notes. Current research on the use of the Livescribe smartpen is limited and does not address specific measures of recorded notes, including total word count, total lecture points, and total words amended.

## CHAPTER 3

### METHOD

#### Introduction

The research design consisted of five phases of implementation: pre-test, training, practice, post-test, and delayed assessment phase. The intervention involved the use of smartpen technology and the guided note-taking strategy. The note-taking strategy used in this study is called JIGSAW. The researcher-developed JIGSAW strategy provided students with explicit instructions on the use of the smartpen note-taking technology in conjunction with explicit note-taking instructions. The JIGSAW strategy was hypothesized to assist students with their note-taking skills and the smartpen technology was predicted to lead to an increase in their ability to identify vocabulary words and content from the lecture. In addition, the strategy required students to write a summary at the end of the lecture.

The independent variable was the note-taking intervention and the dependent variables were the multiple-choice assessments (pre and post), the student notes (e.g., TWC and VOCAB), Immediate Free Recall (IFR - TWC and VOCAB) and Delayed Free Recall (DFR – TWC and VOCAB). All of the measures were used as pre-post measures, with the exception of DFR, which was used only as a posttest measure. To analyze the results, the study used a two-factor (Experimental/Control and Special Ed/Regular) analysis of covariance (ANCOVA) for the variables in the notes and IFR to determine differences between students' pretest and posttest scores, Vocabulary (VOCAB) count in notes, Total Word Count (TWC) in notes, and VOCAB and TWC in the IFR measure. In

addition, a two-factor (Experimental/Control-Special Ed/Regular) ANOVA was used to analyze the TWC and vocabulary in the DFR measure.

To examine the effectiveness of the note-taking intervention, the following research questions were examined:

1. Does the use of a specific note-taking strategy in conjunction with the smartpen technology improve the note-taking skills of students with and without disabilities?
2. To what degree does the intervention assist with retaining vocabulary and content, both for students with and without disabilities?
3. Is there a correlation between notes recorded (TWC and Vocabulary) and achievement measures (multiple-choice posttest)?

### Sample

This study took place in a public school district in the northeastern United States during the 2015–2016 school year. During the school year, the district reported that 13.32% of its student population received special education services. The school reportedly enrolled 3,198 students during the school year. This study focused on students with and without disabilities, including Specific Learning Disability (SLD) and Other Health Impairment (OHI), as measured in a ninth-grade English Language Arts (ELA) class.

The study took place in ninth-grade in both regular and special education English Language Arts (ELA) classrooms. All of the ELA classes in this study followed a uniform curriculum, aligned to grade level and state standards. In these classes, a total of

103 students were enrolled for the spring semester. Of these, 97 students agreed to participate in the study (94% of the students) and were randomly assigned to either the control group (47 students) or the experimental group (50 students). Students' ages ranged from 13 to 16 years. Consent forms were sent home to the parents, as well as a letter explaining the study (Appendices A, B, C). The study included a total of 57 regular education students and 40 students currently receiving special education services. Of the 40 total students receiving special education services, 30 students qualified for special education under the category of Specific Learning Disability (SLD), 7 qualified under the category of Other Health Impairment (OHI), 2 qualified under the category of Autism and 1 qualified under the category of Emotional Disturbance (ED). Teachers also signed a consent form indicating their agreement to participate in the research. Students participated in either general education, inclusive, or special education ELA classes based on their current educational placement. For this study, 76 students received an inclusive, general education ELA curriculum and 21 students received a modified ELA curriculum.

#### Note-taking Intervention

The note-taking intervention is comprised of both the smartpen technology and the JIGSAW strategy. The Livescribe Smartpen™ is a standard size pen with a microcamera by the pen tip. The device records both visual and verbal content during a lecture. The pen captures the audio of the lecture, which students can access by tapping their pen tip to their specific words on their notes page. The pen requires the use of special dot paper, which identifies the location of the pen on the paper with the use of the pen's microcamera. While writing, the pen takes 72 snapshots per second and captures a visual screenshot of the writing. The pen uses software which decodes the screenshot by

providing an (x,y) coordinate pair, telling the *smartpen* precisely where the pen tip is on any given page and syncing these coordinate pairs with the audio recording. For example, if a student is only able to write a vocabulary term (e.g. *simile*) on the dot paper, after the lecture ends, the student puts the pen tip on the vocabulary term and the precise audio portion of the lecture will be played (e.g., *a simile is a comparison of two unlike things by using the terms like or as*), providing the students with the opportunity to amend his or her lecture notes by adding to or correcting the information. Thus, students can listen to information they may have otherwise missed due to the quick pace of the lecture, slow writing, or poor note-taking skills.

The note-taking strategy, JIGSAW (see Figure 1) uses the acronym to assist students in remembering the steps required while using the smartpen to record efficient notes. The first three steps, JIG, are for students to listen and take notes during the lecture. The last three steps, SAW, require students to review and amend their notes once the lecture is over. The first step is to *Jump* to record by having the pen tip touch the record button on the notepad. The second step is to *Initiate* the notes by having the students write their names, date, and topic of the notes on the top of the page. Next, they will *Grab* vocabulary words (and the definition if time permits) and important lecture points that are stated during the lecture. Students should put a star symbol next to lecture points to remind them of their importance, and check for completion of meaning when amending notes. For example, many students with LD may only have enough time during the lecture to write the vocabulary word. Students then mark these missing parts with a star symbol and come back to them later to fill in. There is a strong focus on getting students to use vocabulary in this research study, because vocabulary is correlated with

recall of lecture content (Boyle, 2010b). Successful use of vocabulary knowledge is an example of a high-level academic skill, due to the demands of increased attention required to determine new vocabulary words and concepts that are embedded in educational courses (Ebbers & Denton, 2008). Lectures provide one of the most common ways to teach vocabulary (Kennedy & Wexler, 2013).

When the lecture is over, students were taught to use the SAW portion of the strategy. In the *Scan* step, students are responsible for reviewing their notes for missing information or gaps in their notes. During this step, students would tap the stop button and change the pen-tip color from black to red, then identifying information that is missing. “Reviewing notes in a strategic way may promote reprocessing of information recorded in the notes or recollected” (Kobayashi, 2006). Using headphones for the smartpen, students would complete the *Scan* step and listen to missing portions of their lecture notes by tapping on any word or lecture point and filling in the content and/or vocabulary. Next, students *Amend* their notes by providing annotations and filling in missing information. Students are often incomplete note-takers who record only one third of the important lecture content (Luo, Kiewra, & Samuelson, 2016; Titsworth 2004). Amending notes is necessary because it enhances note completeness, and provides a student-controlled strategy that allows students to revise their notes (Luo, Kiewra & Samuelson, 2016). For the *Amend* step of the strategy, students were taught to add more information to incomplete lecture points (e.g., vocabulary words without definitions), add missing details or examples from the lecture, or elaborate further on partial lecture points to make them more meaningful. When amending their own notes, students were

instructed to isolate the most important details in notes and provide examples heard during the lecture.

Finally, during the *Write* step, students were to a brief summary at the end of their notes, which consists of a minimum of three sentences. The purpose of the *Write* step was to have students connect the main ideas of the lecture to the lesson objective and their own understanding of the information that was presented. Writing this summary required students to reorganize and synthesize the information presented in the lecture and offered them the chance to restate the main points in their own words (Davis & Hult, 1997). For the *Write* step, students were to ask themselves, “What is the most important information that you learned from this lesson today?” King (1992) found that writing summaries to amend notes was an effective method for students to complete after lectures. Therefore in this study students wrote a brief summary at the conclusion of their lecture notes.

#### Procedures

Students in the experimental group in this study used the note-taking intervention. Students were randomly assigned to the experimental or control group. Random assignment was based upon the use of a random number generator. This entire study took place over 17 sessions. During session 1, students participated in the pretest phase. Sessions 2 and 3 consisted of the training phase, in which students in the experimental group were trained in the smartpen technology and JIGSAW strategy. All students in the experimental group were given multiple attempts for the JIGSAW strategy assessment, and were required to score 100% to continue with the training. Sessions 4 – 11 consisted of the practice phase; experimental students practiced using the note-taking intervention with class lectures, while students in the control group used traditional note-taking skills

with the lectures. Session 12 provided the posttest phase to all students. Session 17 consisted of the delayed assessment phase. I created and used a Fidelity Checklist (Appendix D) to maintain and ensure consistency during all steps of the process, including training and presentation of directions for pretest and posttests.

**Pretest Phase.** Session 1 of the study was the pretest phase. Students in both the control and experimental groups participated in the pretest measure. Students were required to watch and listen to a digitally recorded video lecture and record notes with their traditional note-taking skills, followed by an Immediate Free Recall (IFR) measure, and then a content and vocabulary-based assessment. The researcher recorded each video lecture (for pretest and posttest assessment), which were each between 12 and 13 minutes in length. Each video lecture contained 17 cued lecture points and 13 non-cued lecture points, as well as 15 unique vocabulary terms. In addition, both lecture scripts featured similar word counts, with 1950 and 1958 total words, respectively. Both video lectures instructed students in a biographical timeline focusing on the context of the lives of one of two different literary authors (Mark Twain for the pretest and Edgar Allan Poe for the posttest). The content and vocabulary in both pretest and posttest lecture videos had not yet been presented in the ELA curriculum at this grade level, or at previous grade levels. Therefore, the information in both the pretest and posttest lecture videos provided new information to students.

After the video finished, students were instructed to turn in their notes based upon the video lecture. Then, all students were assessed on their knowledge of the lecture content with the IFR measure. Students were provided with a blank piece of paper and instructed to write as much content information and vocabulary as they could remember

from the lecture, within a 5-minute period. After five minutes, students turned in the IFR measure.

Next, students completed the multiple-choice measure. The multiple-choice measure consisted of 20-questions, each question with four options. Multiple-choice questions were created by randomly identifying 10 cued lecture points, seven vocabulary words, and three non-cued lecture points from each video lecture script. The multiple-choice measure was used to evaluate students' comprehension of the lecture and vocabulary terms based on the points scored correctly out of the total possible points on the assessment.

**Training Phase.** Sessions 2 and 3 of this study were the training phase. Over a period of two class sessions, students in the experimental group received training in the JIGSAW note-taking strategy in conjunction with the use of the smartpen technology. The experimental group of students were provided with 60 minutes of training each day in an alternate classroom. They were trained in the note-taking intervention, which included direct instruction in the smartpen technology and the JIGSAW strategy. Researchers have found that students who take higher-quality notes were more successful with processing and recalling information from lectures (Slotte & Lonka, 1999). Using the fidelity checklist (Appendix D), along with direct instruction, was to insure that students were trained appropriately in the note-taking strategy and with high fidelity. Training outcomes for the experimental group was assessed with 100% fidelity. Students in the control group were excluded from the direct instruction of JIGSAW and the smartpen technology and instead worked on traditional ELA assignments, not graded in the course.

During session 2, I began by reviewing PowerPoint slides that addressed how to use the smartpen with strategic note-taking skills. Then, I provided the smartpen technology to the students. They were instructed and provided with a teacher model on how to appropriately use the smartpen technology, including turning the device on and off, using the device with the smartpen notepad, learning how to record notes, rewinding and fast-forwarding through notes and alternating the playback volume. The instructor explained to students the importance of lecture cues and ways to identify lecture cues. This continued with identifying vocabulary words and definitions in lectures. Then, students practiced identifying different lecture points by working independently on the Identifying Lecture Points: Practice Sheet (Appendix J) and reviewed the answers with the instructor as a group. This worksheet was provided to assist students with identifying lecture points, including different formats such as cued importance, cued organizational, and non-cued lecture points.

Next, the instructor introduced the JIGSAW strategy to students and provided students with the JIGSAW Training Worksheet for Students (Appendix G). On the training worksheet, they practiced re-writing the meaning of the acronym JIGSAW and practiced memorizing the technique by folding the paper in half and attempting to independently define each step. Next, the instructor explained the importance of amending notes and informed students about the importance of amending their notes using the smartpen by changing the pen tip to red and listening to the audio recorded during a lecture.

The first part of the practice session required students to use the JIG steps, including *Jump* to record, *Initiate* notes with their name and the date, and *Grab*

vocabulary and lecture cues. The second part of the practice session required students to review their notes by utilizing the SAW steps, including *Scan* for missing information in notes, *Amend* notes by tapping and listening to the pen, and *Write* a brief summary of the topic content. Students were instructed to use their smartpens with the JIGSAW note-taking strategy and take notes. The instructor modeled the use of the smartpen in conjunction with the note-taking strategy. Then, students practiced the JIGSAW strategy with the use of the smartpen by watching a 6-minute long video with cued lecture points and vocabulary words, which was a researcher-created video recording. While students were taking notes, I walked around the room and provided feedback to the students regarding the appropriate use of the strategy and the notes they had recorded.

At the end of session 2, students were encouraged to study the JIGSAW strategy because they were told that they would be taking the JIGSAW quiz the next day (session 3). Students were provided with a separate checklist for using the JIGSAW strategy during note-taking (Appendix H) as well as the JIGSAW Training form (Appendix G). They were instructed to use these forms to study the intervention strategy. For session 3, students within the experimental group first reviewed the materials, then completed the JIGSAW quiz to assess their proficiency of the strategy (Appendix I). The JIGSAW quiz consisted of six questions in fill-in-the-blank form to assess their ability to correctly identify the note-taking strategy (Appendix I). Students were required to score 100% to move forward in the study. However, if a student scored less than 100%, he or she was provided with feedback on errors and was given another two minutes to study, followed by teacher prompting to retake the quiz.

**Practice Phase.** During sessions 4 – 11, students in both the experimental and control group used their note-taking skills over eight practice sessions. At the end of each session, all students were provided with at least five minutes to review their notes. Students within the experimental group used the last three steps of the strategy to: *Scan* their notes for missing information, *Amend* their notes by listening to different parts of the lecture (using headphones), and *Write* a brief summary. All students submitted their notes to their instructor at the end of each lesson for review. Students were encouraged daily to have a note-taking goal of completing all six JIGSAW strategy steps. Upon reviewing student's notes in the experimental group, I validated the use of the JIGSAW strategy by evaluating each student's notes to assess the appropriate use of the JIGSAW note-taking strategy. Each letter of the note-taking intervention strategy was assessed for one point, and each day was assessed out of six possible points. I provided students with a yellow sticky note on their observed notes, which provided students with daily feedback regarding their scores, positive reinforcement, and areas of needed improvement. Costa and Kallick (2001) reported that providing feedback to students through formative assessment increases student achievement. In addition, Crooks (1988) found that instructors noted substantial learning gains when providing formative assessment as part of classroom practice. Student notes from the control group were also collected to assess for any potential crossover of the JIGSAW strategy. None of the notes from the control group demonstrated similar qualities of the JIGSAW strategy.

**Posttest Phase.** Session 12 provided the posttest phase of the study. All students participated in the posttest assessment. Students in the experimental group were instructed to take notes during the video lecture while using the smartpen and the

JIGSAW note-taking strategy; and students in the control group were instructed to use their traditional method of note-taking. After all students completed their notes, students in the experimental group were provided with at least five minutes to amend their notes, using the red pen tip and headphones to listen to specific sections of the recording, (the SAW selection of the strategy). Then, both groups submitted their notes and were instructed to take part in the IFR measure. This measure required students to write their name and date on a plain white piece of paper and write as much information and vocabulary as they retained in a timed, 3-minute period. After the timed period was over, students submitted their notes. Lastly, both groups completed the posttest multiple-choice assessment and turned it in after completion.

**Delayed Assessment Phase.** Session 17 was the last day of the research study and provided the delayed assessment phase of the study, signifying a 5-day delay from the posttest phase. All students were provided with a Delayed Free Recall (DFR) measure. Both the experimental and control groups were provided with a blank piece of white paper and asked to recall as much information and vocabulary as they could about the posttest video, given a timed period of five minutes. This delayed recall was assessed for TWC and vocabulary words noted.

After the DFR, students in the experimental group were provided with the Note-taking Student Survey (Appendix F). This is a social validity feedback form that allowed students to share their opinions, including likes and dislikes about the note-taking strategy and assistive technology. This survey acted similarly to a customer satisfaction survey, with statements such as “I liked like this note-taking strategy more than my traditional note-taking strategy,” and “I felt that I took more notes using this strategy.”

Students in the experimental group were also provided with the opportunity to answer two open-ended questions expressing their opinions of the strategies strengths and weaknesses. Students were asked to express their opinions of the strategy and note-taking technology.

