THE IMPACT OF GUIDED DOODLE NOTE-TAKING ON READING COMPREHENSION: A QUASI-EXPERIMENTAL STUDY

by

Kayla Lorraine DeWald

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

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ABSTRACT

The purpose of this quasi-experimental nonequivalent control-group study is to determine the impact of guided doodle note-taking strategies on middle school students' reading comprehension. The importance of this study is the impact the data makes on the best practices of teacher instruction. The sample size is 101 students set in a city district in the Southeast United States. The students vary in socioeconomic levels, with many of them falling below the poverty line and representing a wide variety of ethnicities and races. Data was collected using pre- and post-test practices. The instrument utilized was the Reading Comprehension Scale. Data were analyzed using an analysis of covariance, ANCOVA. Results are discussed by RQ. The results are found to not be statistically significant, and the research was unable to reject the null hypotheses. It is concluded that any form of note-taking is beneficial for middle school students. Future research on what constitutes as non-verbal stimuli in regard to memory is recommended as well as a study spanning a longer amount of time.

Keywords: reading comprehension, doodle notes, middle schools, ANCOVA

Dedication

I am dedicating this dissertation to Grandmama DeWald, who supported me in all my decisions and would have been so proud of me for completing my doctorate.

I love you and miss you, Grandma. (April 28, 1939 – January 10, 2021).

I am also dedicating this dissertation to my daddy. I am so thankful to have such an amazing father figure to look up to, who encourages me to make the best choices in my life, and who is always there to be my sounding board. Thank you, Daddy, for always supporting my dreams to reach for the moon, even when I land among the stars. I love you.

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I would like to acknowledge my village for allowing me to put the effort toward completing this degree. I am so thankful to have a community of people who support me throughout all my crazy notions, including randomly deciding to get my Ph.D.

My daddy for always believing in me.

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My brother and sister, Bruin and Tori, for providing the competition in the family.

My best friends, Carla and Melanie, for being my hype women no matter what.

My DSS workers for working with me as I navigated through fostering and school.

My foster and adoptive babies for loving me while we stayed up for hours writing papers.

Thank you, to everyone who has been involved in my life and gotten to see the craziness that I bring to everyone. I appreciate the consistent support and love.

I also thank God for guiding me through these past few years. I pray that I continue to serve Him in the way which he has planned. I pray that this dissertation is "gracious, seasoned with salt," and provides guidance for teachers who are looking to best serve their students.

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CHAPTER ONE: INTRODUCTION

Overview

The purpose of this quasi-experimental nonequivalent control-group study was to determine the impact of guided doodle note-taking strategies on middle school students' reading comprehension. Chapter One provides a background for the topics of note-taking and doodling. Included in the background is an overview of the theoretical framework for this study. The problem statement examines the scope of the recent literature on this topic. The purpose of this study is followed by the significance of the current study and the research questions. The chapter concludes with a list of key terms and their definitions.

Background

Doodling is often defined as aimless sketching completed when one is bored or otherwise not cognitively engaged (Amico & Schaefer, 2019; Nash, 2021). Despite the use of the word "aimless" in the official definition, doodling while listening to a lecture or absorbing some other form of information can improve retention. When studied, structured and unstructured doodling helps students with remembering what they have learned in class (Sundararaman, 2020). Doodling has also been shown to prevent mental wandering and daydreaming (Tadayon & Afhami, 2017). It allows students to maintain focus on the lecture and their learning rather than focusing on other thoughts.

In addition, doodling increases visual literacy along with graphics and text. Doodling, sketch noting, and the use of mind maps incorporate what is known as "dual coding theory" where researchers determined that students learn better when information is presented in both visuals and text (Paivio, 1974). They are a form of visual thinking that incorporates constructivist

strategies such as creativity, personal application of learning, and independent thought (Zeyab et al., 2020). These skills are important when considering encoding and recalling information.

Historical Overview

Note-taking is a popular strategy for learning and processing. It is common practice in classrooms for students to take notes in class (Kobayashi, 2005; Peverly & Wolf, 2019). Note-taking is an effective practice because students are processing and synthesizing the information while they are writing. The process of writing notes requires students to be actively engaged in the material being presented and has been shown to increase recall (Nayar & Koul, 2019). This active engagement benefits students by creating deeper levels of understanding (Bohay et al., 2011). Note-taking is also an effective practice because it provides a method of offloading new information to allow for more cognitive activities to take place (Makany et al., 2009).

Notes are typically thought of as words written down on a page, but the concept is a bit more complex. Notes can look different depending on the requirements and the student. Some fields, such as medicine and veterinary sciences, require students to draw diagrams in their notes (Kobayashi, 2006). Guided notes are an option that are utilized for students who need more structure. This is used in situations where students need help taking notes or are designated to have guided notes as an accommodation for class (Beserra et al., 2019; Chen et al., 2017). Notes can also be taken using visual strategies. Sketch-noting and other visual note-taking strategies are utilized when the note-taker wishes to portray the material using imagery. This strategy requires students to synthesize the material and associate the verbal information with imagery, creating a better connection in the brain (Zeyab et al., 2020).

Doodling as an art and method of communication has been found dating back to the ancient Egyptians. The hieroglyphics found written on cave walls are examples of using visual

representations of information (Ali et al., 2021). The practice of doodling, however, is often seen as a negative behavior in the classroom. A student who is doodling during a lecture is considered to be off-task (Beserra et al., 2019).

Doodling as a technique for visual learning and building connections has been considered in research. Andrade (2010) studied the impact of doodling on participants' recall ability when hearing a telephone message. This study utilized structured doodles by encouraging participants to shade in pre-drawn shapes while listening to the recorded message. The findings showed that participants who shaded in the shapes had a higher retention rate compared to the participants who simply listened. Andrade (2010) suggested utilizing this information for cognitive performance purposes, which could apply to educational settings.

Society-at-Large

Understanding the impact of doodling during lectures could impact educational practices. Visual representation of words has been shown to increase recall and memory (Wammes et al., 2017). Doodling has also been shown to reduce mind wandering and daydreaming by providing the brain with an engaging, yet not focused task (Boggs et al., 2017; Meade et al., 2019; Schott, 2011). However, disassociation between the doodling and the information results in stress and a feeling of being overwhelmed (Lewis & Moffett, 2020). Understanding the balance will help educators utilize this information in the classroom.