After data collection had concluded, 15 students were randomly selected to participate in the interview questions. Of the 15 students selected, all were from the experimental group; 10 were identified as receiving special education services, and the other five were identified as receiving regular education services. All conversations were recorded and later transcribed. All interviews took place in an empty classroom with no distractions. Students were given a series of nine open-ended questions, ranging from struggles in English classes to preferences and dislikes about the note-taking intervention. The purpose of providing the interview questionnaire were to determine the diversity of opinions within the student population (experimental group) in regards to the intervention, including the JIGSAW strategy and smartpen technology.

#### Measures

A pretest/posttest experimental research design with a randomized control group was used in this study. The goal of this study was to evaluate the impact of the intervention; therefore, a pretest/posttest experimental design was appropriate, followed by a delayed recall measure. The delayed recall measure was necessary, because the intervention was meant to produce effects that are either permanent or of long duration.

**Total Word Count.** The first measure was a word count of vocabulary and TWC of the recorded notes associated with pretest and posttest video lecture.

**Immediate Free Recall.** The second measure was the IFR measure. Students were given a blank piece of paper and asked to write down as many vocabulary words and content information as they remembered for a timed period. The purpose of this measure was to assess students' performance and knowledge of lectures (Kiewra et al., 1995). The use of the IFR measure assisted in demonstrating the effectiveness of the note-taking intervention by allowing students to show their knowledge of the lecture topic.

**Multiple-Choice Assessment.** The third measure was the 20-point multiple-choice assessment. This was used to assess students' comprehension of the videotaped lecture.

**Delayed Free Recall.** While the above-mentioned measures were administered for both pretreatment and posttreatment, the DFR measure was only administered in the posttest phase of the study. The DFR occurred five school days after the posttest assessment. Similar to the IFR measure, students given a blank piece of paper and asked to write down as much as they could recall from the posttreatment digitally recorded lecture. The DFR was evaluated for TWC and vocabulary word count. This measure assessed students' retention of the final lecture topic. Students were not aware of this measure in advance and were not permitted to review their notes.

To ensure validity of assessment measures, I created the pretest and posttest based upon the lecture content from each digitally recorded lecture. A valid test of comprehension and vocabulary analysis was used to cover the main topics and concepts during the time preceding the test (Salend, 2011). Creating an assessment with multiple-choice items (objective test items) was appropriate for assessing factual knowledge,

which was taught directly (Salend, 2009). In developing these assessments, answer choices avoided using key words from the stem of the question and did not include categorical words such as *always* or *never* (Salend, 2011). Vague terms of language were avoided and all language used in questions was based upon students' reading level (Brookhart & Nitko, 2008).

The last measure was a questionnaire. After the DFR assessment was administered, students in the experimental group were asked to complete a social validity assessment with a feedback form, in the form of an exit survey (Appendix F). The feedback form required students to provide their perceptions of their understanding of the learning process, including the JIGSAW strategy in conjunction with the smartpen technology. The questionnaire consisted of eight statements with a 4-point Likert-type scale rating from 1 (*strongly disagree*) to 4 (*strongly agree*). Their answers were analyzed and included in the results of the study. Finally, randomly selected students from the experimental group were interviewed with the Interview Questions for Social Validity (Appendix E), which asked students eight questions about their opinions of the use of the strategy and the smartpen.

### Materials

Each student in the experimental group was provided with a numbered Livescribe Smartpen™, a numbered *smartpen* notebook with special dot paper, and a pair of Sony™ wired headsets. The purpose of numbering the smartpen technology and notepad was to allow each student to keep track of his or her recorded information throughout the study. The headsets provided to the students were not numbered; they were Sony™ headsets with headphones. Students were provided with the option to use their own headphones or

ear buds. All students were provided with two different colored pen tips to use throughout the study, one black and one red. If students ran out of ink during the course of the study, they were provided with another pen tip. Prior to students amending their notes, they were instructed to switch their pen tip color from black to red so that the researcher could easily determine the extent of amended notes.

### Data Analysis Plan

This research study had five areas of measurement using ANCOVA (Figure 2). These measures were used to assess skilled note-taking and understanding of the lecture by student's notes and achievement scores. To determine whether skilled note-taking occurred, I evaluated students' before treatment and after treatment notes among the control and experimental groups and compared total vocabulary words recorded and TWC recorded in the notes, including amended notes in the experimental group.

Students' understanding of the lecture was measured by a comparison of pretreatment and posttreatment scores from the multiple-choice assessments, vocabulary words recorded in the IFR responses, and TWC recorded in the IFR responses. Therefore, students' understanding of the lecture demonstrated their ability to use cognitive task analysis including executive, encoding, and external storage functioning skills, as well as metacognition and working memory skills. Data were inputted into the IBM SPSS™ version 21.0 predictive analytics software and used to determine results of significance.

<b>Measures</b>	
<i>Note-taking in Students' Notes</i>	<i>Lecture Comprehension/Recall</i>
<ul style="list-style-type: none"> <li>• Vocabulary Words Recorded in Notes</li> <li>• Total Word Count Recorded in Notes</li> </ul>	<ul style="list-style-type: none"> <li>• Multiple-Choice Assessment Scores</li> <li>• Vocabulary Words in IFR</li> <li>• Total Word Count in IFR</li> <li>• Vocabulary Words in DFR *</li> <li>• Total Word Count in DFR *</li> </ul>

*Figure 3.1 Analytic plan.*

\* *Posttest measure*

### *Pretreatment Comparison*

The purpose of this study was to determine the differences measured before and after treatment. Students were randomly assigned to be in either the experimental or control group. At pretreatment, I conducted an analysis of variance (ANOVA) for all experimental and control groups by comparing all pretest measures. However, significant differences were found for two of the variables (multiple choice assessment measure and TWC in IFR measure); the ANOVA could not be used for those variables. Therefore, even though the randomization occurred, the groups were different in the beginning.

### *Posttreatment Comparison*

The analytic design used for this study used a two-factor ANCOVA. “One advantage of adopting a repeated measures design is that, for a fixed sample size, it will generally result in greater precision of parameter estimates and more efficient inferential analyses,” (Lix & Keselman, 2010, p. 15). The covariate in this study assisted by pulling variability out of the outcome that is associated with the differences noted from the pretreatment comparison. The covariate accounted for the fact that not all groups were the same during the pretreatment. Five ANCOVA designs were analyzed, each focusing on one of the posttest measures (test score, TWC in notes, vocabulary in notes, TWC in

IFR, vocabulary in IFR) and the predictor being either the control or intervention factor, with the covariate being the pretest measure. For example, to analyze vocabulary in the notes, using ANCOVA assisted me in identifying the differences between variables accounting for intervention in the pretest and posttest outcome. Factors to explain these results included whether or not the student had the intervention (labeled in this study as 0 for control or 1 for experimental group) or whether they were in general education inclusive class or learning support classroom (labeled in this study as 0 for regular education and 1 for special education). Results used beta weight for intervention to determine the effect size using standard deviation form. It was hypothesized that TWC of students in the experimental group would increase with the JIGSAW research-based intervention strategy in combination with the assistive technology.

Finally, the DFR assessment was analyzed using a two-factor ANOVA. This analysis was used to determine statistical significance with TWC in student notes and vocabulary on the DFR assessments. I ran two models with the experimental/control and regular/special education group. It was hypothesized that students who received the intervention would perform higher than those who were in the control group.

#### *Correlation Between Measures*

Of interest in this study was to examine relationships between variables. One research question from this study addressed this by looking at the relationship between note-taking measures (TWC and vocabulary) and student achievement (posttest scores). “The goal of correlational analyses is to assess whether two variables of interest covary or are related” (Osborne, 2010, p. 55). This was measured through a Pearson correlation with the two factors of note-taking compared with the levels of achievement (posttest

score). It was important to determine which measure of note-taking was beneficial to student learning and achievement.

### *Interrater Reliability*

Using the IFR measures, an independent rater scored all IFR assessments for TWC and vocabulary words. An additional rater randomly selected one-third of the IFR measures and scored them using the same guidelines as the first rater; the results of the second rater allowed for determination of interrater reliability. An independent rater also scored all DFRs, and an additional one-third of the documents were scored a second time by a second rater to determine interrater reliability.

A percentage agreement was used as the measure of interrater reliability, in which educators who were not part of the classroom study evaluated the different variables of data and indicated the percentage of the occasions where the raters agreed in the ratings they assigned to the variables (Huck, 2012). An agreement was recorded if both observers identically scored the answer as correct or incorrect. Likewise, a disagreement was recorded if questions were not scored identically. Percentage agreement for each variable was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100.

A total of 33 of 97 student documents were analyzed for interrater reliability, representing 34% of the sample size. The percentage of interrater reliability for TWC and vocabulary words of pretest notes was 99.47% and 94.12%, respectively. The percentage of interrater reliability for TWC and vocabulary of posttest notes was 99.25% and 90.91%, respectively. Interrater reliability for pretest IFR notes TWC and vocabulary percentage was 99.53% and 94.4%, respectively. Posttest IFR notes had an interrater

reliability of 99.5% for TWC and 100% for vocabulary. In addition, interrater reliability percentage for DFR TWC and vocabulary words was 100% and 100%, respectively.

### Ethical Procedures

Ethical procedures were followed to provide privacy and to protect the rights of the students who chose to take part in this study. Because all students were younger than 18 years, they were required to provide assent to participate and to provide signed consent from their parent or guardian. Each student who participated in the control and experimental group was provided with a concise assent form requiring their signature, as well as a consent form requiring signatures from a parent or legal guardian. The consent and assent forms both indicated any associated risks or potential benefits that may have resulted in participating in this study. A description of the research plan and expected outcomes was provided in the documentation to maintain integrity.

Throughout this study, the confidentiality among the participants was maintained. Students in the experimental group were assigned numbers for their smartpens and notebooks, which corresponded to the data in the analysis framework. In addition, the raw data were not shared with any teachers participating in this study. Data collected will continue to be stored on a locked and encrypted laptop to protect the identity of the participants. I maintain sole access to the data on the encrypted laptop. All student information remains confidential and is not shared with other students, teachers, or paraprofessionals. The data will be retained for a period of three years and then shredded or destroyed to maintain confidentiality.

An exit strategy was established to allow the students in the experimental group to maintain copies of their notes throughout the intervention. Students from the

experimental group were provided with an exit survey to indicate their opinions about the use of the assistive technology with the Note-taking Student Survey (Appendix F). After the data from the study were collected, the control group was provided with the JIGSAW training and the opportunity to use smartpens and notebooks for a period of eight school days.

## CHAPTER 4

### RESULTS

The study involved a pretest/posttest design; therefore, two analyses were appropriate: a repeated measures analysis of variance (ANOVA) or an analysis of covariance (ANCOVA) using the pretest as the covariate. As an initial analysis, the experimental and control groups were compared on all of the pretest measures. Significant differences were found for two of the variables (Multiple-choice Assessment Score: Experimental Mean = 15.21; Control Mean = 13.56;  $t = 2.27$ ,  $p = .025$ ; Immediate Free Recall Total Word Count: Experimental Mean = 50.82; Control Mean = 43.60;  $t = 2.13$ ,  $p = .037$ ). Because of these initial differences, the repeated measures ANOVA could not be used for these two variables. To make all of the analyses consistent, I decided to conduct ANCOVAs for all of the variables, using the pretest as the covariate. All of the analyses, therefore, used a two-factor (Experimental/Control–Special Education/Regular Education) ANCOVA. The repeated measures could have been used for other variables, but because ANCOVA had to be used for these two variables, ANCOVA was used to keep the analysis consistent across all of the dependent variables. In addition, a paired sample t-test was conducted between the pretest and unadjusted posttest. The t-test was computed comparing post-test mean minus the pre-test mean. The comparisons were computed as two-tailed probabilities.

#### Analysis for Pretest and Posttest Multiple-Choice Scores

The means and standard deviations for the pretest, posttest, and adjusted posttest scores on the multiple-choice assessment are presented in Table 4.1. The adjusted posttest means were necessary to adjust for pretest variability. This assisted by removing some of

the variability in the posttest while conserving the difference between groups (Trochim, 2006). The results for the ANCOVA are presented in Table 4.2.

Table 4.1

*Means and Standard Deviations (SD) for Pretest and Posttest Scores on the Multiple-Choice Assessment*

Type of Student	Group	Pretest Mean (SD)	Unadjusted Posttest Mean (SD)	Adjusted Posttest Mean	Change in Multiple-Choice Scores
Regular Education	Experimental	15.21 (2.87)	14.24 (3.69)	13.89	-0.97
	Control	16.17 (3.24)	15.72 (2.52)	14.96	-0.45
Special Education	Experimental	11.29 (3.23)	11.00 (3.94)	12.29	-0.29
	Control	13.67 (3.66)	12.11 (3.56)	12.40	-1.56

Table 4.2

*ANCOVA Results for Pretest and Posttest Scores Tests of Between-Subjects Effects*

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial $\eta^2$
Pre to Posttest Score	169.470	1	169.470	17.069	.000	.156
Regular vs special education	80.285	1	80.285	8.086	.005	.081
Experimental vs control	7.688	1	7.688	0.774	.381	.008
Within Subject Interaction	5.356	1	5.356	0.539	.465	.006

*Notes.* Dependent variable = posttest score.  $R^2 = .351$  (Adjusted  $R^2 = .323$ )

As shown in Table 4.2, there is a significant difference between the regular education and special education students ( $p = .005$ ; regular education,  $M = 14.43$ ; special education,  $M = 12.25$ ), with a medium effect size of partial eta squared (.081). The difference between the experimental group and the control group was not significant, nor was the interaction. Therefore, for the multiple-choice assessment, the data show only that regular education students perform at a higher level compared with special education students.

### Analysis for Total Word Count in Notes

The change in Total Word Count (TWC) was derived by subtracting the posttest from the pretest for the experimental and control group. The means and standard deviations for the pretest TWC, posttest TWC, and adjusted posttest TWC are presented in Table 4.3. The results for the ANCOVA are presented in Table 4.4. The results for the paired sample t-test with TWC for pre and posttest are presented in Table 4.5.

Table 4.3  
*Means and Standard Deviations (SD) for Total Word Count (TWC) Notes*

Type of Student	Group	Pretest	Unadjusted	Adjusted	Change in TWC
		TWC Mean (SD)	Posttest TWC Mean (SD)	Posttest TWC Mean	
Regular education	Experimental	137.90 (56.09)	167.62 (50.17)	162.17	29.72
	Control	149.55 (58.11)	134.62 (48.20)	124.57	-14.93
Special education	Experimental	105.14 (42.14)	157.71 (47.73)	165.18	52.57
	Control	82.89 (62.56)	85.78 (37.39)	102.02	2.89

Table 4.4  
*ANCOVA Results for Pretest and Posttest Total Word Count Tests of Between-Subjects Effects*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial $\eta^2$
Pre to Posttest TWC	44,307.307	1	44,307.307	25.136	.000	.215
Regular vs special education	1,844.136	1	1844.136	1.046	.309	.011
Experimental vs control	58,838.396	1	58,838.396	33.379	.000	.266
Within Subject Interaction	3708.224	1	3708.224	2.104	.150	.022

*Notes.* Dependent variable = posttest total word count.  $R^2 = .439$  (Adjusted  $R^2 = .414$ ).

Table 4.5  
*Paired Sample t-test Means for Pretest and Posttest Total Word Count in Notes*

Type of Student	Group	Pretest Mean	Posttest Mean	T-Test	Sig.
Regular Education	Experimental	137.90	167.62	2.84	.008
Regular Education	Control	149.55	134.62	1.85	.079
Special Education	Experimental	105.14	157.71	4.09	.001
Special Education	Control	82.89	85.78	.22	.830

Table 4.4 shows an effect between the experimental group and control group ( $p < .001$ ). No significant difference was noted between the regular and special education groups ( $p = .309$ ). This shows that there is a difference at the posttest when pretest differences are controlled. Furthermore, partial eta squared within the experimental vs. control group shows a large effect size (.266).

Table 4.5 shows statistical significance for both regular education ( $p = .008$ ), and special education experimental groups ( $p = .001$ ). Therefore, students in both the regular education and special education experimental groups made significant gains based on their pretest and posttest TWC averages.

In Table 4.3, the mean change in TWC for the regular education experimental group is  $M = 29.72$  ( $167.62 - 137.90 = 29.72$ ). The mean for the regular education control group is analyzed with subtraction as well ( $134.62 - 149.55 = M = -14.93$ ). This process was repeated for the special education group to obtain the change in TWC. Students in the regular education experimental group recorded a higher average of words ( $M = 29.72$ ) in the posttest compared with the pretest. By dividing the change in TWC from the pretest TWC mean, I was able to determine the percentage change between pretest and posttest TWC in notes. For the regular education experimental group, there

was a 21.5% increase in average words recorded from pre to posttest measure. Students in the regular education control group recorded a reduced average of words in the posttest compared to the pretest ( $M = -14.93$ ). Students in the special education experimental group recorded a higher average number of words ( $M = 52.57$ ) in the posttest compared with the pretest, which represents an average increase of 50%. Whereas students in the special education control group made minimal gains ( $M = 2.89$ ), which represents an average increase of only 3.48%. Furthermore, when observing posttest TWC among the special education groups, the experimental group recorded an average of 157.71 words, while the control group recorded 85.78 words. This indicates that special education experimental group recorded an increased average of 71.93 words, or 54.3% more, when compared to the special education control group in the posttest notes.