It is also imperative to provide guidance on note-taking as well as doodling when expecting students to take notes during a lesson. Guided notes provide an option for teacher assisted note-taking, but also allows for students to input their own information from the lecture. Guided notes have been shown to increase student achievement at the university level (Chen et al., 2017). Guided doodles are a strategy that can be used to maintain focus on the lesson but also

activate the engagement found when students doodle. These doodles are known as structured doodles and have been shown to produce similar results in one's recall ability as typical written notes (Nayar & Koul, 2019).

Theoretical Background

The human brain is designed to take in visual information more than other types. The use of visuals in educational activities creates an environment that encourages attentiveness and retention (Schunk, 2020). The connection between verbal information and visual imagery allows for a deeper understanding of concepts and word meanings (Paivio, 2014). Research has shown that children tend to use visual imagery to help remember ideas and concepts than adults (Schunk, 2020). This provides evidence for building visual imagery into educational environments.

Dual-coding theory explains how verbal and non-verbal processes work together to allow a person to mentally process both visual and verbal information. Dual-coding theory assumes that the brain has structures that connect verbal and visual information (Paivio, 1974). These structures are in place to allow for a deeper and more intense connection. This theory posits that words that have more concrete meanings, such as apple or dog, are more likely to have a visual connection in a person's mind than words with abstract meanings, such as friendship and growth (Clark & Paivio, 1991; Schunk, 2020). The integration of this imagery and verbal connections can be used to facilitate memory in educational settings.

It is believed that Aristotle was the first to understand and practice the connection between images and words. This came from his belief that thoughts form mental images in one's brain (Paivio, 2014). These mental images can help build the connections needed to understand word meanings and promote memorization of the meanings. Images are more likely to be

recalled than words (Paivio, 2014). Storing images into long term memory is a topic that has been debated, but it has been determined that long term memory can store both verbal and visual information (Schunk, 2020).

Dual-coding theory provides a solid theoretical background for the understanding of how using doodle notes helps build stronger connections in one's memory. The use of images or doodles during note-taking in a lecture could create a visual connection (Clark & Paivio, 1991). By providing students with a visual to associate with their lecture information, educators are providing the opportunity for their students to store the information using the dual coding process (Paivio,1974; Wammes et al., 2017). This knowledge provides guidance for the research questions.

Problem Statement

The literature available on the idea of note-taking and doodling separately provided a foundation for this study. The current studies that used structured doodles provided participants with a set of predesigned shapes that were to be shaded in while listening to information (Andrade, 2010; Nayar & Koul, 2019). Studies that considered unstructured doodling as a tool for recall found that the cognitive load of listening and deciding what to draw was too much for the participants to process and resulted in a lower recall level (Meade et al., 2019; Singh & Kashyap, 2014). The literature available suggested future research on the combination of learning tools, including doodling and note-taking specifically in the humanities courses, that would provide more opportunities for this blending to be successful (Nayar & Koul, 2019; Zeyab et al., 2020).

It is suggested that structured doodling be studied as a tool to increase recall (Sundararaman, 2020; Tadayon & Afhami, 2017). Many studies also shared limitations regarding

sample size and time frame of the task used as the lecture (Ali et al., 2021; Andrade, 2010; Boggs et al., 2017; Nayar & Koul, 2019; Tadayon & Afhami, 2017; Zeyab et al., 2020). It is also noted that there was a lack of literature available that showed the impact of doodling on recall and memory when students were required to recall the information after time has passed, as in a typical school setting. Many studies, including Boggs et al. (2017) and Meade et al., (2019), called for more information regarding doodle note-taking in a real-world setting. The problem was that the literature did not combine the concepts of doodling and guided note-taking into one, nor did the research available address the impact of these note-taking strategies on middle school students.

Purpose Statement

The purpose of this quantitative, quasi-experimental nonequivalent control-group study was to determine the impact of guided doodle note-taking strategies on middle school student reading comprehension. This study looked at student reading comprehension skills after time had passed and more material had been covered. The independent variable was the note-taking strategy used and the dependent variable was the student's reading comprehension, or the process of creating meaning from the text through personal interactions and other engagement (Frankel et al., 2019). The covariates considered were academic ability and previous knowledge. Controlling for these covariates allow for a better picture of the true impact of the note-taking strategies used. The guided structured doodle notes served as the experimental treatment, with the control group being traditional written guided note-taking strategies. Guided notes were defined as partially completed note pages assigned to students during class to increase note-taking skills and provide students with quality material for future studying (Chen et al., 2017; Feudel & Panse, 2021). Guided doodle notes build from that by adding images for students to

color and add to while participating in note-taking. Student reading comprehension skills were measured using a valid and reliable instrument. The instrument used was a self-reporting tool that allowed students to reflect on their reading comprehension skills.

The population studied included middle school students in a high-poverty, highly diverse public school located in central North Carolina. The students were from all ethnicities and backgrounds, as well as a range of socio-economic levels. However, 75% or more of the students fell under the level of free and reduced lunch. The students included in the study were in the seventh grade and their ages ranged from 11 to 14. They were all in the same grade level. All students included in the study had returned permission forms signed by guardians.

Significance of the Study

This study provides educators with empirical evidence regarding the impact of guided doodle note-taking in the traditional K-12 classroom. Structured doodling has been shown to both increase recall and decrease recall ability (Meade et al., 2019). Note-taking in the traditional verbal form has shown increased achievement and recall in college students (Chen et al., 2017; Morehead et al., 2019). Visual note-taking has also shown to serve as a strong teaching tool (Zeyab et al., 2020). Guided notes have been studied and shown to improve learning performance in college students (Chen et al., 2017). Similarly, structured doodling has shown to increase recall abilities when compared to free doodling (Boggs et al., 2017; Sundararaman, 2020).

Combining the variables from the studies mentioned to specify a guided doodle note-taking procedure provides educators with the information needed to ensure success in their classrooms. The results from this study could assist in informing best practices in the classroom setting and allow for higher learning and retention in students across K-12 settings. Nayar and

Koul (2019) suggested a learning tool that combined doodling and note-taking for future research. This study set out to determine if a combination tool was effective in increasing student recall.

Research Questions

Quantitative data was collected to provide evidence surrounding the hypotheses. The following research questions were designed to investigate the purpose of the study:

RQ1: Is there a difference in the self-reporting of reading comprehension skills between all students who complete guided doodle notes during lecture and those who complete guided written notes during lecture, when controlling for academic ability and previous knowledge?

RQ2: Is there a difference in the self-reporting of reading comprehension skills between female students who complete guided doodle notes during lecture and those who complete guided written notes during lecture, when controlling for academic ability and previous knowledge?

RQ3: Is there a difference in the self-reporting of reading comprehension skills between male students who complete guided doodle notes during lecture and those who complete guided written notes during lecture, when controlling for academic ability and previous knowledge?

Definitions

The following terms will be utilized as defined below:

1. *Doodling* – The act of doodling is creating drawings that are dissimilar to the task at hand (Meade et al., 2019; Sundararaman, 2020).
2. *Guided Notes* – Guided notes are partially completed note pages assigned to students during class to increase note-taking skills and provide students with quality material for future studying (Chen et al., 2017; Feudel & Panse, 2021).

3. *Note-taking*– This is the process of writing down information during an activity in which the participant feels the material presented is important to be retained (Bohay et al., 2011; İlter, 2019).
4. *Reading Comprehension* – Reading comprehension is the process of creating meaning from the text through personal interactions and other engagement (Frankel et al., 2019).

CHAPTER TWO: LITERATURE REVIEW

Overview

A systematic review of the literature was conducted to explore the impact of guided doodle note-taking strategies on the recall of middle school English language arts students. This chapter offers a review of the research on this topic. Dual coding theory was utilized as a theoretical framework and is discussed in the first section. This is followed by a review of recent literature on the process of learning, note-taking, and doodling. Lastly, the literature surrounding the impact of doodling on recall and a comparison of structured and unstructured doodling are discussed. Finally, a gap in the literature was identified regarding research that utilizes guided doodle note-taking strategies in the K-12 classroom setting.

Theoretical Framework

The theoretical framework for this study was based on the dual coding theory presented by Allan Paivio (1974). This theory explained the connection between verbal and visual learning and the impact these mediums have on memory. It has been revised over time to include new findings. This section details the origins and development of this theory and the rationale for this research study.

Dual coding theory was developed by Paivio (1974) to answer the question of how memory stored information. He theorized that memory and learning had systems that connected verbal and visual information in the brain. Paivio developed dual coding theory to support the notion that memories take shape as images or videos in the brain and can connect this imagery with verbal information. Paivio stated that the two systems, verbal and visual, are interconnected but can also run independently. For example, one can be speaking while imagining images of another location unrelated to the conversation they are having (Paivio, 1974). These two systems

have stark differences as well. Long-term memory storage can occur in visual and verbal forms, but the verbal form tends to be used more for abstract concepts, while the visual format is used for concrete ideas (Schunk, 2020).

The theory presents the understanding that long-term memory uses a verbal system and an imaginal, non-verbal system to create memory and knowledge (Paivio, 1974). These two systems are connected and are utilized in different scenarios, with verbal being used for abstract concepts and imaginal being used for concrete ideas (Schunk, 2020). This theory connects the concept of a stimulus, such as the auditory stimuli of a phone ringing, with a nonverbal sensory pair, such as the idea of picking up the phone when it rings. The brain connects the ringing auditory stimuli with the physical action of answering the phone (Paivio, 2014).

Connections in dual coding theory can be referential or associative. Referential connections are the connections that marry a verbal stimulus to a referred nonverbal image. For example, when students learn the word *dog*, they may hear it and imagine a dog they know personally (Clark & Paivio, 1991). This reference ties the image to the word, building a stronger connection. Associative connections are created from associations made when one encounters a verbal stimulus (Clark & Paivio, 1991). An example is a child who is learning that the stove is hot. They hear the word *stove* and realize they get burnt when touching the appliance. The child builds the association between the word *stove* with the sensory impact of being burnt to learn to not touch the stove.

Dual coding theory highlights the importance of connecting learning and memory's verbal and nonverbal aspects. Utilizing both verbal and imagery codes have been proven to enhance memory (Clark & Paivio, 1991). Over time, verbal and nonverbal skills have been combined when considering intelligence. The Stanford-Binet Intelligence Scales and the Army

Alpha and Beta Examinations, as well as other tests used around the world, utilize both verbal and nonverbal criteria when examining intelligence (Paivio, 2014).

Doodle note-taking strategies utilize both the visual and verbal aspects of learning and memory. Dual coding theory presents a foundation for why this learning process would be successful by explaining how the brain stores visual and verbal information. Doodle notes can help provide visuals for abstract concepts taught in the classroom, allowing students to create a visual memory. This memory is more likely to be recalled than one that is simply stored as verbal memory (Clark & Paivio, 1991; Schunk, 2020). By creating these codes for students through guided doodle notes, teachers can increase the stored memories and, in turn, the recall of information their students have (Schunk, 2020). This study set out to design a setting where this foundation was tested and used visual and verbal coding to increase student recall.

Related Literature

Educators spend much of their time considering the learning process in their classrooms. They are responsible for determining what tools to use in their lessons to serve their students best and impact their memory and learning. Both note-taking and doodling are tools that can be utilized in the classroom. This section reviews the existing literature surrounding the process of learning and memory. It also synthesizes the literature surrounding note-taking and doodling. This synthesis provides a deeper understanding of these concepts as a foundation for the present study.

The Process of Learning

To understand how doodling affects student learning, one must understand how learning occurs. Learning as a cognitive process occurs when neural connections are formed and strengthened (Schunk, 2020). Humans learn through verbal and non-verbal epochs (Paivio,

2014). These epochs also intertwine to create a third learning subsection that utilizes verbal and nonverbal skills. The periods of these epochs depend on the person. Their environment and learning styles determine which epoch will result in the most effective learning (Paivio, 2014; Schunk, 2020).

Incorporating the traditional three learning styles in delivering information is considered best practice. It is common for teachers to utilize a learning inventory that will help them see what group each of their students falls under (Nguyen et al., 2022). However, good instruction incorporates all three learning styles into their lessons. This combination results in enhanced learner achievement and performance, and creates the recipe for a deeper understanding of the content (Zeyab et al., 2020).

Meaningful learning occurs when students engage in three cognitive processes: paying attention to relevant information, organizing the materials into coherent representations, and integrating the new information with existing knowledge (Clark & Mayer, 2016). The learning environment must be conducive to these stages and allow for active processing to occur (Lagoudakis et al., 2022). Educators must find the balance of cognitive processing to maximize student engagement and learning. An excess of extraneous information or essential processing causes a distraction for students, resulting in a lower ability to retain the information. Learning experiences that require the underutilization of generative processing result in lower student engagement (Clark & Mayer, 2016). Finding the right balance allows students to maintain the optimal level of active engagement, resulting in higher retention (Lagoudakis et al., 2022).