#### Analysis for Total Vocabulary in Notes

The means and standard deviations for the prevocabulary count, postvocabulary count, and adjusted postvocabulary count are presented in Table 4.6. The results for the ANCOVA are presented in Table 4.7. The results for the paired sample t-test with vocabulary for pre and posttest are presented in Table 4.8.

Table 4.6  
*ANCOVA Results for Pretest and Posttest Total Word Count Tests of Between-Subjects Effects*

Type of Student	Group	Pretest	Unadjusted	Adjusted	Change in Vocabulary Count in Notes
		Notes Vocabulary Count Mean (SD)	Posttest Notes Vocabulary Count Mean (SD)	Posttest Notes Vocabulary Count Mean	
Regular education	Experimental	1.76 (2.01)	3.93 (2.61)	3.87	2.17
	Control	2.45 (1.78)	3.34 (2.24)	2.98	0.94
Special education	Experimental	1.00 (1.26)	2.67 (2.10)	2.94	1.67
	Control	0.83 (1.33)	1.72 (1.96)	2.06	0.89

Table 4.7  
*ANCOVA Results for Pretest and Posttest Vocabulary Count in Notes Tests of Between-Subjects Effects*

Source	Type III Sum of Squares	Df	F	Sig	Partial $\eta^2$
Pre to Posttest vocabulary	50.084	1	10.553	0.002	.103
Regular vs special education	17.793	1	3.749	0.056	.039
Experimental vs control	17.847	1	3.761	0.056	.039
Within Subject Interaction	.001	1	.000	0.988	.000

Notes. Dependent variable = posttest vocabulary.  $R^2 = .201$  (Adjusted  $R^2 = .166$ ).

Table 4.8  
*Paired Sample t-test Means for Pretest and Posttest Vocabulary Count in Notes*

Type of Student	Group	Pretest Mean	Posttest Mean	T-Test	Sig.
Regular Education	Experimental	1.76	3.93	4.66	.000
	Control	2.45	3.34	2.20	.036
Special Education	Experimental	1.00	2.67	2.98	.007
	Control	.83	1.72	1.74	1.00

As shown in Table 4.7, no statistically significant results were found. However, regular vs. special education groups and experimental vs. control groups were close to statistical significance ( $p = .056$ ). Partial eta squared for both groups shows a small effect size (.039).

Paired sample t-test results in Table 4.8 show that students within both the regular experimental group ( $p = .000$ ) and the special education experimental group ( $p = .007$ ) demonstrated statistical significance. It should be noted that students in the regular education control group also demonstrated significance ( $p = .036$ ). Therefore, students within in the regular education and special education experimental groups demonstrated a higher vocabulary count in the posttest assessment compared to the pretest, as well as the regular education control group.

As shown in Table 4.6, the mean changes in vocabulary recorded in notes indicates improvement within the experimental groups when comparing pre to posttest notes. By dividing the change in vocabulary from the pretest vocabulary mean, I was able to determine the percentage change between pretest and posttest vocabulary in notes. First, the regular education experimental group increased the number of words recorded, ( $M = 2.17$ ) indicating a 123% increase. Second, the special education experimental group increased the number of vocabulary words recorded ( $M = 1.67$ ) representing a 167% increase. Since the regular education control group was found statistically significant with the paired t-test ( $p = 0.36$ ), it should be noted that the regular education control group also improved their vocabulary recorded by an average 107%.

#### Analysis for Total Word Count in Immediate Free Recall

The means and standard deviations for the pretest Immediate Free Recall (IFR) TWC, posttest IFR TWC, and adjusted posttest IFR TWC are presented in Table 4.9. The results for the ANCOVA are presented in Table 4.10. The results for the paired sample t-test with TWC in IFR for pre and posttest are presented in Table 4.11.

Table 4.9

*Means and Standard Deviations (SD) for Pretest and Posttest Total Word Count (TWC) in Immediate Free Recall (IFR)*

<b>Type of Student</b>	<b>Group</b>	<b>Pretest IFR TWC Mean (SD)</b>	<b>Unadjusted Posttest IFR TWC Mean (SD)</b>	<b>Adjusted Posttest IFR TWC Mean (SD)</b>
Regular education	Experimental	57.48 (14.94)	56.48 (17.60)	51.16
	Control	46.17 (14.60)	49.21 (17.78)	49.80
Special education	Experimental	41.62 (17.51)	58.90 (21.17)	61.88
	Control	39.44 (17.10)	38.28 (12.56)	42.39

Table 4.10

*ANCOVA Results for Pretest and Posttest Total Word Count (TWC) in Immediate Free Recall (IFR)*

<b>Source</b>	<b>Type III Sum of Squares</b>	<b>df</b>	<b>Mean Square</b>	<b>F</b>	<b>Sig.</b>	<b>Partial <math>\eta^2</math></b>
Pre to Posttest IFR TWC	6390.106	1	6390.106	23.932	.000	.206
Regular vs special education	56.580	1	56.580	0.212	.646	.002
Experimental vs control	2415.449	1	2415.449	9.046	.003	.090
Within Subject Interaction	1870.836	1	1870.836	7.007	.010	.071
Error	24,565.315	92	267.014			

*Notes.* Dependent variable = Posttest immediate free recall total word count.  $R^2 = .320$  (Adjusted  $R^2 = .290$ ).

Table 4.11

*Paired Sample t-test Means for Pretest and Posttest Total Word Count in Immediate Free Recall*

<b>Type of Student</b>	<b>Group</b>	<b>Pretest Mean</b>	<b>Posttest Mean</b>	<b>T-Test</b>	<b>Sig.</b>
Regular Education	Experimental	57.48	56.48	-.31	.759
	Control	46.17	49.21	.95	.350
Special Education	Experimental	41.62	58.90	3.85	.001
	Control	39.44	38.28	-.29	.769

As shown in Table 4.10, significant differences were noted between experimental and control groups ( $p = .003$ ). There is a significant interaction between the type of student and group ( $p = .010$ ). Partial eta squared results show a medium effect size (.090).

In addition, looking at the interaction between the type of student and the group, partial eta squared shows a medium effect size (.071).

Table 4.11 shows statistical significance with the special education experimental group ( $p = .001$ ). Therefore, students within the special education experimental group demonstrated improvements in TWC recorded during the IFR measure.

Table 4.9 shows that the regular and special education experimental groups, both demonstrated high TWC on the posttest IFR in TWC, with  $M = 56.48$  and  $M = 58.90$ , respectively. This table shows an improvement for the special education experimental group compared with the pretest IFR, with an average increase of 17.28 words. By analyzing the percentage change for TWC in IFR, the experimental group increased their total words written by 82% in the posttest measure, whereas 18% either decreased or stayed the same (Appendix O). In the control group, only 38.7% increased their total words written in the IFR measure, whereas 61.3% either decreased or stayed the same.

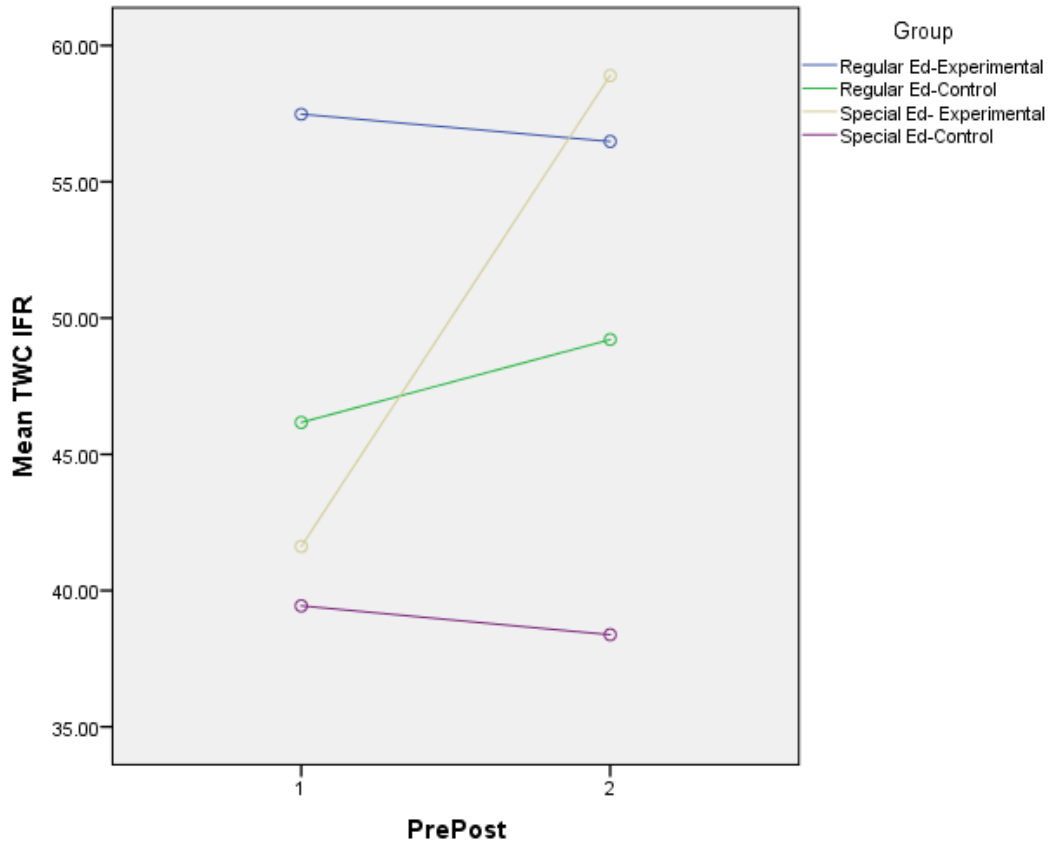


Figure 4.1  
 Estimated Marginal Means of Posttest Immediate Free Recall Notes and Total Word Count

Figure 4.1 shows that the special education experimental group demonstrated a dramatic difference in scores, starting out with the third lowest in TWC scores and ending up scoring the highest on the posttest IFR assessment. This finding shows a significant effect in the intervention process in relation to TWC in free-recall notes. By comparison with special education students in the control group, the special education experimental group scored the lowest on their TWC and continued to score the lowest on the posttest assessment.

### Analysis for Vocabulary in Immediate Free Recall

The means and standard deviations for the pretest IFR vocabulary, posttest IFR vocabulary, and adjusted posttest IFR vocabulary are presented in Table 4.12. The results for the ANCOVA are presented in Table 4.13.

Table 4.12  
*Means and Standard Deviations (SD) for Pretest and Posttest Vocabulary in Immediate Free Recall (IFR)*

Type of Student	Group	Pretest Vocabulary in IFR Mean (SD)	Unadjusted Posttest Vocabulary in IFR Mean (SD)	Adjusted Posttest Vocabulary in IFR Mean	Change in Vocabulary in IFR Mean
Regular education	Experimental	0.31 (0.71)	0.48 (0.63)	0.48	0.17
	Control	0.28 (0.75)	0.76 (0.87)	0.75	0.48
Special education	Experimental	0.10 (0.43)	0.33 (0.57)	0.33	0.23
	Control	0.06 (0.23)	0.33 (0.48)	0.33	0.27

Table 4.13  
*ANCOVA Results for Pretest and Posttest Vocabulary in Immediate Free Recall Tests of Between-Subjects Effects*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial $\eta^2$
Pre to Posttest IFR Vocabulary	.010	1	.010	0.021	.885	.000
Regular vs special education	1.813	1	1.813	3.859	.052	.040
Experimental vs control	.446	1	.446	0.949	.333	.010
Within Subject Interaction	.442	1	.442	0.941	.335	.010
Error	43.209	92	.470			

*Notes.* Dependent variable = Posttest Immediate Free Recall Vocabulary. IFR = immediate free recall.  $R^2 = .066$  (Adjusted  $R^2 = .025$ ).

As shown in Table 4.13, no statistical difference was found between regular education and special education groups ( $p = .052$ ). The partial eta squared results show a small effect size (.040). No statistical difference was noted between experimental and control groups ( $p = .333$ ). However, there was close to statistical significance for the regular and special education group ( $p = .052$ ). The control group recorded a higher

difference in means when comparing pretest to posttest in categories of regular and special education ( $M = 0.48$ , and  $M = 0.27$ , respectively).

Analysis for Total Word Count in Delayed Free Recall

The results for the ANOVA are presented in Table 4.14 and Table 4.15.

Table 4.14

*ANOVA Results for Total Word Count in Delayed Free Recall (DFR) Tests of Between-Subjects Effects*

<b>Source</b>	<b>Type III Sum of Squares</b>	<b>df</b>	<b>Mean Square</b>	<b>F</b>	<b>Sig.</b>	<b>Partial <math>\eta^2</math></b>
Regular vs special education	1532.017	1	1532.017	3.010	.086	.032
Experimental vs control	677.987	1	677.987	1.332	.251	.014
Within Subject Interaction	1.018	1	1.018	0.002	.964	.000
Error	46,823.374	92	508.950			

*Notes.* Dependent variable = total word count in delayed free recall assessment.  $R^2 = .044$  (Adjusted  $R^2 = .012$ ).

Table 4.15

*Descriptive Statistic Results for Total Word Count in Delayed Free Recall*

<b>Type of Student</b>	<b>Group</b>	<b>Mean</b>	<b>SD</b>	<b>n</b>
Regular education	Experimental	44.41	24.584	29
	Control	39.17	19.687	29
Special education	Experimental	36.43	23.611	21
	Control	30.76	22.219	17

*Note.* Dependent variable = total word count in delayed free recall assessment.  $SD$  = standard deviation;  $n$  = number of students;  $N$  = total number of participants =97.

As shown in Table 4.14, no statistical difference was found for TWC on the delayed free recall assessment. As shown in Table 4.15, a total of 96 students participated in the Delayed Free Recall (DFR) assessment. One student was consistently absent and did not complete the DFR.

### Analysis for Vocabulary in Delayed Free Recall

The results for the ANOVA vocabulary scores compared between experimental and control and regular and special education groups are presented in Table 4.16 and Table 4.17.

Table 4.16

*Descriptive Statistic Results for Vocabulary in Delayed Free Recall*

<b>Source</b>	<b>Type III Sum of Squares</b>	<b>df</b>	<b>Mean Square</b>	<b>F</b>	<b>Sig.</b>	<b>Partial <math>\eta^2</math></b>
Regular vs special education	1.065	1	1.065	5.847	.018	.060
Experimental vs control	.029	1	.029	0.157	.692	.002
Within Subject Interaction	2.128	1	2.128E-5	0.000	.991	.000

*Notes.* Dependent variable = vocabulary in delayed free recall assessment.  $R^2 = .061$  (Adjusted  $R^2 = .030$ ).

Table 4.17

*ANOVA Results for Vocabulary in Delayed Free Recall Descriptive Statistics*

<b>Type of Student</b>	<b>Group</b>	<b>Mean</b>	<b>SD</b>	<b>N</b>
Regular education	Experimental	0.31	0.471	29
	Control	0.28	0.528	29
Special education	Experimental	0.10	0.301	21
	Control	0.06	0.243	17

*Notes.* Dependent variable = vocabulary in delayed free recall assessment. *SD* = standard deviation; *n* = number of students; *N* = total number of participants =97.

As shown in Table 4.16, in the area of DFR measuring for vocabulary word count, no significant difference was noted between experimental and control groups ( $p = .692$ ). There was statistical significance in the area of regular and special education ( $p = .018$ ). On the DFR assessment, regular education students recorded more vocabulary words.

#### Experimental Group Analysis With Daily JIGSAW Practice

Students' notes from the experimental group were measured daily during their 8-day practice sessions. Each note-taking session was measured on a 6-point scale,

identifying their appropriate use of the JIGSAW strategy. The results from the descriptive statistics are presented in Table 4.18.

Table 4.18

*Experimental Group Descriptive Statistics for Daily Practice JIGSAW Score*

<b>Day</b>	<b><i>N</i></b>	<b>Minimum</b>	<b>Maximum</b>	<b>Mean</b>	<b><i>SD</i></b>
1	48	0	5	3.06	1.983
2	45	2	6	4.53	0.869
3	49	0	6	4.12	2.058
4	45	0	6	4.56	1.575
5	37	0	6	5.03	1.572
6	36	0	6	4.58	2.156
7	47	0	6	4.98	1.751
8	46	0	6	5.07	1.831

*Notes.* *n* = number of students who participated daily (experimental group); *N* = total number of participants = 97.

As shown in Table 4.18, students started out with a low average on Day 1 of appropriately using the JIGSAW scale ( $M = 3.06$ ) and progressed to their highest score on the final day of practice ( $M = 5.07$ ). The goal was for students to score 6 out of 6 daily on their practice notes by using the six letters of the JIGSAW acronym (1 letter/step = 1 point). Students scored an average of 4.49 out of the 6-point scale for the JIGSAW strategy. Students started off with an average of three points and by the eighth day were scoring an average of five out of six points, demonstrating an understanding of the JIGSAW strategy.

#### Analysis Between Measures

A Pearson Correlation was used to determine a possible correlation between notes recorded (TWC and Vocabulary) with student achievement (multiple-choice posttest). This compared the two factors of note-taking to the level of achievement (multiple-choice posttest). This was analyzed with all groups in the study. The results are shown in Table 4.19.

Table 4.19  
*Analysis Between Measures Correlations*

		<b>Posttest Total Word Count</b>	<b>Posttest Vocabulary</b>
Posttest Score on Multiple-Choice Assessment	Pearson Correlation	.192	.321*
	Sig. (2-tailed)	.060	.001
	<i>N</i>	97	97

\*Correlation is significant at the 0.01 level (2-tailed).

As shown in Table 4.19, the Pearson Correlation indicated that there is no significant correlation between posttest score on multiple-choice assessment and TWC recorded in posttest notes ( $p = .060$ ). However, a correlation was found between posttest score on multiple-choice assessment and vocabulary recorded in posttest notes ( $p = .001$ ). This shows a Pearson Correlation of 0.321, which represents a small to medium correlation. This shows a small correlation with the number of vocabulary words recorded for students in the posttest notes with their overall score for the posttest multiple-choice assessment. Therefore, students who recorded more vocabulary words scored higher on the multiple-choice posttest.

#### Social Validity Survey Responses

All students in the experimental group completed the Note-taking Student Survey (Appendix F). This survey required students to circle answers that best matched with their opinions (1 = *strongly disagree*, 2 = *disagree*, 3 = *agree*, 4 = *strongly agree*). Students were given eight questions about their views of the ease of use for the smartpen, the note-taking strategy, and whether or not they believed they had improved their note-

taking skills. Descriptive statistics were used to determine the percentage of answers selected. The results are shown in Table 4.20.

Table 4.20  
*Descriptive Statistics for Social Validity Survey Questions*

<b>Question</b>	<b>Mean</b>	<b>SD</b>
1: I liked this strategy more than my traditional note-taking strategy.	3.08	0.724
2: I felt that I took more notes using this strategy.	3.24	0.687
3: This note-taking strategy helped me remember lectures more clearly.	3.12	0.746
4: I felt more focused using this note-taking strategy than my traditional note-taking style.	2.98	0.795
5: Using the smartpen technology was quick to learn and easy to use.	3.48	0.646
6: I plan on continuing to use this note-taking strategy and the pen in the future.	2.78	0.790
7: In my opinion, I think this strategy and smartpen helped to improve my English grade.	2.88	0.689
8: I felt more relaxed while using the note-taking strategy and smartpen technology.	2.88	0.799

Fifty students participated in the experimental group and completed the note-taking survey forms. As shown in Table 4.20, students on average agreed with the first statement, “I liked this strategy more than my traditional note-taking strategy,” ( $M = 3.08$ ). Next, students responded “agree” for the second question, “I felt that I took more notes using this strategy,” the most common answer was also agree ( $M = 3.24$ ). Many students selected agree ( $M = 3.12$ ) for “this note-taking strategy helped me remember lectures more clearly.” In addition, students responded to the fourth question with a mean of 2.98, representing close to “agree,” in response to the statement, “I felt more focused using this note-taking strategy than my traditional note-taking style.” Regarding the fifth statement, a high average of students responded close to “strongly agree,” when responding to the statement, “using the smartpen technology was quick and easy to use”

( $M = 3.48$ ). For the sixth statement, students averaged in the disagree category, which stated, “I plan to continue using this note-taking strategy and pen in the future” ( $M = 2.78$ ). It should be noted that students were aware of the cost of the smartpen technology and considered this statement to represent purchasing their own product and using the strategy. Results showed the same mean for statements seven, with a mean of 2.88, representing “disagree,” for the statement, “In my opinion, I think this strategy and smartpen helped improve my English grade.” It should be noted that students were aware that they were not graded for the note-taking pre or posttest notes or assessments. Finally for statement eight, students responded with a mean of 2.88, representing “disagree,” to “I felt more relaxed while using the note-taking strategy and smartpen technology.”

#### Interviews for Social Validity

Fifteen students were selected to participate in the interview measure for social validity. Students from the experimental group were randomly selected to provide verbal responses based on the Interview Questions for Social Validity (Appendix E). The interview consisted of nine open-ended questions. All participants were assigned alternative names to maintain confidentiality.

Students were asked to describe their perceived ease of use with the smartpen and the strategy. George stated that learning the note-taking strategy and use of the smartpen was “very easy.” James explained, “I liked using it. It was really cool to be able to go back on my notes and like add what I forgot to add because I didn’t hear it well the first time so I was able to listen to it again.” Raul explained that the use of the note-taking strategy, “helped me realize that it’s not all about being fast . . . it’s about focusing on the teacher cues.” Patricia stated she liked using the smartpen and the strategy because now,

“I’m not rushed.” Jose explained that he preferred using the smartpen and note-taking strategy because it, “helps to hear recordings to know what the teacher said if you . . . missed it.”

Students were questioned about their perceptions of their note-taking skills before the study. Joseph answered, “I mean, I don’t have good long-term memory, so I probably wouldn’t remember as much as I did when I could record it with the [smart]pen.” Nathan stated, “I think my note-taking skills were . . . really sloppy so the smartpen helped a lot.” Brittany responded by saying, “I would say that I used to miss most of the notes, because I wouldn’t be able to remember them, but now I get most of them.” James explained that before the note-taking strategy was introduced, “I tried to write everything that I heard really quickly, but then again I would leave little things out.”

When asked if they believed their note-taking skills had improved or stayed the same after the study, Rebecca stated that she felt that her notes were “improved. I got a lot more notes.” Other students, such as Brittany and Tony felt that their notes had “stayed the same.” Students were also asked to describe their perceived level of focus during the smartpen and note-taking strategy. Bella explained that she felt more focused “just because of the recording aspect. You kind [of] had to write stuff in order to listen to it.” Yet Raul felt that he was, “less focused because it would just record it and it would make it easier to go back and write it down all over again in one shot instead of taking two chances to do it.”

Students were also questioned about what they disliked about the smartpen. Bella said, “it’s hard to hold and if people like coughed in the background that’s all you could hear over the talking.” Ralph stated, “I was a little nervous about losing the pen cap

sometimes . . . I also was afraid to lose some of the pen tips [because they were so small].” Raul explained that if he could change something about the pen, he would change, “the thickness where the tip of the pen is, because it’s a lot harder to write with a fatter pen.”

### Summary

The results from this study found that students who received the intervention recorded more TWC in posttest notes compared to the control group. Students in the experimental group also demonstrated a higher recording of vocabulary comparing pretest to posttest notes. They also demonstrated higher means for vocabulary recorded when comparing posttest to pretest assessments. Despite the fact that students did not demonstrate significant difference between groups on multiple-choice posttest, differences were found on the IFR measure with regard to TWC. The data shows significance among students in the experimental group for both regular and special education, with a higher average of TWC recorded in the IFR posttest assessment compared with the respective control group. The control group of both regular and experimental recorded a higher difference in mean vocabulary in the IFR comparing pretest to posttest. No statistical difference was found for TWC on the DFR assessment, yet the regular education students recorded more vocabulary compared with the special education students. In addition, a Pearson Correlation found statistical significance with the posttest score and vocabulary recorded in posttest notes ( $p = .001$ ). A small to medium correlation was noted (0.321). Therefore, students who recorded more vocabulary words during the lectures scored higher on the multiple-choice posttest.

The data from the social validity assessment signify that the majority of students involved in the experimental group agreed with the use of the smartpen and note-taking strategy. Furthermore, they agreed that the smartpen and note-taking strategy assisted them in recording more notes, remember the lectures more clearly and contribute to increasing their focus on the lecture. The means were in the high 2s, representing “disagree” (it should be noted that the means were close to 3, representing “agree,”  $M = 2.88$  and  $2.78$ ) when asked about their plans to continue using the smartpen and note-taking strategy in the future and whether or not they felt that it affected their ELA grade. Results from the interview questions showed that students in the experimental group responded positively towards the ease of use of the smartpen and note-taking strategy. In addition, some participants believed that the strategy and smartpen helped improve their overall notes, whereas others felt that their notes had “stayed the same.”

## CHAPTER 5

### DISCUSSION

The purpose of this research study was to provide an intervention using the smartpen assistive technology and the researcher-created JIGSAW note-taking strategy. Students in the intervention group demonstrated mastery of the JIGSAW strategy in conjunction with the smartpen assistive technology by completing the JIGSAW student quiz (Appendix I) and by demonstrating increased mean Total Word Count (TWC) in daily practice JIGSAW scores.

Using a pre and posttest design, several significant results were found. ANCOVA results showed statistical significance among pre and posttest TWC in notes within the experimental groups. Therefore, students who received the intervention recorded more notes during the lecture than students in the control group. In addition, students who received the intervention demonstrated improved recall, as measured by TWC in their Immediate Free Recall (IFR). Finally, the social validity assessments found positive results by students who received the intervention strategy. Students within the experimental group “strongly agreed” that the strategy was easy to use and “agreed” that they took more notes while using the intervention.

Previous studies have found that special education students with learning disabilities struggle with slower cognitive processing speed and, therefore, are unable to keep the pace with the lecture (Kennedy & Ihle, 2012). However, with the use of this study’s intervention, students improved their note-taking skills, as demonstrated by their improved vocabulary and recall.

First, the experimental groups exceeded the number of total words recorded in the posttest notes measure, when compared to the control group. Within this measure, students in the experimental groups recorded a higher average of words in the posttest notes compared to the pretest notes. The special education students within the experimental group recorded a 50% increase in average total words recorded, and the regular education experimental group recorded a 21.5% increase in average total words from the pre to posttest notes measure. Furthermore, when observing posttest TWC among the special education groups, the special education experimental group recorded an increased average of 71.93 words, or 54.3% more, when compared to the special education control group in the posttest notes. This shows that the use of the note-taking strategy with the smartpen technology assisted student note-taking by helping them to easily identify missing content and amend their notes.

Second, students who received the intervention recorded more vocabulary words in their posttest notes when compared to students within the control group. Special education students in the experimental group increased the amount of vocabulary words recorded by 167%, when compared to pretest notes. Furthermore, regular education students in the experimental groups made gains by increasing the number of vocabulary words recorded by 123%. This shows that the use of the intervention helped students record more vocabulary words in their notes.

Third, both special and regular education students within the experimental group demonstrated a higher TWC on the posttest IFR measure, when compared to the control group. ANCOVA results for the pre and posttest TWC in the IFR showed statistical significance between experimental and control. When comparing pretest to posttest IFR,

the combined experimental group (e.g., special education and general education) improved their TWC. Students within the overall experimental group demonstrated an 82% increase of total words recorded in posttest notes when compared to pretest notes. These results indicate that students who received the intervention were able recall more lecture information.

While previous studies have indicated that students with slower transcription speeds struggle with recording notes (Piolat et al., 2005), using the smartpen note-taking intervention helped to circumvent this issue because students were able to go back to their notes and retrieve portions of the lecture that they had missed. Social validity assessments indicated that students “strongly agreed” that the smartpen technology was easy to use and “agreed” that they took more notes by using the JIGSAW intervention strategy. The results from the interview portion of my study showed that students felt the use of the smartpen directly assisted them in recording more notes. Results from the questionnaire show that students who received the intervention felt strongly that they took more notes during this strategy and that the intervention helped them to remember lectures more clearly. Students on average “agreed” that they liked the JIGSAW strategy more than their traditional note-taking strategy and agreed that the strategy helped them remember lectures more clearly.

The findings from this study support previous note-taking research. Previous research has suggested that the act of note-taking leads to an increase in student’s access to working memory and processing of the material (Carrier & Titus, 1979; Just & Carpenter, 1992). Students in the experimental group had access to the smartpen technology, which provided them with the opportunity to repeat selections from the

lecture and add content to their notes (Van Schaack, 2009). The data from this study also support previous research that students who are trained in note-taking strategies improve their TWC in notes (Boyle & Weishaar, 2001). In addition, students in the intervention were able to score significantly higher in notes recorded compared with the control groups. This finding concurs with Tsai and Wu's 2010 study, which also found that providing strategic note-taking training to students resulted in them recording more information from lectures and conversations. Moreover, in Suirtsky's study, students who used the AWARE note-taking strategy increased content in notes by 26% (Suirtsky, 1992b). With the JIGSAW strategy and assistive technology, the special education students within the experimental group increased the content they recorded from lectures by 82% compared to the pretest notes.

In addition, a Pearson correlation was used to identify possible correlations between note-taking (including TWC and vocabulary) and student achievement as measured by the posttest score. Although no significant correlation was found between posttest score and TWC, a small to medium Pearson correlation of  $r = .321$  was identified between the vocabulary words recorded in student notes and multiple-choice assessments. This finding indicates that students who recorded more vocabulary had higher scores on the multiple-choice posttest assessment.

One disappointing finding was that experimental students did not perform statistically better than students in the control group on the multiple-choice assessment measure. Other note-taking intervention studies (Kobayashi, 2005) seem to confirm this finding, yet have hypothesized that cued assessment measures (e.g., multiple-choice) may not be sensitive enough to detect learning differences that are a result of a note-taking

intervention. Kobayashi (2005) conducted a meta-analysis and found that across 57 studies, those that provided noncued measures, (free-recall assessments) had a higher weighted effect size compared to cued measures (multiple-choice assessments). According to Kobayashi, the recognition test provided “lots of retrieval cues, whereas the recall test condition demands learners to create retrieval cues more autonomously” (p. 256).

Despite not finding significant differences on the cued measure (e.g., multiple-choice assessment) between experimental and control groups, students using the intervention did show significant differences on the IFR noncued measure. Students who are asked to respond to noncued assessments (e.g., IFR) often struggle with recalling information from lectures (Kiewra & Benton, 1988). When students in this study were provided with the intervention, they performed better on pre to post IFR, as measured by TWC. The IFR assessment required students to provide content without receiving lecture cues for specific information. Kobayashi suggested that the purpose of note-taking is to assist students in collecting information with minimal retrieval cues required to recall the information. This suggestion concurs with the student’s increased content information applied on the IFR assessments in this study. Success is not about the number of words that the students write; it is instead about the content and vocabulary words that students can recall from notes (IFR).

The lack of improvement in the posttest assessment can possibly be attributed to three factors: less time for studying, lack of effect toward ELA grades, and/or lack of written or visual cues. First, students were provided with the digitally recorded lecture and then were provided with the multiple-choice assessment in a timed period of five

minutes. Special education students may have scored higher on the assessment if they were provided with additional time to study and a studying strategy. Second, all students performed lower on the posttest assessments compared with the pretest. It is possible that students presented less motivation for scoring highly on the assessment because the scores did not contribute to their ELA grades. Instead, students were told to try their best on the assessments. Third, students may have struggled with audiological processing or identifying cued lecture points. Students may have performed better if they were provided with visual cued lecture points, such as visual cues written on the board or presented at the beginning of the lecture on a worksheet. This visual information may have aided students with to identifying vocabulary words, definitions, and specific content.

The results from this study have several implications for ELA teachers in inclusive classrooms, including training students with a note-taking strategy, utilizing spoken cues, and writing vocabulary terms on the board. Furthermore, students may benefit if teachers provide additional time for students to amend their notes (more than five minutes) and also permit them to take their notes home to study. This study showed that students who were provided with training in the JIGSAW note-taking strategy were able to record more lecture points. Students who were provided with direct instruction were less likely to choose weak strategies that led to partial or incomplete notes (Bui et al., 2013). Teachers should implement the JIGSAW strategy and the assistive technology in their ELA classrooms to assist students in the note-taking process. If implemented, teachers should provide direct instruction on the JIGSAW note-taking strategy and require students to memorize the acronym and the steps of the process. Teachers should

also evaluate student's use of the smartpen technology and make sure that students are correctly using the pen with the specific JIGSAW steps, such as "Jump to record." If students do not complete the first step, they will not have the use of the recorded notes and will lose the ability to go back and review the audio version of the lecture. For students to have the ability to record lecture points, it is imperative that teachers provide spoken lecture cues. These can be stated by saying, "it is important to remember that . . ." or "you should write this down."