Memory

Memory is an essential aspect of learning. Memory and non-verbal imagery have been used to interpret intellectual abilities for over 2,000 years (Paivio, 2014). Memory is looked at in

various ways, including neurological connections related to external stimuli and encoding of knowledge in an organized fashion. Repetition of stimuli and activities increases these connections, resulting in memories being formed and learning to occur (Schunk, 2020). These connections are made more potent when they combine both the verbal and nonverbal aspects of learning. The concept of *a picture is worth 1000 words* relates to the impact of nonverbal imagery tying in with the verbal part of learning (Nayar & Koul, 2019).

Memory consists of two significant subsections: short-term and long-term memory. Memory begins with information processing and sensory stimulation, with visual or auditory stimuli tied to a sensory effect. Information begins in the short-term memory bank but cannot be held there for long (Clark & Mayer, 2016; Schunk, 2020) The working memory is where the information is organized into representations that make sense to the learner. What follows is the integration of the new material with existing knowledge (Clark & Mayer, 2016). When the brain processes the information and can relate it to the information stored in long-term memory, it is moved from short-term to long-term and filed with related material (Schunk, 2020). The process is similar to a filing cabinet in the brain, where information is matched and stored with like concepts.

Managing the working memory is key to successful learning experiences. Students who experience a working memory overload are more likely to become frustrated, slowing down the learning process. Educators must be mindful of cognitive load when creating learning experiences (Clark & Mayer, 2016). Grade school educators are at an advantage regarding this process as memory performance peaks during the first two decades of life. However, researchers cannot be sure whether the improvement of memory over these first two decades is because of

the acquisition of new information, or because of the brain's ability to effectively recall prior knowledge (Brod & Shing, 2022).

The Impact of Stress on Memory

An individual's stress level affects the way one's brain processes and stores information. High-stress levels can adversely affect memory (Khayyer et al., 2021). When an individual is experiencing high stress levels, the way information is stored into their memory is impacted. If stress is occurring during the processing and encoding period, it benefits learning and memory storage. However, if stress occurs during the retrieval process, memory has been shown to become impaired (McManus et al., 2022). An increase of cortisol in the body during a stressful event is what researchers have suggested may impact memory retrieval (M. Marin et al., 2019).

The emotions experienced during an event can also influence how the event is remembered (Khayyer et al., 2021; McManus et al., 2022). In fact, memories that are tied to an emotional connection are more likely to be remembered due to a difference in the encoding process than those that are not. Stress typically evokes a negative emotional state, resulting in a bias in what is being processed and stored in memory (M. Marin et al., 2019). Higher anxiety and stress can lead to one focusing on negative stimuli and processing out other stimuli in the environment (Khayyer et al., 2021).

Stress in the learning environment has the potential to help or hinder a student's learning. Low levels of stress in the learning environment can positively influence a student's encoding processes. The stressor must be introduced after the learning occurs, however, or the risk of hindering the learning is present. Students who experience stressors after a learning experience are more likely to retain the information than those who experience the stressor before the experience (Khayyer et al., 2021; McManus et al., 2022).

Gender Differences in Memory and Learning

The comparison between boys and girls in educational research is a contrast that can be found easily when searched. Despite some researchers presenting that gender cannot be used as a category to differentiate between specific skills, these comparisons begin as early as preschool or before (Bartlett & Camba, 2023). Uppstad et al. (2021) compared the responses of boys and girls during their early educational years and found that formal education tended to level the playing field for gender differences by second grade. However, Roivainen et al. (2021) found that females had a higher processing speed than men when compared. It was determined that this difference was neurological or physiological in nature.

Other researchers agreed with the concept that gender differences may be neurological or physiological in nature. Acar-Erdol and Akin-Arikan (2022) mentioned that maturation differences could account for the biological perspective of educational gender differences. The use of metacognition strategies differs between boys and girls. Girls use their metacognition skills to understand the words and are more likely to utilize their note-taking and summarizing strategies. Boys, on the other hand, use their metacognition skills to connect their reading with previous knowledge (Acar-Erdol & Akin-Arikan, 2022). This can be attributed to evidence found that supported a difference in brain laterality. Researchers have found some evidence supporting that males used more right-brain, non-verbal strategies to solve problems while females were more likely to use left-brain, verbal strategies (Bartlett & Camba, 2023).

Gender differences can be found in working memory as well. Bedyńska et al. (2020) found that males had a lower working memory than females due to a higher stereotypical threat related to language achievement. This can be attributed to the way in which males process the information compared to females. Males utilize more of the parietal regions of their brains when

approaching memory tasks, meaning they use more visual tools in memory. Females utilize more of the brain's limbic and prefrontal areas, resulting in more verbal memory tools (Hill et al., 2014).

How Learning Happens

Learning happens with a change in the learner's knowledge occurs (Clark & Mayer, 2016). Learning takes place within the brain, meaning a basic understanding of how the brain works is important to understanding how learning happens. Stimuli enter the brain through the reticular activating system and are filtered subconsciously by what are deemed important. Students' reticular activating systems will filter out information that they do not find interesting because their filter is not as mature as an adult's (Willis & Willis, 2020). Once the information has made it through the filter, it is in the short-term, or working, memory (Schunk, 2020; Willis & Willis, 2020). The short-term memory stores the information for a limited amount of time, until the brain decides the information is important and stores it in long-term memory or discards it. (Schunk, 2020).

Short-term memory can be overloaded with too much information, especially when learning new information (Paas & van Merriënboer, 2020). This leads to cognitive overload and not all information is absorbed (Lim et al., 2019). Educators who are conscious of the cognitive load of their students can work to maintain an acceptable level of information being presented at a time. Cognitive load reduction techniques are imperative for students to be able to begin the integration process of memory building, especially for students who are learning new material. Off-loading strategies and chunking can also enhance the ability for students to increase the information in their short-term memory (Clark & Mayer, 2016; Paas & van Merriënboer, 2020; Willis & Willis, 2020).

Benefits of Offloading

Offloading information helps the brain process what is important and can assist with developing more long-term memories. Note-taking is a form of offloading that is used frequently in school settings. Essentially, offloading information consists of storing important information in an external environment. This can include notebooks, phones, calendars, etc. It can be considered a learning strategy if used as a tool to learn new information (Dong et al., 2022). Reminders are also considered a form of offloading. Reminders are beneficial when the brain has a higher amount of information to process. This provides a tool that encourages the remembrance of information while not increasing the current mental load (Peper et al., 2023).

Offloading using reminders has a few benefits for memory. Reminders can help children and adults alike offload information that they would otherwise have to keep stored in their memory. The utilization of external tools for offloading is an increasing practice, with technology and other tools becoming more standard in people's lives (Dong et al., 2022). These reminder tools help decrease the cognitive load, allowing for more capacity in one's memory. Peper et al. (2023) found that reminders helped with increasing prospective memory but were more beneficial when the reminder required participants to produce relevant information regarding the event or topic specified in the reminder.

When researched, children could offload information but could not place value in what was offloaded (Dong et al., 2022). It was hypothesized that because of the lower metacognition skills of middle school students, their ability to place value on specific information to be offloaded was decreased. Dong et al. (2022) suggested that the limited working memory of middle school students impacted their ability to determine the value of information. Their study utilized word pairing as a tool for memory, which is like pairing words with images in this study.

Note-taking

Note-taking is a common practice for offloading information that is used in modern education (L. Marin & Sturm, 2021). The process includes jotting down information from a lecture or other class material. The process requires students to take in the information presented and write it down in their own words (İlter, 2019). Note-taking can also be considered an intervention for students with learning disabilities or other impairments (Harrison et al., 2020). An understanding of note-taking as a strategy is imperative to be able to understand how doodle note-taking strategies affect recall.

Note-taking is a more modern educational practice (L. Marin & Sturm, 2021). The origin of note-taking did not involve selecting the most important pieces of information to jot down. Note-taking began as a process to write down everything that was said during a lecture. The note-taker must have possessed speed and precision to be successful at taking notes. The concept has evolved over time. There are examples of community note-taking where students all work together to create a collective set of notes. There are also examples of students writing rough notes during the lecture only to transcribe them into more detailed and informative notes after the lecture (Korsgaard, 2020). As time as progressed, the process of note-taking has evolved into what we are familiar with today. This has introduced a variety of strategies designed to help the learner pull out the key points of a lecture to review later (Chen, 2021; Korsgaard, 2020).

With the increase of technology, digital tools have been introduced to note-taking. Note-taking has moved from solely being a paper and pencil activity to including digital options, such as typing notes on word processors and the inclusion of multimedia information. Studies have been conducted on the efficacy of digital note-taking versus long-hand note-taking. Long handed written notes have won out as the preferred method of note-taking when compared to digital

note-taking. Students are more likely to remember the material when writing long handed notes (Ihara et al., 2021; Vasylets et al., 2022; Wong & Lim, 2021). The action of writing long handed notes also prevents students' minds from wandering off the presented topic (Wong & Lim, 2021). Vasylets et al. (2022) also found that students who took notes digitally had a slower processing speed than those who took notes using paper and pencil. This was attributed to the idea that digital tools allowed students to edit their notes quicker than those who were writing long handed but resulted in lower speed fluency.

The act of taking notes requires multiple cognitive skills that must be taught to students. They are expected listen to the lecture, pull out the key information, and jot that information down in a way that will benefit their review later. This process requires metacognitive skills including coding, sequencing, classification, and more. Students are expected to use these skills effectively while the information is still in their working memory so they can write the notes that will be most beneficial during their review (İlter, 2019). The students need to be able to comprehend the material being taught. Writing notes in their language and style increases this comprehension. It also allows the students to design their notes and code the information taught in a way that makes the best sense to them (Makany et al., 2009).

However, research has shown that students typically take incomplete notes that do not represent an understanding of the material taught (Ponce et al., 2020). Students have a difficult time deciding what information is key and what to include in their notes. Instead of summarizing the material, students will often jot down arbitrary words and phrases that may not be of importance to the material (Rusdiansyah, 2019). Providing students with partial or complete sets of notes for them to use has been found as an effective method to combat this struggle (Colliot et al., 2021; Ward & Vengrin, 2021).

The Efficacy of Note-Taking

Taking notes has a highly positive value as a learning strategy and helps off-load the information being processed to allow more information to come through (Boggs et al., 2017; Flippo & Bean, 2018; Makany et al., 2009). The process also allows students to encode their hearing or reading material. This encoding process enables students to build new connections in their brains, storing the information in their long-term memory bank (Nayar & Koul, 2019). Note-taking not only utilizes multiple cognitive skills, but also ties the motion of writing in with the learning. The movement of writing notes adds to the connections being made in the brain, resulting in higher levels of recall (L. Marin & Sturm, 2021).

Writing the notes in the students' own language is important to the efficacy of the process (Morehead et al., 2019). Paraphrasing what is being taught results in higher understanding versus copying notes word for word (İlter, 2019). What a student does with the notes following the lecture also impacts the efficacy of the note-taking process. Students who organize their notes and practice creating key points within the information are more likely to remember the information than those who do not (Chen, 2021). Studies agreed that it allowed students to review their notes while studying rather than relying on memory alone (Kobayashi, 2005; Makany et al., 2009).

Criticisms of Note-Taking

The practice of taking notes has been criticized as much as praised. In a meta-analysis of note-taking studies, Wong and Lim (2021) found that note-taking may have hindered learning more than helped it. Students who are more focused on the concept of writing the notes down are not as likely to process the information they are receiving. Students may also be preoccupied with the mechanical aspects of note-taking, including the style and the structure of their writing,

causing a distraction while learning. Note-taking requires many cognitive processes necessary to process information, meaning that students cannot process the information because their brains are focusing on the notes. Without guidance, the process can rely too much on the learner's ability to process the new information (Clark & Mayer, 2016; Makany et al., 2009). These distractions hinder the encoding process and prevent students from committing the information to memory, especially when it impacts novice learners.

It has also been found that certain types of information may not be conducive to the practice of note-taking. For example, note-taking does not benefit students when the assessment requires a simple recall. The information being assessed will get intertwined with the encoding processes, and students can get confused when determining the correct answer (Kobayashi, 2005). It is also difficult for students to comprehend a verbal lesson and write verbal notes because both tasks require similar cognitive skills (Sundararaman, 2020).

Efficacy of Guided Notes

Students who have not been taught how to properly take notes may struggle more than those who have (Chen, 2021; Morehead et al., 2019). Guided notes are a strategy that can be used to teach students how to take notes or provide an easier, more focused method of note-taking (Feudel & Panse, 2021). Studies have shown that students also interacted more with the material when provided guided notes with which to follow along (Biggers & Luo, 2020). Guided notes have been shown to support students with special learning needs, such as those with ADHD and other learning disabilities (Harrison et al., 2020; Lefki et al., 2019).

Guided notes allow students to offload some of the mental requirements of note-taking, giving them more capacity to focus on the lecture (Astra et al., 2020; Feudel & Panse, 2021). Researchers have found that when students have access to guided notes, they are able to interact

with the instructor and the material more than if they were focused on writing down key points with no guidance (Feudel & Panse, 2021). It has also been found that the use of guided notes can increase students' critical thinking abilities (Astra et al., 2020). Understanding how the use of guided notes supports critical thinking and the ability to focus on the lecture information provides a framework for understanding how images can impact the efficacy of notes.