Another aspect that could have improved this study is to require teachers to write vocabulary words on the board. During the observation of student notes, many students struggled with recording and spelling vocabulary words based on the lecture. Instead, teachers should spell vocabulary words, proper names, and provide a visual cue as well for all vocabulary words—either by writing the words on the board or providing them earlier to the students. This strategy will assist students with spelling and identification of the important vocabulary terms. Furthermore, teachers should also consider providing students with more time to amend their notes. With this study, students were given five minutes to amend and review their notes for missing information. Within this study, students were not able to study their notes or take them home to study prior to the multiple-choice assessment. Therefore, teachers should provide their students with a period of time to study their notes.

While there were positive results in this study, it is also important to note the limitations of this study. The limitations of this study included overall sample size, using the technology only in the ELA classroom, and restricted time to amend their notes. First, a limitation in this study was the overall sample size, including the size for students with

disabilities. Despite having a considerable sample size of 97 students, it would have been beneficial to have a larger sample for the control and experimental groups. This would ideally provide a larger portion of special education students as well. Given the sample size of this study, only 42 students were identified as having learning disabilities, and these students were split between experimental and control groups. Future studies should consider using this intervention with larger groups of students with disabilities.

Second, students were provided with the smartpen technology only in their ELA classes and not throughout their content courses or school day. In this study, students were only provided with the opportunity to use the assistive technology during the 90-minute ELA classes. These students might have benefitted from using the note-taking intervention with other subject areas. Doing so would have given them more practice time and allowed them to generalize the intervention to other subject matter.

Another limitation is restriction in time period given for students to amend their notes. It is imperative that students have ample time to participate in the amending process of their notes. This gives students the opportunity to review their notes for missing information and to listen to the lecture and fill in the gaps within their notes. For the study to be effective, students should be provided with ample time to review the audio version of the lecture and amend their notes with information that they had missed due to slow transcription speed, working memory, or encoding functions. The timed period of five minutes should be extended. In addition, students were not provided with the opportunity to take the smartpen technology home with them to study their notes as a homework activity. Students should be required to study their notes at home to increase

their knowledge of the content. If students were provided with the opportunity to take the technology home, they would have ample time to both amend and then study their notes.

Overall, this results of this study found that the use of the researcher-created JIGSAW strategy assisted both regular and special education students in taking better notes. The cost of a Livescribe Echo smartpen ranges from \$130 to \$200, depending on the amount gigabytes preferred. The purchase of the smartpen comes with the notepad with the special dot paper and ink cartridges (pen tips). Given the results of this study, students who receive direct instruction in the JIGSAW strategy take more complete notes with the smartpen and retain more information in their working memory. Furthermore, the cost of a smartpen is significantly less than other assistive technology devices that can be used for note-taking, such as an iPad or tablet device. For example, an iPad ranges from \$400 to \$500, which is considerably more than the cost of a smartpen device.

In addition, the use of the smartpen provides the look of normalcy in the high school classroom; they are using what appears to be the same device as all of the other students in the class: a pen. Whereas students who are provided with an iPad or tablet to take notes during class may feel outcast or alone in their different methods of note-taking styles. One of the goals of this study was to provide students with a note-taking intervention that can be used in inclusive classrooms without bringing additional attention to the student by using a noticeable piece of assistive technology. With the use of the smartpen, students stated that they felt that they took more notes and remembered lectures more clearly.

In conclusion, the findings from this study illustrate three main points. First, special education students within the experimental group recorded more information

(TWC) on the IFR measure when compared to all other groups (e.g., regular education, control group). First, special education students within the experimental group recorded an increase of 33.3% of average TWC, and regular education experimental group recorded an increase of 17.7% of average TWC, when comparing students notes from pre to post. Furthermore, when observing posttest TWC among the special education groups, the special education experimental group recorded an increased average of 54.3% more, when compared to the special education control group in the posttest notes. Second, the experimental group recorded a higher number of vocabulary words when compared to students within the control group on their posttest notes. Special education students within the experimental group increased the amount vocabulary words recorded by 62.5%, and the regular education experimental group increased by 55.2%, when compared to the pretest notes. Third, special education students within the experimental group demonstrated a stronger recall, as measured by TWC on the IFR measure. The intervention was clearly successful on this measure as students within the special education experimental group increased their TWC by 82% when comparing pre to posttest IFR.

The results indicated that the act of taking notes provided a framework to assist students in identifying and recording information and content. Students who were trained in the study were able to record more notes compared to students in the control group. Similarly, students in the experimental group were able to recall more content when given a free-recall assessment. Students who received the intervention indicated that the smartpen was easy to use. With the use of the JIGSAW strategy, students felt that they took more organized notes during lectures. Overall, the use of the smartpen technology

and the JIGSAW strategy should continue to be used and researched in ELA classrooms to assist students with learning disabilities during the note-taking process.

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## APPENDIX A

### PARENTAL LETTER AND CONSENT FORM

**Title of the Research:** Smartpen Technology and Note-taking Strategy on Achievement for Students with Disabilities in Secondary English Classes

**Investigator and Department:** Rachael Joyce, M.Ed.,  
Education Doctoral Student Researcher, and Dr. Joseph Boyle, Temple University  
Associate Professor, Special Education Teaching & Learning  
367 Ritter Hall  
1301 Cecil B. Moore Ave.  
Philadelphia, PA 19122  
phone: (215) 204-1099

Dear Parents and Guardians,

We invite you to take part in this research study because your child is participating in an English 9 education class, in either an inclusive or learning support classroom. This study is designed to evaluate the effects of a specific note-taking strategy in conjunction with the assistive technology of the Livescribe 4GB Echo Smartpen™, to determine the effects of high school students' note-taking skills, specifically in the areas of comprehension, vocabulary skills and total words written. With the use of this voice and text recording pen, students in the experimental group are hypothesized to have increased scores in comprehension, vocabulary and content.

Some students will be taught to use the *smartpens* and others, in a control group, will be using traditional note-taking. Your child will be given an identification number, and he or she will not be identified by name. If you decide for your child to be in this research study, you will be asked to sign this consent form. If you decide for your child to be in this research study, your child will be asked to record notes using *smartpen* or he or she will be asked to record notes with their traditional note-taking methods.

In addition, the researcher will review your child's English Language Arts school record to collect previous marking period grades. The researcher will also send you a demographic information request form, identifying your child's native language, age and whether or not he or she receive special education services.

There are no foreseeable risks to participation in this study. You will be made aware of any significant new findings that may change your decision to remain in this study. Your child's performance in this study will not be used to assess his/her intelligence, compare him/her with other students, affect his/her grades, nor affect his/her standing in school.

Your consent for your child's participation in this study is voluntary. You may decide for your child not to participate in this study. If you decide your child may be in the study, your child may withdraw from the study at any time with no penalty of any kind. The alternative to have your child participate in this project is to not have him/her participate.

**Who can I talk to about this research?**

Participation in this research study is voluntary and requires signed permission from both the parent or guardian and the student involved. If you or your child has questions, concerns or complaints, please contact the research team at (215) 630-4472. This research has been reviewed and approved by an Institutional Review Board. You may talk to them at (215) 707-3390 or e-mail them at [irb@temple.edu](mailto:irb@temple.edu) with any questions or concerns.

**Why is this research being done?**

Previous research has shown that some students struggle with note-taking skills due to the speed of the lecture and poor note-taking skills. Most students generally record less than half of the critical ideas presented in the lecture (Rahmani & Sadeghi, 2011). There is less information for students to review for upcoming assessments if they are not recording important lecture points. One study found that both high and low ability students showed higher comprehension after specific instruction and practice in taking notes (Faber, Morris & Lieberman, 2000). It is hypothesized that students who are provided with the specific note-taking intervention, in combination with the assistive technology of the *smartpen* will have increase scores in the area of vocabulary, and total words written.

**How long will the research process occur?**

This research study will take place over 20 class periods and will not change the curriculum presented to the students in any way. There are no foreseeable risks, or inconveniences to the subjects who are participating in this research.

**What happens to the information collected for this research?**

To the extent allowed by law, we limit the viewing of personal information to people who have to review it. We cannot promise complete secrecy. The IRB, Temple University, Temple University Health System, Inc. and its affiliates, and other representatives of these organizations may inspect and copy your information to make sure that the study team is following the rules and regulations regarding research and the protection of human subjects.

Throughout this study, information will be recorded and stored. This will occur with students both in the experimental group and the control group. Students in the experimental group will be working with the *smartpen* technology, which will record audio versions of the lecture as well as .pdf documents of each student's notes. After the posttest, all student information from the *smartpen* will be transferred to a locked computer and each copy of student information will be recoded into a unique number for each individual student. In addition, both students in the experimental and control group will record hard copies of their notes and assessments during the pretest, practice sessions and posttest. All notes will be collected and stored with the researcher. Student names will be removed and re-identified with a unique number for each student. Information will be maintained for up to 3 years, in case further review is required.

No information will be shared with teachers who are not assigned as classroom teachers to the students. No information will be shared with school administration. Any information that is reviewed by Temple University researchers will not have student contact information on the copies and will instead be labeled by a unique student number to be used throughout the data collection of the study. For the practice sessions, students in both groups will receive hard copies of their own notes in order to study for the regular English curriculum materials.

**Will being in the research help my student in any way**

We cannot promise any benefits to your child from taking part in this research. However, possible benefits include increased understanding of specific note-taking skills, improved total word count and vocabulary words and definitions recorded in notes, and higher achievement scores on lecture-based assessments.

**Directions:** Please complete the section below if you would like your child to participate in this research study. Thank you.

**Signature Block for Child Parent/Guardian**

Your signature documents your permission for the child named below to take part in this research.

\_\_\_\_\_  
Printed name of child (Student)

\_\_\_\_\_  
Signature of parent or legal guardian providing consent

\_\_\_\_\_  
Date

\_\_\_\_\_  
Printed name of parent or legal guardian providing consent

**Please indicate whether parent or guardian below:**

\_\_\_\_\_ Parent

\_\_\_\_\_ Guardian

## APPENDIX B

### STUDENT LETTER AND ASSENT FORM

**Title of the Research:** Smartpen Technology and Note-taking Strategy on Achievement for Students with Disabilities in Secondary English Classes

**Investigator and Department:** Rachael Joyce, M.Ed.,  
Education Doctoral Student Researcher, and Dr. Joseph Boyle, Temple University  
Associate Professor, Special Education Teaching & Learning  
367 Ritter Hall  
1301 Cecil B. Moore Ave.  
Philadelphia, PA 19122  
phone: (215) 204-1099

Dear Students,

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This assent form may contain words that you do not understand. Your teacher will read this to you as you read along. Please ask the researcher or your parent or teacher to explain any words or information that you do not understand before signing this document.

**What you should know about this research study:**

- Someone will explain this research study to you.
- You volunteer to be in this research study, whether you take part is up to you.
- You can agree to take part now and later change your mind.
- Whatever you decide, it will not be held against you.
- Feel free to ask all the questions you want before and after you decide.

**Who can I talk to about this research?**

Participation in this research study is voluntary and requires signed permission from both the parent or guardian and the student involved. If you or your parent or guardian has questions, concerns or complaints, please contact the research team at (215) 630-4472. This research has been reviewed and approved by an Institutional Review Board. You may talk to them at (215) 707-3390 or e-mail them at [irb@temple.edu](mailto:irb@temple.edu) with any questions or concerns.

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technology of the *smartpen* will have increase scores in the area of vocabulary, and total words written.

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**What happens to the information collected for this research?**

To the extent allowed by law, we limit the viewing of personal information to people who have to review it. We cannot promise complete secrecy. The IRB, Temple University, Temple University Health System, Inc. and its affiliates, and other representatives of these organizations may inspect and copy your information to make sure that the study team is following the rules and regulations regarding research and the protection of human subjects.

Throughout this study, information will be recorded and stored. This will occur with students both in the experimental group and the control group. Students in the experimental group will be working with the *smartpen* technology, which will record audio versions of the lecture as well as .pdf documents of each student's notes. After the posttest, all student information from the *smartpen* will be transferred to a locked computer and each copy of student information will be recoded into a unique number for each individual student. In addition, both students in the experimental and control group will record hard copies of their notes and assessments during the pretest, practice sessions and posttest. All notes will be collected and stored with the researcher. Student names

will be removed and re-identified with a unique number for each student. Information will be maintained for up to 3 years, in case further review is required.

I will do everything that I can to protect the confidentiality of your records. I will also keep this information confidential by limiting individual's access to the research data and keeping it in a secure location. No information will be shared with teachers who are not assigned as classroom teachers to the students. No information will be shared with school administration. Any information that is reviewed by Temple University researchers will not have student contact information on the copies and will instead be labeled by a unique student number to be used throughout the data collection of the study. For the practice sessions, students in both groups will receive hard copies of their own notes in order to study for the regular English curriculum materials.

**Will being in the research help my academics in any way?**

We cannot promise any benefits to you from taking part in this research. However, possible benefits include increased understanding of specific note-taking skills, improved total word count and vocabulary words and definitions recorded in notes, and higher achievement scores on lecture-based assessments.

**Directions:** Please complete the section below if you would like to participate in this research study. Thank you.

**Signature Block for Child Participant**

Your signature documents your permission to take part in this research.

---

Signature of person obtaining assent (Student)

---

Date

---

Printed name person obtaining assent (Student)

## APPENDIX C

### TEACHER LETTER AND CONSENT FORM

**Title of the Research:** Smartpen Technology and Note-taking Strategy on Achievement for Students with Disabilities in Secondary English Classes

**Investigator and Department:** Rachael Joyce, M.Ed.,  
Education Doctoral Student Researcher, and Dr. Joseph Boyle, Temple University  
Associate Professor, Special Education Teaching & Learning  
367 Ritter Hall  
1301 Cecil B. Moore Ave.  
Philadelphia, PA 19122  
phone: (215) 204-1099

Dear Teacher,

We invite you to take part in this research study because your students are participating in an English 9 education class, in either an inclusive or learning support classroom. This study is designed to evaluate the effects of a specific note-taking strategy in conjunction with the assistive technology of the Livescribe 4GB Echo Smartpen™, to determine the effects of high school students' note-taking skills, specifically in the areas of comprehension, vocabulary skills and total words written. With the use of this voice and text recording pen, students in the experimental group are hypothesized to have increased scores in comprehension, vocabulary and content.

Some students will be taught to use the *smartpens* and others, in a control group, will be using traditional note-taking. All students in the class will be given an identification number, and students will not be identified in this study by name. If you decide for your classroom to participate in this research study, you will be asked to sign this consent form. Furthermore, for any students to be involved, they must provide a signed parent consent form and a student assent form to be included in the study.

Students who are not included will continue with their traditional note-taking methods throughout the regularly scheduled lessons.

There are no foreseeable risks to participation in this study. You will be made aware of any significant new findings that may change your decision to remain in this study. Your students' performance in this study will not be used to assess their intelligence, compare with other students, affect their grades, nor affect their standing in school.

Your consent for your class to participate in this study is voluntary. You may decide for your classroom not to participate in this study.

### **Who can I talk to about this research?**

Participation in this research study is voluntary and requires signed permission from both the parent or guardian and the student involved. If you have questions, concerns or complaints, please contact the research team at (215) 630-4472. This research has been reviewed and approved by an Institutional Review Board. You may talk to them at (215) 707-3390 or e-mail them at [irb@temple.edu](mailto:irb@temple.edu) with any questions or concerns.

### **Why is this research being done?**

Previous research has shown that some students struggle with note-taking skills due to the speed of the lecture and poor note-taking skills. Most students generally record less than half of the critical ideas presented in the lecture (Rahmani & Sadeghi, 2011). There is less information for students to review for upcoming assessments if they are not recording important lecture points. One study found that both high and low ability students showed higher comprehension after specific instruction and practice in taking notes (Faber, Morris & Lieberman, 2000). It is hypothesized that students who are

provided with the specific note-taking intervention, in combination with the assistive technology of the *smartpen* will have increase scores in the area of vocabulary, and total words written.

**How long will the research process occur?**

This research study will take place over 20 class periods and will not change the curriculum presented to the students in any way. There are no foreseeable risks, or inconveniences to the subjects who are participating in this research.

**What happens to the information collected for this research?**

To the extent allowed by law, we limit the viewing of personal information to people who have to review it. We cannot promise complete secrecy. The IRB, Temple University, Temple University Health System, Inc. and its affiliates, and other representatives of these organizations may inspect and copy your information to make sure that the study team is following the rules and regulations regarding research and the protection of human subjects.

Throughout this study, information will be recorded and stored. This will occur with students both in the experimental group and the control group. Students in the experimental group will be working with the *smartpen* technology, which will record audio versions of the lecture as well as .pdf documents of each student's notes. After the posttest, all student information from the *smartpen* will be transferred to a locked computer and each copy of student information will be recoded into a unique number for each individual student. In addition, both students in the experimental and control group will record hard copies of their notes and assessments during the pretest, practice sessions and posttest. All notes will be collected and stored with the researcher. Student names

will be removed and re-identified with a unique number for each student. Information will be maintained for up to 3 years, in case further review is required.

No information will be shared with teachers who are not assigned as classroom teachers to the students. No information will be shared with school administration. Any information that is reviewed by Temple University researchers will not have student contact information on the copies and will instead be labeled by a unique student number to be used throughout the data collection of the study. For the practice sessions, students in both groups will receive hard copies of their own notes in order to study for the regular English curriculum materials.

**Will being in the research help my student in any way?**

We cannot promise any benefits to your students from taking part in this research. However, possible benefits include increased understanding of specific note-taking skills, improved total word count and vocabulary words and definitions recorded in notes, and higher achievement scores on lecture-based assessments.

**Directions:** Please complete the section below if you would like your classroom to participate in this research study. Thank you.

**Signature Block for Teacher**

Your signature documents your permission for your English 9 classroom to take part in this research.

---

Signature of person providing consent (Teacher)

---

Date

---

Printed name person providing consent (Teacher)

APPENDIX D  
FIDELITY CHECKLIST

Rachael Joyce  
Temple University

Directions for Researcher: Mark each space with a check mark when step is completed.

Class \_\_\_\_\_ Date: \_\_\_\_\_

**Pretest Session for Experimental and Control Group**

- \_\_\_\_\_ Welcome students participating in the study
- \_\_\_\_\_ Instruct students to watch the video and participate with their traditional note-taking strategy
- \_\_\_\_\_ Provide students with blank, lined paper to take notes
- \_\_\_\_\_ Instruct students to write their name and the date at the top
- \_\_\_\_\_ Play the video lecture on Mark Twain
- \_\_\_\_\_ Have students turn in their notes on the lined paper
- \_\_\_\_\_ Provide students with blank paper for the Immediate Free Recall
- \_\_\_\_\_ Instruct students to write their name and the date on the blank paper
- \_\_\_\_\_ Instruct students to write as much as they remember from the lecture, for a period of 3 minutes
- \_\_\_\_\_ Collect the IFR notes from students
- \_\_\_\_\_ Explain to students that they will now take a 20-question quiz focusing on the lecture
- \_\_\_\_\_ Provide students with the quiz

\_\_\_\_\_ Remind them to write their name and date on the quiz

\_\_\_\_\_ Allow students time to complete the quiz

\_\_\_\_\_ Collect the quiz from students

### **Training Session for Experimental Group - Day 1:**

\_\_\_\_\_ Welcome students participating in the study

\_\_\_\_\_ Introduce smartpen strategy with brief description of smartpens and strategy

\_\_\_\_\_ Ask students about problems they encounter when recording notes in classes

\_\_\_\_\_ Explain the purpose of the study to students

\_\_\_\_\_ Discuss traditional note-taking

\_\_\_\_\_ Discuss strategic note-taking

\_\_\_\_\_ Introduce the smartpen technology

\_\_\_\_\_ Explain how to identify lecture cues

\_\_\_\_\_ Explain how to identify vocabulary words and definitions

\_\_\_\_\_ Provide students with Identifying Lecture Points practice worksheet

\_\_\_\_\_ Instruct students to identify each cued lecture point

\_\_\_\_\_ Discuss correct answers with class

\_\_\_\_\_ Introduce the JIGSAW strategy

\_\_\_\_\_ Provide students with the JIGSAW Training Worksheet for Students

\_\_\_\_\_ Have students rewrite the meaning of the acronym JIGSAW

\_\_\_\_\_ Have students fold the paper in half and try to define each letter

\_\_\_\_\_ Instruct students in the importance of Amending Notes

\_\_\_\_\_ Instruct students how to amend notes with red pen tip and listening to audio

- \_\_\_\_\_ Have students practice the first three steps, JIG (Jump to record, initiate notes, grab vocabulary and lecture cues)
- \_\_\_\_\_ Have students practice the next two steps, SA (scan for missing information and amend notes)
- \_\_\_\_\_ Instruct students to amend at least 6 notes each time
- \_\_\_\_\_ Teach students how to Write a summary using at least three sentences
- \_\_\_\_\_ Provide students with the JIGSAW Student Checklist for Note-taking
- \_\_\_\_\_ Encourage students to study for the JIGSAW student quiz tomorrow

**Day 2:**

- \_\_\_\_\_ Individually quiz students on their knowledge of the JIGSAW steps
- \_\_\_\_\_ Students must demonstrate 100% mastery of each JIGSAW step
- \_\_\_\_\_ Trainer reviews JIGSAW steps with students
- \_\_\_\_\_ Students are provided with an assigned smartpen number and folder
- \_\_\_\_\_ Students are instructed to use assigned smartpen and folder daily in English class
- \_\_\_\_\_ Students are instructed to use JIGSAW checklist daily after amending notes

**Posttest Session for Experimental and Control Group**

- \_\_\_\_\_ Welcome students to the final video lecture of the study
- \_\_\_\_\_ Instruct students to watch the video and participate with their traditional note-taking strategy
- \_\_\_\_\_ Provide students with blank, lined paper to take notes
- \_\_\_\_\_ Instruct students to write their name and the date at the top

- \_\_\_\_\_ Play the video lecture on Edgar Allan Poe
- \_\_\_\_\_ Have students turn in their notes on the lined paper
- \_\_\_\_\_ Provide students with blank paper for the Immediate Free Recall
- \_\_\_\_\_ Instruct students to write their name and the date on the blank paper
- \_\_\_\_\_ Instruct students to write as much as they remember from the lecture, for a period of 3 minutes
- \_\_\_\_\_ Collect the IFR notes from students
- \_\_\_\_\_ Explain to students that they will now take a 20-question quiz focusing on the lecture
- \_\_\_\_\_ Provide students with the quiz
- \_\_\_\_\_ Remind them to write their name and date on the quiz
- \_\_\_\_\_ Allow students time to complete the quiz
- \_\_\_\_\_ Collect the quiz from students

**Delayed Free Recall Assessment for Experimental and Control Group**

- \_\_\_\_\_ Welcome students to the final measurement of the study
- \_\_\_\_\_ Ask students to recall the last video lecture on the topic of Edgar Allan Poe
- \_\_\_\_\_ Provide the class with blank note paper
- \_\_\_\_\_ Instruct students to write their name and date on the top of the paper
- \_\_\_\_\_ Instruct students to write as much information as they remember from the video lecture, including lecture cues and vocabulary words
- \_\_\_\_\_ Time students for a period of 3 minutes
- \_\_\_\_\_ Collect all student assessments

## APPENDIX E

### INTERVIEW QUESTIONS FOR SOCIAL VALIDITY

This interview were provided to 10 randomly selected special education students and five general education students in the experimental group. Below are the interview questions. Answers were recorded with audio versions and transcribed for analysis.

#### **Questions**

1. What are your thoughts about using:
  - a. The smartpen strategy?
  - b. The smartpen?
2. How would you describe your note-taking skills before this strategy was introduced?
3. Do you think your note-taking skills have improved or stayed the same after the use of this strategy and smartpen? If you think they have improved, in what way?
4. Do you think you were more or less focused while using this new technology and strategy? If more, explain why.
5. What was your favorite thing about using the smartpen?
6. What did you dislike about using the smartpen?
7. Do you think using the smartpen is complicated and has too many steps to use, without instruction?
8. What do you typically struggle with the most in English class?
9. If you could change anything about the smartpen, what would you change and why?

APPENDIX F

NOTE-TAKING STRATEGY STUDENT SURVEY

**Name:** \_\_\_\_\_ **Date:** \_\_\_\_\_

1. I liked this strategy more than my traditional note-taking strategy.

Circle the number that you agree with:

1 = strongly disagree      2 = disagree  
3 = agree                      4 = strongly agree

2. I felt that I took more notes using this strategy.

Circle the number that you agree with:

1 = strongly disagree      2 = disagree  
3 = agree                      4 = strongly agree

3. This note-taking strategy helped me remember lectures more clearly.

Circle the number that you agree with:

1 = strongly disagree      2 = disagree  
3 = agree                      4 = strongly agree

4. I felt more focused using this note-taking strategy than my traditional note-taking style.

Circle the number that you agree with:

1 = strongly disagree      2 = disagree  
3 = agree                      4 = strongly agree

5. Using the smartpen technology was quick to learn and easy to use.

Circle the number that you agree with:

- 1 = strongly disagree      2 = disagree  
3 = agree      4 = strongly agree

6. I plan on continuing to use this note-taking strategy and pen in the future.

Circle the number that you agree with:

- 1 = strongly disagree      2 = disagree  
3 = agree      4 = strongly agree

7. In my opinion, I think this strategy and smartpen helped to improve my English grade.

Circle the number that you agree with:

- 1 = strongly disagree      2 = disagree  
3 = agree      4 = strongly agree

8. I felt more relaxed while using the note-taking strategy and the smartpen technology.

Circle the number that you agree with:

- 1 = strongly disagree      2 = disagree  
3 = agree      4 = strongly agree

**Directions:** Answer each question in the space provided.

9. What did you like about using the note-taking strategy and smartpen?

10. What did you dislike about using the note-taking strategy and smartpen?

APPENDIX G

JIGSAW TRAINING WORKSHEET FOR STUDENTS

Name: \_\_\_\_\_ Date: \_\_\_\_\_

**JIGSAW Strategy**

- J = Jump to tap Record
- I = Initiate the notes
- G = Grab key vocabulary and content
- S = Scan for missing information
- A = Amend notes by listening to pen
- W = Write a brief summary of lecture

**Directions:** Rewrite what each letter of JIGSAW means on the space below.

J \_\_\_\_\_

I \_\_\_\_\_

G \_\_\_\_\_

S \_\_\_\_\_

A \_\_\_\_\_

W \_\_\_\_\_

**Directions:** Fold the paper in half. Now try to define each letter without looking at the answer key.

J \_\_\_\_\_

I \_\_\_\_\_

G \_\_\_\_\_

S \_\_\_\_\_

A \_\_\_\_\_

W \_\_\_\_\_

## APPENDIX H

### JIGSAW STUDENT CHECKLIST FOR NOTE-TAKING

Name: \_\_\_\_\_ Date: \_\_\_\_\_

#### **JIGSAW Strategy**

J = Jump to tap Record

I = Initiate the notes

G = Grab key vocabulary and content

S = Scan for missing information

A = Amend notes by listening to pen

W = Write a brief summary of lecture

**Directions:** Check off each item that you have completed while listening to the lecture.

\_\_\_\_\_ J. Did I *jump* to tap the record button on the notepad with the smartpen?

\_\_\_\_\_ I. Did I *initiate* the notes by writing my name, class period, and date?

\_\_\_\_\_ G. Did I *grab* key vocabulary words and content by writing them down?

**Directions:** After note-taking, check the following steps.

\_\_\_\_\_ S. Did I *scan* my notes for missed vocabulary definitions or missing content?

\_\_\_\_\_ A. Did I *amend* my notes by changing my pen-tip to red and listening to the  
specific points in the lecture?

\_\_\_\_\_ W. Did I *write* a brief summary of the lecture using 1–3 sentences?

APPENDIX I  
JIGSAW STUDENT QUIZ

Name: \_\_\_\_\_ Date: \_\_\_\_\_

**Directions:** Fill in the blank for each letter of the JIGSAW note-taking strategy. If you do not get it right the first time, you are able to try again.

J \_\_\_\_\_

I \_\_\_\_\_

G \_\_\_\_\_

S \_\_\_\_\_

A \_\_\_\_\_

W \_\_\_\_\_

J \_\_\_\_\_

I \_\_\_\_\_

G \_\_\_\_\_

S \_\_\_\_\_

A \_\_\_\_\_

W \_\_\_\_\_

APPENDIX J

IDENTIFYING LECTURE POINTS: PRACTICE SHEET

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Period: \_\_\_\_\_

**Directions:** Write the acronym for the correct choice on the lines below.

**Cued Importance, Cued Organizational, or NonCued?**

CI – Cued Importance	CO – Cued Organizational	NC – NonCued
----------------------	--------------------------	--------------

\_\_\_\_\_ Teacher says, “There are three kinds of nouns: common nouns, proper nouns, and pronouns.”

\_\_\_\_\_ Teacher says, “You need to remember that a sonnet contains 14 lines, typically with two rhyming stanzas.”

\_\_\_\_\_ Teacher says, “A gerund is a noun formed from a verb by adding –ing (often known as an -ing word).”

\_\_\_\_\_ Teacher says, “Write this down, the dot over the lowercase letter “i” and “j” is called a superscript dot.”

\_\_\_\_\_ Teacher says, “Charles Dickens is best known for his three novels:  
1. Oliver Twist, 2. A Christmas Carol, and 3. A Tale of Two Cities.”

\_\_\_\_\_ Teacher says, “A sentence that contains all 26 letters of the alphabet is called a ‘pangram.’”

- \_\_\_\_\_ Teacher says, “You will need to remember that an adverb is a word used to modify verbs.”
- \_\_\_\_\_ Teacher says, “Only one word in English ends with the letters “mt.” It is dreamt.”
- \_\_\_\_\_ Teacher says, “It is important to remember that a haiku poem consists of three lines, with the first and last line having 5 syllables, and the middle line having 7.”
- \_\_\_\_\_ Teacher says, “It is important to know that Cuneiform script is one of the earliest known systems of writing that was used by the Sumerians of southern Mesopotamia.”
- \_\_\_\_\_ Teacher says, “You should know that when you write something down with a pen and paper, you are stimulating a part of your brain known as the reticular activating system.”
- \_\_\_\_\_ Teacher says, “There are four different types of adjectives, they are . . . .”
- \_\_\_\_\_ Teacher says, “The word ‘alphabet’ comes from the letters of the Greek alphabet: alpha and beta.”
- \_\_\_\_\_ Teacher says, “Write this down, a preposition is always followed by a noun, pronoun, or gerund.”

APPENDIX K  
MARK TWAIN SCRIPT

Twain Script

R. Joyce

**NC1.** Born on November 30<sup>th</sup>, 1835, in Missouri, Samuel L. Clemens wrote under the pen name Mark Twain and went on to pen several novels. Two of his major classics of American literature include *The Adventures of Tom Sawyer* and *Adventures of Huckleberry Finn*.

**NC2.** He was also a riverboat pilot, journalist, lecturer, entrepreneur and inventor. Twain died on April 21<sup>st</sup>, 1910, in Redding, Connecticut. Writing grand tales about Tom Sawyer, Huckleberry Finn and the mighty Mississippi River, Mark Twain explored the American soul with wit and a sharp eye for truth. He became a national treasure.

Let's first discuss Mark Twain's early life . . .

**C1.** The first thing that you should remember is that Samuel Clemens is also known by his pen name, Mark Twain.

“Sam” was born on November 30<sup>th</sup>, 1835, in the tiny village of Missouri. Sam Clemens later became known as Mark Twain, so as I describe his early life I will be calling him Sam Clemens and later on I will call him Mark Twain.

**NC3.** Sam was the sixth child of parents John and Jane Clemens. When he was 4-years-old, the Clemens family moved to nearby Hannibal, a bustling town of 1,000 people. Sam Clemens is best known for living in Hannibal Missouri, which is found on the banks of the Mississippi River.

**NC4.** John Clemens, Sam's father, worked as a storekeeper, lawyer, judge and **land speculator**. A **land speculator** buys land and tries to sell it for a large profit. John dreamed of wealth but never achieved it and sometimes found it hard to feed his family. John Clemens was an unsmiling fellow; according to one legend, young Sam never saw him laugh. His mother by contrast was a fun-loving, tenderhearted homemaker who would often tell her family stories in the evening. She became head of the household in 1847 when John Clemens died unexpectedly.

**C2.** It is important to remember that when Sam's father died his family became almost **destitute**, meaning extremely poor, and lacking food, clothing and shelter. Sam's family was forced into years of economic struggle—a fact that would shape the career into the promising writer, Mark Twain.