Guided notes can also take the form of graphic organizers. Graphic organizers are visual displays that are used to provide an outline of the text or information (Colliot & Jamet, 2020). These organizers provide a structure to allow for a guided note-taking process, which has been shown to improve educational outcomes (Allen et al., 2020). Graphic organizers and guided notes provide a generative learning strategy, which has been shown to increase learning in younger learners when compared to unguided note-taking (Ponce et al., 2020).

Graphic Organizers

Graphic organizers are another form of guided notes. Graphic organizers are guided notes that use visual tools to help students learn and remember information. Examples of commonly used graphic organizers are t-charts, tree charts, and maps (Jeon et al., 2023). Graphic organizers have been studied and found to be effective learning tools in a variety of subjects (Fabros & Ibañez, 2021; Qi & Jiang, 2021; Ward & Vengrin, 2021). The use of pictorial representations and graphics has been shown to increase student learning versus the use of only verbal representations (Clark & Mayer, 2016). However, the type of organizer does impact the effectiveness of the tool (Jeon et al., 2023).

Studies have been done to determine the effectiveness of different types of graphic organizers and summaries of learning materials. Students can be responsible for creating and completing the organizer or teachers can provide students with a pre-made organizer that the

students are responsible for filling in. It has been found that the pre-made organizers are preferred by students and result in a higher understanding of the material. When compared, students who completed instructor-created organizers scored higher on tests than those who were responsible for creating their own graphics or had no graphic organizer at all (Clark & Mayer, 2016; Colliot et al., 2021; Ward & Vengrin, 2021).

Generative Learning Strategies

Generative learning strategies are those designed to promote active engagement in the materials being presented. These strategies support the integration of new information with prior knowledge, providing students with the opportunity to move information from short to long-term memory (Clark & Mayer, 2016). Students who are instructed to read materials without being provided the opportunity to actively engage in the text are less likely to retain and comprehend the materials when compared to those who are encouraged to utilize generative learning strategies (Brod, 2020; Ponce et al., 2020). These strategies can be applied to multiple age ranges, subjects, and content. Breitwieser and Brod (2021) found success using generative learning strategies with students ranging from ages 9-11, as well as university students aged 17-29. Meanwhile, AL-ASadi and Judi (2021) found success using generative learning strategies when teaching youth sport club members how to dribble a football.

Generative learning stems from two prior frameworks. The select-organize-integrate (SOI) framework focuses on organizing learning materials into structures that will allow students' working memory to process the information and categorize it to store in their long-term memory. The interactive-constructive-active-passive (ICAP) framework takes that organization concept a bit further by specifying which level of engagement is being reflected (Fiorella, 2023).

Both frameworks utilize constructivist concepts and require students to consider their prior knowledge when building their understanding of the new material (Breitwieser & Brod, 2021).

The activation of prior knowledge is a practice that has been found to benefit learning. Brod and Shing (2022) found that students who can relate new information to congruent prior knowledge can easily integrate the new information into their preexisting knowledge structures. Strategies that require the activation of prior knowledge include activities such as concept mapping, drawing, and questioning, among others. These activities promote comprehension and require students to actively process what they are reading and learning to synthesize the material (Brod, 2020). Not all generative learning strategies have equal success. Breitwieser and Brod (2021) found that generating predictions and examples were two of the best strategies to increase memory in students. Questioning and graphic organizers also increase student memory when compared to other generative learning strategies (Ponce et al., 2020).

Reading Comprehension

Reading comprehension is the processing of the material being read through the utilization of one's cognitive skills. Students who are aware of the processes necessary for reading comprehension can utilize strategies that align with their comprehension goals, therefore increasing their reading comprehension abilities (Cartwright & Duke, 2023). Reading, in and of itself, is not an inherent human skill. Reading and reading comprehension must be explicitly taught (İlter, 2019; Sousa, 2022).

Reading requires one's brain to actively engage multiple neural systems to successfully comprehend what is being read. Students must use their visual processing skills to see the word, auditory skills to sound the word out in their heads, and then their frontal lobe helps build the understanding (Sousa, 2022). These processes happen almost subconsciously for skilled readers,

such as educators. However, it does not happen as seamlessly for students. The utilization of multiple neural systems is generally a difficult skill to master, but can potentially be impossible for students who are not made aware of what is required of them (Cartwright & Duke, 2023; Mangen & Pirhonen, 2022). Students must be able to recognize shortcomings when reading a text, meaning they must be self-aware enough to realize when they do not understand and be able to utilize specific strategies to remedy that issue (Frankel et al., 2019).

As students age and progress through the educational system, the materials they are exposed to increase in difficulty. This presents a concern for students who struggle with reading comprehension due to having never been explicitly taught the skill or being unable to master the skill (Reyes & Bishop, 2019). Higher text complexity and the expectation of learning through independent reading as students enter secondary school leads to more interest in reading comprehension in middle grades and higher (Clemens et al., 2021). This skill must be taught to students as a process that guides readers with goals that are achieved by actively engaging in the text (Cho et al., 2022).

Teachers must be prepared to teach these reading skills for the instruction to be beneficial. Professional development has been shown to provide teachers with the confidence and skills needed to effectively teach reading skills (Tiba, 2023). Medina et al. (2021) found that teachers who participated in a sustained professional development schedule to teach reading skills felt that they were more knowledgeable about the strategies. They also noted that they saw changes in their students' behavior during the reading lessons. Kimhi et al., (2022) reported similar findings. Teachers were provided with need-based professional development that focused on research-based comprehension strategies. The teachers in this study also reported an improvement in their students' reading comprehension skills and shared that they felt more

competent as educators. These studies reveal that teachers who are prepared through specific professional development can effectively teach these reading skills and better serve their students.

Studies have shown that students who were explicitly taught reading strategies and comprehension skills scored higher on post-tests than those who did not (Dugasa et al., 2022; Li et al., 2022; Peng et al., 2023). Li et al. (2022) found that the experimental group significantly outperformed the control group when tested on reading comprehension ability after reading strategy instruction. Dugasa et al. (2022) found similar results, reporting that students who were exposed to explicit strategy instruction were better able to respond to higher-order thinking questions. Peng et al. (2023) discovered that the number of strategies taught was not as important as the quality of the teaching. Students who received more strategies in their instruction did not necessarily perform higher, but rather the right combination of strategies increased student scores (Peng et al., 2023).