**NC5.** Sam lived in Hannibal from ages 4 to 17. It was also a slave state. Sam's father owned one slave and his uncle owned several. In fact, it was on his uncle's farm that Sam spent many boyhood summers playing in the slave quarters, listening to tall tales and the slave **spiritualists** that he would enjoy throughout his life. **Spiritualists** were popular during this period, and they believed in the communication with the dead.

**NC6.** The town Hannibal on the banks of the Mississippi was a great place to grow up. In town, there were revivalists who would often visit. The **revivalists**, also called clergy, would hold religious revivals and often pray. Other events included **minstrel** shows. A **minstrel** is a singer or musician who performs songs of poetry. Because of its location, steamboats would arrive in the town of Hannibal three times a day, tooting their whistles.

**NC7.** Despite the quaint living, violence was commonplace, and young Sam witnessed much death. When he was 9 years old he saw a local man murder a cattle rancher, and at 10 he watched a slave die after a white overseer struck him with a piece of iron. Sam was fearful as he watched these **impetuosities**, meaning sudden rash and violent actions.

**C3.** You should write this down . . . The town of Hannibal inspired several of Mark Twain's fictional locales, including 'St. Petersburg' in *Tom Sawyer* and *Huckleberry Finn*. These imaginary river towns are complex places: sunlit and **exuberant**, meaning lively and with energy and excitement. But his fictional towns also contained cruelty, poverty, drunkenness, loneliness, and life-crushing boredom. All of that had been a part of Sam Clemens' boyhood experience.

**C4.** This is also important . . . When Sam's father died, Sam needed to find a way to survive. So he found employment as an apprentice printer at the *Hannibal Courier*, which paid him with a meager ration of food. His job was to arrange the type for each of the newspaper's stories, allowing Sam to read the news of the world while completing his work.

**NC8.** Then in 1857, 21-year-old Clemens fulfilled a dream: He began learning how to pilot a steamboat on the Mississippi. Sam became a licensed pilot by 1859, and he soon found regular employment navigating the **shoals** and channels of the great river. A **shoal** is a place where a river has shallow water.

**C5.** Try to remember that the pseudonym Mark Twain, meant “two fathoms deep” on the Mississippi, and was called out on the steamboat to indicate the boat was in sufficiently deep water. Twain loved his career—it was exciting, well paying, and high-status, roughly akin to flying a jetliner today. However, his service was cut short in 1861 by the outbreak of the Civil War, which halted most civilian traffic on the river.

**NC9.** As the war began, the people of Missouri angrily split between support for the Union and the Confederacy. Clemens opted for the side of the **Confederacy**. The **Confederacy** represents the 11 Southern states that separated from the United States and attempted to create their own nation.

**C6.** It is important to note that Sam decided to join the Confederate Army in June of 1861, but he only served for a couple of weeks until his volunteer unit disbanded. Where would he find his future, bringing him both excitement and cash? His answer: the great American West.

**NC10.** In search of a new career, Sam headed west in July of 1861 at the invitation of his brother who had just been appointed Secretary of the Nevada Territory.

**C7.** You should remember that Sam chose to live in Nevada, and stayed there for the next five years. Lured by the infectious hope of striking it rich in Nevada's **silver rush**, Sam traveled across the open frontier from Missouri to Nevada by stagecoach. The **silver rush** attracted many visitors to the prospect mining silver ore in the Comstock Lode by Mount Davidson. Along the journey Sam encountered Native American tribes for the first time as well as a variety of unique characters, mishaps and disappointments. These events would find a way into his short stories and books, particularly *Roughing It*, which was later published in 1870, 8 years later. But at the time, his travels didn't work out for Sam. By the middle of 1862, he was flat broke and in need of a regular job.

**C8.** It's important to remember the title of Mark Twain's first published book, *Jim Smiley and His Jumping Frog*. It was his big break in 1865 when one of his tales about life in a mining camp was printed in newspapers and magazines around the country.

**NC11.** His next step up the ladder of success came in 1867. Twain was hired by the *Alta California* newspaper to write about his travels. Sam took a five-month sea cruise in the Mediterranean and provided humorous writings about the sights of the world. He also signed up for a steamship tour of Europe and the Holy Land. His travel letters, full of vivid descriptions and tongue-in-cheek observations, met with such audience approval that they were later reworked into his first book in 1869, *The Innocents Abroad*.

**NC12.** At age 34, this Westerner had become one of the most popular and famous writers in America. It was also on this trip that Twain met his future brother-in-law, Charles

Langdon. Langdon reportedly showed Twain a picture of his sister, Olivia, and Twain fell in love at first sight.

**C9.** It's important to note that this picture started a love affair between Twain and Olivia. And after courting for two years, Twain and Olivia or "Livy" were married in 1870. Livy was 24 years old at the time of her marriage and the daughter of a rich New York coal merchant. They settled in Buffalo, New York, where Twain had become a partner, editor and writer for the daily newspaper the *Buffalo Express*.

**C10.** You should write down that Twain and Livy had a total of four children. Their son was named Langdon Clemens. Then they moved to Hartford, Connecticut in 1871, and had their three daughters, Clara, Suzy and Jean. The family lived in Connecticut for 17 years, and while there Sam completed some of his most famous books.

**C11.** It is important to remember that some of Mark Twain's most famous works include: *The Adventures of Tom Sawyer* (1876) and *Life on the Mississippi* (1883) capturing both his Missouri memories and depictions of the American scene. Yet, his social commentary continued with titles such as *The Prince and the Pauper* (1881) exploring class relations and *A Connecticut Yankee in King Arthur's Court* (1889) which criticized oppression while examining the period's explosion of new technologies. And, in perhaps his most famous work, *Adventures of Huckleberry Finn* (1884), Twain attacked the institution of slavery and the continued poor treatment of African Americans in his own time.

*Huckleberry Finn* was also the first book published by Sam's own publishing company, The Charles L. Webster Company.

**C12.** You should note the success, or lack of success that Mark Twain had in the long run. Twain had a **fugacious** financial success, meaning a fleeting success that faded quickly. Even though his books were successful, he never achieved the long-term financial success he expected. Although Twain enjoyed financial success during his Hartford years, he continually made bad investments in new inventions which eventually brought him to bankruptcy. His publishing company also eventually went bankrupt.

**NC13.** Sure, he was well known, but he was not as rich as he had hoped due to poor investments. Probably the most famous American author of the late 19th century, he was much photographed and applauded wherever he went. Indeed, he was one of the most prominent celebrities in the world, traveling widely overseas, including a successful round-the-world lecture tour in 1895-'96, undertaken to pay off his debts.

**C13.** It is important to note another tragedy that struck Mr. Twain . . . the loss of his loved ones. Early in their marriage Twain and Livy lost their toddler son, Langdon to **diphtheria**. **Diphtheria** is an infectious disease caused by bacteria, which causes inflammation of the throat that hinders swallowing. It can also cause fatal heart and nerve damage by producing a bacterial toxin in the blood. This is currently prevented in our society with immunization methods.

**C14** A few years later, another loved one was lost with the death of his daughter. In 1896, Suzy died at the age 24 from **spinal meningitis**. The loss broke Twain's heart. **Spinal meningitis** is an inflammation of the spinal cord, and is usually fatal. It is caused by a strain of bacteria. It usually occurs with a fever and red spots on the skin.

**C15** You should remember that another trouble occurred with his youngest daughter. Twain's daughter Jean was diagnosed with severe **epilepsy** in the mid-1890s. In 1909, when she was 29 years old, she died. **Epilepsy** is a central nervous system or neurological disorder and therefore it is genetic and not caused by bacteria or contagious. It is seen with sudden and recurrent episodes of sensory disturbance, loss of consciousness, or convulsions, associated with abnormal electrical activity in the brain.

**C16.** Please remember that unfortunately, tragedy continued for Twain. In 1903, after living in New York City for three years, his wife Livy became ill and died a year later. After her death, Twain became somewhat bitter, even while projecting an **amiable persona** to his public. An **amiable persona** means to display a friendly or pleasant manner.

**C17.** It is important to note the date and age of Mark Twain's death. He died on April 21<sup>st</sup>, 1910, at the age of 74, at his country home in Redding, Connecticut. He is buried in Elmira, New York.

**C:** Cued lecture point

**N:** Non-cued lecture point

**Total Cued Lecture Points: 17**

**Total Vocabulary Words: 15**

List:

1. Land speculator
2. Destitute
3. Spiritualist
4. Revivalist
5. Minstrel
6. Impetuositities
7. Exuberant
8. Shoal
9. Confederacy
10. Silver rush
11. Fugacious
12. Diphtheria
13. Spinal Meningitis
14. Epilepsy
15. Amiable persona

**Total Words: 1958**

## APPENDIX L

### EDGAR ALLAN POE SCRIPT

Edgar Allan Poe Script

R. Joyce

**NC1.** Edgar Allan Poe is a major author in the literary world due to his short stories, poems and critical theories. Poe is often regarded in literary history as the architect of the modern short story. In his own work, he demonstrated a brilliant command of language and techniques as well as an inspired and original imagination.

Let's first discuss Edgar Allan Poe's early life . . .

**C1.** It is important to note the type of home and family that Edgar Poe was born into. Poe was born to traveling actors in Boston on January 19<sup>th</sup>, 1809. He was the second of three children.

**NC2.** His other brother William Poe would also become a poet before his early death, and his sister Rosalie Poe would grow up to teach **penmanship** at a Richmond girls' school. **Penmanship** is the art and skill of writing words by hand. *When* Poe was 3-years-old, both of his parents had died and he was taken in by the wealthy tobacco merchant John Allan and his wife in Richmond, Virginia. Poe's siblings went to live with other families.

**C2.** Remember who raised or reared Poe, it was the Allan family. Mr. Allan raised Poe to become a businessman and a Virginia gentleman. But Poe had dreams of being a writer like the British poet whom he **emulated**, Lord Byron. To **emulate** someone is to look up to them and desire to imitate them.

**NC3.** Early poetic verses were found in Poe's handwriting on the backs of Allan's **ledger sheets**, which shows how little interest Poe had in business. **Ledger sheets** are documents that contain records of financial accounts.

**C3.** Next, you should write down that Poe attended school in 1826 at the University of Virginia. Here, he excelled in his classes, but also accumulated a **cumbersome** debt. The word **cumbersome** means a burden or troublesome. The miserly Mr. Allan sent Poe to college with less than a third of the money he needed, and Poe soon took up gambling to raise money to pay his expenses. By the end of his first term Poe was so desperately poor that he had to burn his own furniture to keep warm.

**NC4.** Humiliated by his poverty and furious with Mr. Allan for not providing enough funds in the first place, Poe returned to home to Richmond, Virginia.

**C4.** You should remember that after his failure to find enough money to stay in the University, Poe decided to join the United States Army in 1827. He was 18-years-old. Poe had no money, no job skills, and had been shunned by Mr. Allan. Poe did reasonably well in the U.S. Army and attained the rank of Sergeant Major. Poe later joined West

Point Academy in hopes of becoming a high-ranking officer, but was kicked out and expelled from the program. During this time period, he had also learned that his foster parents Mr. and Mrs. Allan had died only a few years apart. Mr. Allan did not include Poe in the will and he therefore had no money to his name.

**C5.** It's important to note that Poe then went looking for some of his blood relatives. He found refuge with his Aunt, Maria Clemm and his cousin, Virginia. Aunt Maria became a new mother to Poe and she welcomed him into her home. His cousin Virginia first acted as a courier to carry Poe's love letters, but Virginia herself soon became the object of Poe's desire.

**C6.** This is important. Poe was one of the first famous authors who tried to make a full career and live financially off of his writing alone. Poe lived with the Clemm's in poverty and had started publishing his short stories, one of which won a contest.

**NC5.** The connections Poe established through the contest allowed him to publish more stories and to eventually gain an editorial position at the *Southern Literary Messenger* in Richmond. It was at this magazine that Poe finally found his life's work as a magazine writer.

**C7.** You should recognize Poe's success with the magazine the *Messenger*. Within a year, Poe had made it the most popular magazine in the south with his sensational stories as well as with his scathing book reviews. He had increased magazine **circulation** from

500 to 3500 copies. **Circulation** of a magazine means the amount being produced and distributed to the public.

**NC6.** Poe soon developed a reputation as a **dauntless** critic who not only attacked an author's work but also insulted the author and the northern literary establishment. The word **dauntless** means without fear or intimidation. Poe targeted some of the most famous writers in the country. One of his victims was the **anthologist** and editor Rufus Griswold. An **anthologist** is a writer with a collection of writings, usually in the same literary form.

**C8.** You should note that Poe actually married his cousin, Virginia! At the age of 27, Poe brought his Aunt Maria and her daughter, Poe's cousin, Virginia Clemm to Richmond. Poe courted and later married his cousin Virginia, who was not yet fourteen. The marriage proved a happy one, and the family is said to have enjoyed singing together at night. Virginia expressed her devotion to her husband.

**NC7.** Poe and Virginia were married for 10 years before her untimely death.

**C9.** You should remember where Poe lived next. Poe moved to Philadelphia in 1838 and wrote for a number of different magazines. He served as editor of *Burton's* and then *Graham's* magazines while continuing to sell articles to *Alexander's Weekly Messenger* and other journals.

**NC8.** In spite of his growing fame, Poe was barely able to make a living. For the publication of his first book of short stories, *Tales of the Grotesque and Arabesque*, he was only paid with twenty-five free copies of his book. The word **arabesque** in the title means a complicated design or intricate pattern. Many of his writings also showed his unique interest in **cryptography**. **Cryptography** is the art of writing and solving secret codes, which were often placed in newspapers.

**C10.** You should note that Poe wanted to start his own journal, called *The Penn*, as he was living in Philadelphia. He also wanted authors to make more money for their work. Most authors were given only \$9 dollars for their short stories. To change the face of the magazine industry, Poe proposed starting his own journal, but he failed to find the necessary funding.

**C11.** Now you need to remember what happened to Poe's young bride. Tragedy struck in 1842 when Poe's wife contracted **tuberculosis**, the disease that had already claimed Poe's mother, brother, and foster mother. **Tuberculosis** is a bacterial infection that can spread through the lymph nodes and bloodstream to any organ in your body. It is most often found in the lungs. In the winter of 1847 that Virginia died at the age of twenty-four. Poe was devastated, and was unable to write for months. His critics assumed he would soon be dead. The bacteria that cause tuberculosis is transmitted through the air and therefore, the disease can be contagious. There was no cure for tuberculosis until antibiotics were created in the 1950's.

**C12.** Yet, Poe survived. Remember that Poe then tricked the literary world. In search of better opportunities, Poe moved to New York again in 1844 and introduced himself to the city by perpetrating a **hoax**. A **hoax** is to trick or deceive others by telling them a lie. His “news story” of a balloon trip across the ocean caused a sensation, and the public rushed to read everything about it—until Poe revealed that he had fooled them all.

**C13.** It’s important to remember the published story that brought Poe success: The January 1845 publication of *The Raven* made Poe a household name. *The Raven* made Poe famous and he drew large crowds to his lectures. He was also beginning to demand better pay for his work.

**NC9.** He also published two other books that year, and briefly lived his dream of running his own magazine when he bought out the owners of the *Broadway Journal*.

**C14.** You should take note of Poe’s mysterious death: Poe died in Baltimore on October 7, 1849 at the age of 40. The exact cause of Poe’s death is an **enigma**. An **enigma** is a puzzling or inexplicable situation. Poe was found in the bar room of a public house that was being used as a polling place for an election.

**NC10.** A magazine editor had sent Poe to Washington College Hospital, where Poe spent the last days of his life far from home and surrounded by strangers.

**C15.** You should remember that Poe's first biographer, the person who told his life story, was actually one of his biggest enemies, his publishing rival Rufus Griswold. He wrote a **libelous** obituary about Edgar Allen Poe. **Libelous** means to write with unjust injury of falsely of another person. Griswold wrote negatively about Poe to attempt revenge for some of the offensive things Poe had said and written about him.

**NC11.** Griswold wrote a memoir about Poe and portrayed him as a drunken, womanizing madman with no morals and no friends. Griswold's attacks were meant to cause the public to dismiss Poe and his works, but the biography had exactly the opposite effect and instead drove the sales of Poe's books higher than they had ever been during the author's lifetime. Griswold's distorted image of Poe created the Poe legend that lives to this day while Griswold is only remembered as Poe's first biographer.

**C16.** You should be able to identify the types of writing that Poe was famous for, which were many short stories and narrative poems. Poe's versatile writings include short stories, poetry, a novel, a textbook, a book of scientific theory, and hundreds of essays and book reviews. He had a gift for suspense and delightfully twisted plots. But his real gift was his ability write for people who crave the **macabre**. Macabre means involving death or violence in a way that is strange, frightening, or unpleasant.