Reading Strategies

Reading strategies are designed to provide students with a framework of steps required to actively engage and process the material being learned. These strategies can be considered an internal conversation that has the purpose of helping the learner understand what is important and build a schema for the material (Sun et al., 2021; Yapp et al., 2021). When conducting their meta-analysis, Yapp et al. (2021) developed a list of ten core reading strategies. They are as follows:

- Activation of background knowledge helps support learning.
- Context clues help readers guess meanings of words or phrases.
- Semantic mapping helps readers create meaning-based connections.

- Making predictions requires readers to think ahead, making the process more efficient.
- Creating visual images allows readers to engage more with the text.
- Skimming and scanning through the text allows readers to focus on important information.
- Utilizing subheadings, headings, and images helps build a holistic understanding.
- Connecting new and existing knowledge encourages inferencing and long-term memory storage.
- Asking questions while reading encourages a deeper understanding and anticipation of the outcome.
- Recognizing the text structure and signal words allows the reader to gain a deeper understanding of the logical structure of the text.

Variations of these skills are found in multiple other studies as well (Duke & Cartwright, 2021; Li et al., 2022; Peng et al., 2023; Sun et al., 2021). All the strategies guide students through one of the three critical thinking skills: understanding, analyzing, and evaluating (Dugasa et al., 2022). These skills are necessary for building the framework for reading comprehension. However, the combination of the strategies is imperative to their success. The methods in which these strategies are employed are also key in building reading comprehension (Peng et al., 2023).

Students learn differently, meaning the strategies that resonate with them will also be different from others. Students who are engaged in a strategy or combination of strategies in a way that is conducive to the way their brain processes information are more likely to learn the material (Frankel et al., 2019). The utilization of various teaching methods and cognitive load reduction strategies will increase student comprehension. These can include retelling and graphic

organizers to help off-load information (Peng et al., 2023). Other methods can include verbal ques from the instructor and modeling (Elston et al., 2022).

Changes in technology have created new strategies that students can use for better reading comprehension. Education has moved from paper and pencil to digital experiences, reading and writing skills included. Students are engaging in reading differently than before; teachers must adapt their strategies to best support the change (Jian, 2022). Digital texts provide the opportunity for students to engage with the material using hypertext, specific highlighting, and a difference in text navigation (Lebedeva, 2022; Mangen & Pirhonen, 2022).

Digital texts also require students to utilize traditional reading skills in a new way. Students can access multiple texts related to a topic digitally, requiring their cognitive processes to work differently than if the material was on paper (Park et al., 2020). Teachers have adjusted for this new cognitive load requirement by utilizing tools such as interactive games and segmenting classes into smaller sections (Pongsatornpipat, 2022). Augmented reality has also been studied as a tool to assist students with digital reading comprehension (Shaaban & Mohamed, 2023).

However, research has not fully supported the transition to digital reading technologies. Screen time has been shown to decrease student concentration and attention span, lowering the cognitive processes required for reading comprehension (Mangen & Pirhonen, 2022). When compared, students who were provided the material in print scored higher on reading comprehension questions than those who were provided digital versions of the same material (Jian, 2022). Ben-Yehudah and Eshet-Alkalai (2021) found similar results when studying if the medium congruency affected comprehension scores. They found that incongruent media was not

as influential on the comprehension scores, but that participants who were exposed to the digital format of the material scored less than those exposed to the print version.

Reading Comprehension and Memory

When asked, students stated that comprehension meant the ability to remember or retain key information from the text (Frankel et al., 2019). Researchers have studied the connection between student memory and reading comprehension skills. Reading comprehension requires students to synthesize materials and determine the relevance of information (Rusdiansyah, 2019). These skills utilize a student's executive functionality, meaning that they must have built these abilities up to successfully process the information. The reading comprehension process occurs within the working memory realm and takes up quite a bit of space. Higher executive functioning skills are necessary for adequate reading comprehension to occur (Nouwens et al., 2021).

Students who have higher executive functions, such as shifting and working memory, can be more successful with reading comprehension tasks (Brunfaut et al., 2021; Wu et al., 2020). Working memory has been shown to have direct implications on reading comprehension skills (Nouwens et al., 2021; Wu et al., 2020). Students with higher working memory abilities can recall information more effectively (Schunk, 2020; Willis & Willis, 2020). Students must be able to allocate their limited working memory functions to the process of comprehension to successfully decipher and fully understand the information (Cho et al., 2022).

Semantic knowledge and abilities have been found to impact reading comprehension. Students who have more background knowledge and can connect what they are reading to their existing knowledge are more likely to comprehend what they are reading (Nouwens et al., 2017). Students who can relate to the material they are reading are more likely to show a higher reading comprehension (Frankel et al., 2019). Semantic knowledge also provides students with a

foundation needed to predict information, which is a key strategy in reading comprehension (Reyes & Bishop, 2019).

Reading Comprehension and Note-Taking

Note-taking is a strategy that teachers can use to help students off-load some of the information being processed by their short-term memory. This allows more information to be processed quickly (Paas & van Merriënboer, 2020; Willis & Willis, 2020). Students who are encouraged to take notes during reading are more likely to have the mental capacity needed to adequately comprehend the material (Rusdiansyah, 2019). It can be argued that note-taking in and of itself can be a form of comprehension, through the determination of key ideas and the construction of meaning from the information presented when creating notes (Frankel et al., 2019).

Doodling

Doodling has been associated with mind-wandering and boredom but can also be associated with education and psychology. Doodling consists of sketches made when one's mind is preoccupied or wandering (Sundararaman, 2020). When a student’s brain is not stimulated enough, one can begin to daydream, and one’s mind may wander. This results in students not processing the lesson heard, and therefore not learning the material. Some students begin doodling while listening to a lecture. Doodling is shown to prevent daydreaming and help keep a student's mind on task with what they are hearing or reading (Andrade, 2010; Tadayon & Afhami, 2017).

Doodling is an effective way to give a student a *brain break* and allow creativity to creep into the monotony of a lecture or a specific lesson. Students who are permitted to doodle during class are more likely to keep their brains engaged with the content while they are drawing

mindless images (Sundararaman, 2020). Doodling works during auditory lessons because students utilize their brains' verbal and visual portions (Sundararaman, 2020). This allows for cross-lateral interactions, resulting in higher neurological connections being made and memories being formed with more solidity (Schunk, 2020). The more connections made within the brain, the higher chance of recall (Willis & Willis, 2020).