**NC12.** Poe could see into the darkest corners of the human mind. He lived and died in poverty. He was a man whose loved ones died from tuberculosis. Poe knew dark places so well because he had so often been there himself. His writing style was called **dark**

**romanticism** of the time period. **Dark romanticism** is considered a literary genre mainly about pain and agony in romance.

**NC13.** He wrote spooky stories in part because he knew they would sell. Though he professed to be in the writing business just for the money, Poe nonetheless changed American literature forever. You don't need to look much farther than today's bestseller lists to see that America still loves a good suspense story.

**C17.** You should remember the titles of his most famous works. These include short stories that have been in print since 1827. These include: *The Tell-Tale Heart*, *The Raven*, and *The Fall of the House of Usher*. The name Poe brings to mind images of murderers and madmen, premature burials, and mysterious women who return from the dead. He is widely acknowledged as the inventor of the modern detective story and an innovator in the science fiction genre, but he made his living as America's first great literary critic and author. Poe is seen as a morbid, mysterious author lurking in the shadows of moonlit cemeteries or crumbling castles. This is the Poe of legend.

**C:** Cued lecture point

**N:** Non-cued lecture point

**Total Cued Lecture Points: 17**

**Total Vocabulary Words:**

1. Penmanship
2. Ledger sheets
3. Emulate
4. Circulation
5. Cumbersome
6. Cryptology
7. Dauntless
8. Anthologist
9. Arabesque
10. Hoax
11. Enigma
12. Libelous
13. Macabre
14. Tuberculosis
15. Dark romanticism

**Total Word Count: 1950**

APPENDIX M  
MARK TWAIN QUIZ

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Period: \_\_\_\_\_

Mark Twain Quiz

**Directions:** Write the correct answer on the corresponding line.

\*The correct answers are highlighted for the purpose of publication in this dissertation.

\_\_\_\_\_ 1. What types of jobs did Twain have?

- A. Court recorder and typist
- B. Farmer and banker
- C. Lawyer, accountant, and farmer
- D. Riverboat pilot, journalist, and lecturer

\_\_\_\_\_ 2. Which of the following is the best definition of **silver rush**?

- A. The attraction of visitors with the prospect of mining silver ore in the West
- B. An attempt to buy and sell silver at quickly and without notice
- C. Visitor collecting coins from auctions
- D. Lack of finances leading people to steal silver from stores

\_\_\_\_\_ 3. What does the name Mark Twain mean?

- A. Two fathoms deep, in terms of the water
- B. A large mountain peak, up in the clouds
- C. Someone who is motivated to succeed
- D. A jealous and cruel person

\_\_\_\_\_ 4. Which of the following is the best definition of **spinal meningitis**?

- A. Similar to the whooping cough, a contagious illness
- B. An inflammation of the spinal cord which is usually fatal; it's contagious
- C. A genetic disorder that causes seizures
- D. An illness which causes spots all over the body

\_\_\_\_\_ 5. What is Mark Twain's pseudonym (other name)?

- A. Samuel Collins
- B. Simon Clemens
- C. Samuel Clemens
- D. Simon Collins

\_\_\_\_\_ 6. Where did Sam stay for five years, which inspired the story *Roughing It*?

- A. The Philippines
- B. New York
- C. Philadelphia
- D. Nevada

\_\_\_\_\_ 7. Which of the following is the best definition of **minstrel**?

- A. A singer or musician who performs songs of poetry
- B. A large festival or bazaar
- C. A circular amphitheater
- D. A conductor of a large band

\_\_\_\_\_ 8. What book was Sam's first big break and first published book in 1865?

- A. Huckleberry Finn
- B. The Innocents Abroad
- C. California Truths
- D. Jim Smiley and His Jumping Frog

\_\_\_\_\_ 9. Which of the following is the best definition of **impetuosities**?

- A. Acting cool, calm and collected
- B. Sudden rash and violent actions
- C. Commanding attention from others
- D. Slowly building emotions

\_\_\_\_\_ 10. What happened to Twain's wife in 1903?

- A. She left Twain for another man and later divorced him
- B. She took the children and left Twain alone
- C. She died and left Twain bitter
- D. She moved away without telling Twain her location

\_\_\_\_\_ 11. Who did Sam marry?

- A. Olivia Langdon
- B. Samantha Clemens
- C. Cynthia Butterfields
- D. Beatrice Ashcroft

\_\_\_\_\_ 12. Which of the following is the best definition of **amiable persona**?

- A. A person who displays a negative and cruel personality
- B. To isolate oneself from others
- C. A person who displays empathy and sympathy for others
- D. To display a friendly or pleasant manner

\_\_\_\_\_ 13. How many children Twain and his wife have together?

- A. one child
- B. two children
- C. three children
- D. four children

\_\_\_\_\_ 14. Which of the following are some of Mark Twain's most famous works?

- A. Life on the Highway, Roughing It
- B. Adventures of Huckleberry Finn, Tom Sawyer
- C. Roughing It, Nevada Inspired Memoirs
- D. Truths of Twain

\_\_\_\_\_ 15. What happened to Twain's youngest daughter, Jean?

- A. She died from epilepsy
- B. She died spinal meningitis
- C. She died from diphtheria
- D. She ran away from home and married in Europe

\_\_\_\_\_ 16. Which of the following is the best definition of **epilepsy**?

- A. Someone who talks very quickly and without control
- B. A contagious illness that causes body sores
- C. A disorder in the central nervous system that is hereditary and not contagious
- D. A disease that causes skin irritation

\_\_\_\_\_ 17. How successful was Mark Twain financially?

- A. He became incredibly wealthy based on his investments
- B. Twain had a fleeting financial success that faded quickly
- C. Twain lived life as bankrupt and incredibly poor writer
- D. Twain received an increase of funds from his publications

\_\_\_\_\_ 18. What dream job did Twain end up fulfilling in 1857?

- A. He became a general in the army
- B. He went to Nevada for the silver rush
- C. He worked as a riverboat pilot
- D. He was employed as a professional lawyer

\_\_\_\_\_ 19. Which of the following is the best definition of **destitute**?

- A. Missing a loved one
- B. To be dehydrated and malnourished
- C. Extremely poor, lacking food, clothing, and shelter
- D. To be extremely wealthy and prosperous

\_\_\_\_\_ 20. How did Twain first find out about the love of his life?

- A. He met her at a restaurant and bar
- B. Her brother Charles showed Twain a picture of her
- C. Twain met her on a lecture tour in Europe
- D. Twain was introduced to her by his parents

APPENDIX N

EDGAR ALLAN POE QUIZ

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Period: \_\_\_\_\_

Edgar Allan Poe Quiz

**Directions:** Write the correct letter on the corresponding line.

\*The correct answers are highlighted for the purpose of publication in this dissertation.

\_\_\_\_\_ 1. Which of the following is the best definition of **anthologist**?

- A. A person who studies humanity including traditions and culture
- B. A writer with a collection of writings, usually in the same literary form
- C. A writer with a variety of writings in all categories
- D. A person who studies human anatomy and behaviors

\_\_\_\_\_ 2. Why do Poe's autobiographers believe he wrote stories based on horror?

- A. To express his grief
- B. He genuinely enjoyed scaring people
- C. To provide classic literary suspense to the public
- D. He knew they would be easy to sell

\_\_\_\_\_3. Which of the following is the best definition of **macabre**?

- A. Involving death or violence in a way that is strange, frightening or unpleasant
- B. A pleasant memory or experience
- C. Diction or word choice
- D. A drudging or uninteresting tale

\_\_\_\_\_4. How did Poe trick the literary world in 1844?

- A. He wrote about a false hot-air balloon trip over the ocean.
- B. He published an inaccurate novel about singing crickets.
- C. He wrote a false story in the newspaper about a contagious disease.
- D. He published a column giving advice to others through a fake name.

\_\_\_\_\_5. What story published in 1845 brought Poe his vast success and recognition?

- A. The Tales of the Headless Horseman
- B. The Tell-Tale Heart and the Fanatical Skeleton
- C. The Raven
- D. The Macabre and Miseries

\_\_\_\_\_6. Which blood relatives did Poe later find?

- A. His long lost parents
- B. His sister and brother
- C. His aunt and cousin
- D. His uncle and cousin

\_\_\_\_\_7. Which of the following is the best definition of **ledger sheets**?

- A. Documents that contain records of financial accounts
- B. Medical history records
- C. Training documents for aspiring writers
- D. Graphic organizers for writers

\_\_\_\_\_8. What type of home was Edgar Allan Poe born into?

- A. A family of actors, who died before he was 3 years old.
- B. A wealthy family who ranked high in society
- C. A European family who had recently moved to America
- D. A poor, farm working family

\_\_\_\_\_9. Who was Edgar Allan Poe's first biographer?

- A. Rupert Grint
- B. Randolph Gallaway
- C. Gregory Roger
- D. Rufas Griswold

\_\_\_\_\_10. Which of the following is the best definition for **circulation**?

- A. The amount being produced or distributed to the public
- B. To collect illegal document from the public
- C. To conceal secret documents from the public
- D. To reproduce copyright material

- \_\_\_\_\_ 11. What type of writing did Poe publish?
- A. Various short poems
  - B. Short stories and narrative poems
  - C. Dramatic novels focusing on detective work
  - D. Dramatic love stories
- \_\_\_\_\_ 12. What represents the earliest work of Poe's?
- A. His secret publications in the local newspaper
  - B. His love letters to ladies he was courting
  - C. Poetic verses written on the back of ledger sheets
  - D. His novel, The Tell-Tale Heart
- \_\_\_\_\_ 13. Where did Poe live in 1838, after his wife's death?
- A. Poe moved to Albany, New York
  - B. Poe moved to Charleston, Virginia
  - C. Poe moved to Atlanta, Georgia
  - D. Poe moved to Philadelphia, Pennsylvania
- \_\_\_\_\_ 14. Which of the following is the best definition of **dark romanticism**?
- A. A time period during the bubonic plague
  - B. Long lost love stories from the dark ages
  - C. A literary genre about pain and agony in romance
  - D. A literary genre about true love and great courtship

\_\_\_\_\_15. What school did Poe attend in 1826?

- A. University of Albany
- B. University of Pennsylvania
- C. University of Virginia
- D. New York University

\_\_\_\_\_16. Which of the following is the best definition of **cumbersome**?

- A. Convenient and simple
- B. Light and small
- C. Burden or troublesome
- D. Helping or aiding

\_\_\_\_\_17. What caused the death of Poe's young bride?

- A. She was sick while at sea and died on her travels
- B. She contracted tuberculosis
- C. She committed suicide after years of poverty
- D. She died of cancer

\_\_\_\_\_18. In addition to being an author, what else did Poe do for employment?

- A. He worked as a literary critic
- B. He worked on his neighbors farm
- C. He wrote obituaries for the local newspaper
- D. He wrote an advice column under a pseudonym

\_\_\_\_\_19. Which of the following is the best definition of **arabesque**?

- A. Expressing plain or simplicity
- B. A complicated design or intricate pattern
- C. Transparent or clear items
- D. Sparkly and shimmering

\_\_\_\_\_20. What did Poe attempt that was unique to authors at the time?

- A. To write more novels than any other author
- B. Make a full career out of his writing and live off of his profits
- C. Buy multiple publishing companies
- D. Set a record for fastest typewriting speed

APPENDIX O

PERCENTAGE CHANGE FOR TOTAL WORD COUNT ON IFR NOTES

**Change in Total Words in IFR Notes**

Experimental Group					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-90.00	1	2.0	2.0	2.0
	-87.00	1	2.0	2.0	4.0
	-74.00	1	2.0	2.0	6.0
	-68.00	1	2.0	2.0	8.0
	-55.00	1	2.0	2.0	10.0
	-44.00	1	2.0	2.0	12.0
	-41.00	1	2.0	2.0	14.0
	-26.00	1	2.0	2.0	16.0
	-15.00	1	2.0	2.0	18.0
	2.00	1	2.0	2.0	20.0
	3.00	1	2.0	2.0	22.0
	4.00	1	2.0	2.0	24.0
	9.00	1	2.0	2.0	26.0
	11.00	1	2.0	2.0	28.0
	17.00	2	4.0	4.0	32.0
	18.00	1	2.0	2.0	34.0
	31.00	1	2.0	2.0	36.0
	33.00	1	2.0	2.0	38.0
	34.00	1	2.0	2.0	40.0
	37.00	1	2.0	2.0	42.0
	38.00	1	2.0	2.0	44.0
	40.00	1	2.0	2.0	46.0
	41.00	1	2.0	2.0	48.0
	43.00	1	2.0	2.0	50.0
	44.00	2	4.0	4.0	54.0
	47.00	1	2.0	2.0	56.0
	52.00	1	2.0	2.0	58.0
	55.00	2	4.0	4.0	62.0

64.00	1	2.0	2.0	64.0
65.00	1	2.0	2.0	66.0
72.00	1	2.0	2.0	68.0
74.00	1	2.0	2.0	70.0
75.00	1	2.0	2.0	72.0
77.00	1	2.0	2.0	74.0
79.00	1	2.0	2.0	76.0
81.00	1	2.0	2.0	78.0
86.00	1	2.0	2.0	80.0
93.00	1	2.0	2.0	82.0
95.00	1	2.0	2.0	84.0
96.00	2	4.0	4.0	88.0
99.00	2	4.0	4.0	92.0
108.00	1	2.0	2.0	94.0
115.00	1	2.0	2.0	96.0
158.00	1	2.0	2.0	98.0
159.00	1	2.0	2.0	100.0
Total	50	100.0	100.0	

a. Ex/Con = EX

### Change in Total Words in IFR Notes

Control Group					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-119.00	1	2.1	2.1	2.1
	-99.00	1	2.1	2.1	4.3
	-81.00	1	2.1	2.1	6.4
	-79.00	1	2.1	2.1	8.5
	-76.00	1	2.1	2.1	10.6
	-64.00	1	2.1	2.1	12.8
	-62.00	1	2.1	2.1	14.9
	-47.00	1	2.1	2.1	17.0
	-46.00	1	2.1	2.1	19.1
	-40.00	2	4.3	4.3	23.4
	-39.00	3	6.4	6.4	29.8
	-33.00	1	2.1	2.1	31.9
	-29.00	1	2.1	2.1	34.0
	-25.00	1	2.1	2.1	36.2
	-24.00	2	4.3	4.3	40.4
	-23.00	1	2.1	2.1	42.6
	-22.00	1	2.1	2.1	44.7
	-19.00	1	2.1	2.1	46.8
	-15.00	1	2.1	2.1	48.9
	-13.00	1	2.1	2.1	51.1
	-8.00	1	2.1	2.1	53.2
	-6.00	2	4.3	4.3	57.4
	-5.00	1	2.1	2.1	59.6
	-3.00	1	2.1	2.1	61.7
	1.00	1	2.1	2.1	63.8
	6.00	1	2.1	2.1	66.0
	8.00	2	4.3	4.3	70.2
	12.00	1	2.1	2.1	72.3
	22.00	1	2.1	2.1	74.5
	24.00	1	2.1	2.1	76.6

30.00	1	2.1	2.1	78.7
37.00	1	2.1	2.1	80.9
40.00	1	2.1	2.1	83.0
41.00	1	2.1	2.1	85.1
45.00	1	2.1	2.1	87.2
63.00	1	2.1	2.1	89.4
69.00	1	2.1	2.1	91.5
75.00	1	2.1	2.1	93.6
80.00	1	2.1	2.1	95.7
82.00	1	2.1	2.1	97.9
101.00	1	2.1	2.1	100.0
Total	47	100.0	100.0	

a. Ex/Con = CON

APPENDIX P

SCHOOL DISTRICT LETTER OF SUPPORT



LETTER OF SUPPORT

December 8<sup>th</sup>, 2015

To Whom It May Concern:

[Redacted] would be pleased to serve as the research site for your proposed dissertation study, "Smartpen Technology and Note-Taking Strategy on Achievement for Students with Disabilities in Secondary English Classes." We support the participation of our English Language Arts teachers to help implement the intervention developed by the project and to collect data in the classrooms during this project. The emphasis on helping student's record better notes to improve their achievement makes this study very timely and useful to our students. This research will produce valuable research in vocabulary, comprehension and overall note taking skills for high school students with disabilities.

Since this project is of high interest to our teachers, I do not anticipate any problems identifying teachers interested in participating in this study. This study is greatly welcomed by our teachers because students are increasingly using assistive technology to record notes for their classes.

Thank you for inviting [Redacted] to take part in this research study. I am very excited about the potential of our partnership with this study, and look forward to soon hearing about its results.

Sincerely,

A large black rectangular redaction box covering the signature of the principal.

Principal