Doodling to Reduce Stress

Adolescents have developing executive functions and are less likely to be able to manage stress as well as adults (Cumming et al., 2019). When students are overly stressed, information does not transfer to the prefrontal cortex where it can be stored (Willis & Willis, 2020). Mindfulness activities have been studied to reduce stress in adults and students (Barnes et al., 2019; Cumming et al., 2019). Doodling and coloring are commonly considered activities. Coloring has reduced stress levels in adults in various situations, including work environments and health concerns (Barnes et al., 2019; Ramos Salazar, 2019; Turturro & Drake, 2022). Spontaneous doodling has been shown to help adults feel less anxious (Nash, 2021).

Doodling as an Art Form

Doodling also adds a visual component to learning, promoting an artistic activity tied with a verbal or auditory activity. Creative activities, such as doodling and other art forms, have improved academic achievement (Tadayon & Afhami, 2017). Images linked to verbal information have also improved recall and achievement. Farley et al. (2014) studied the impact of associating lexical items with visual images on student recall. They found that students who were provided an image and the word could remember the word and meaning at a higher rate than those who were just supplied the word. Even using a delayed post-test, students in the picture group could perform higher than those in the non-picture group (Farley et al., 2014).

Intertwining the concept of note-taking and art through doodling creates a connection between the two that builds an emotional impact. Lewis and Moffett (2020) studied how note-taking interrupted the learning process. These researchers found that students who were given the freedom to doodle while taking notes had an interesting collaboration between the two. They discussed how notes were generally verbal and tended to hold a more public connotation, while doodles were images and art that carried a more private connotation. They also looked at how notes turned into doodles and vice versa. These images result in an encoding process that is like words holding meaning. The images doodled by the students had a specific meaning concerning the content (Lewis & Moffett, 2020). This action allows the encoding process to assign meaning to the content created and defined by the art created by the student, leading to a higher likelihood of the content being stored in long-term memory (Nayar & Koul, 2019).

Learning by Doing

The concept of *learning by doing*, where students draw an image to represent a definition, has been shown to have higher recall rates than students who simply wrote out the definition (Wammes et al., 2017). Andrade (2010) found that adults who participated in doodling while listening to a phone call about party guests were able to remember more of the guests' names than the control group who did not doodle. It was concluded that doodling is a tool that can assist concentration (Andrade, 2010) and that utilizing doodling as an undemanding secondary task can increase memory (Sundararaman, 2020). It is evident from these studies that doodling can be categorized as an artistic, secondary activity during a task that requires a higher concentration on verbal or auditory processing.

Other examples of students creating pictorial notes have been shown to increase student recall and achievement. Ziadat (2021) studied the use of sketch noting in mathematics education

as a tool to assist students with dyscalculia. He found that students who utilized the sketch noting process scored higher on the post-test on mathematical words. Another study found that students who were able to use verbal and pictographic notes showed improvement between pre- and post-test results (Clark & Mayer, 2016; Peterson et al., 2021).

Doodling and Recall

Multiple studies have been done to inform researchers about the impact of doodling on recall and memory. It is accepted that pictures are more quickly remembered than words (Wammes et al., 2017). These studies often compared a group of students who doodled while listening to a lecture versus those who did not. Sundararaman (2020) studied the impact of doodling during lessons on high school students. The findings suggested that students who doodled during the lecture had higher academic performance and memory retention. The researcher determined that students who were permitted more extended periods of free doodling result in more *naturalistic doodling* and allowed students to maintain focus on the lecture being presented (Sundararaman, 2020).

Studies have also found that students reported fewer instances of daydreaming or mind-wandering than students who were not permitted to doodle (Ali et al., 2021; Sundararaman, 2020). Sundararaman (2020) explained that the students who doodled during the lecture could utilize their total encoding capacity by adding the mindless doodling task to maintain focus on the material being taught. These findings supported other research that showed that a secondary task, such as doodling while participating in a primary task like a lecture or reading, resulted in higher recall and kept the students engaged (Nayar & Koul, 2019).

Doodling can also be used as a strategy for students who are considered English language learners. Ali et al. (2021) conducted a study to determine the impact of doodling on the

reading comprehension of high school students. The findings showed a significant difference between the scores of students in the treatment group compared to those in the control group. The researchers determined that doodling is a more effective and preferred strategy than traditional methods of teaching reading comprehension (Ali et al., 2021).

Despite the positive correlations found in studies, other studies have found that some types of doodling do not affect memory and recall. Meade et al. (2019) conducted an experimental study and suggested that the type of doodling impacted the recall ability. Unstructured doodling led to worse memory recall than other note-taking forms. This idea contradicts other studies but guides future research, including the present study. Singh and Kashyap (2014) also found that doodling had no significant impact on recall or recognition. However, significant covariates were listed as limitations that could have hindered the study. These findings suggest that structured or guided doodling in a controlled environment may prove more successful.

Structured vs. Non-Structured Doodling

Overall, doodling as a teaching strategy to improve memory is supported by research. Drawing can lead to high psychological engagement when the drawing does not overwhelm the student's cognitive load (Clark & Mayer, 2016). However, there is a debate between using structured and non-structured doodling. Structured doodling is where students are expected to shade in specific shapes and fill out a given sheet, such as guided doodle notes. Non-structured doodling is when students are allowed to free draw and create the doodles themselves.

Structured and unstructured doodling positively impacts memory and recall (Nayar & Koul, 2019; Sundararaman, 2020). Non-structured doodling does not have as high a success rate as structured doodling. Unstructured doodling has been found to decrease recall ability. Boggs et

al. (2017) conducted a study meant to increase the validity of a previous study that supported doodling as a method of recall improvement. Andrade (2010) gave the participants a structured doodle task while listening to an auditory stimulus. Boggs et al. (2017) added to this idea by adding an unstructured doodling group. It was found that unstructured doodling led to a decrease in recall when compared to participants who completed note-taking and structured doodles.

Another study found similar results. Meade et al. (2019) also compared the impact of structured doodling, unstructured doodling, and writing on student recall. It was concluded that writing and structured doodling provided a higher recall than unstructured doodling. They theorized that these findings resulted from the required cognitive focus of unstructured doodling. Students who are allowed to free draw during a lesson must decide what to draw. This decision-making process utilizes too much of the brain's focus, and students are putting more energy into their doodles rather than maintaining focus on the lecture. This is known as the *bottleneck effect* and explains that multi-tasking is only successful when the tasks do not compete for cognitive function (Sundararaman, 2020). Not only does having students generate their own drawings require too much extraneous processing, but it can also result in inaccurate drawings (Clark & Mayer, 2016).

Structured doodling has been shown to have similar recall effects as traditional note-taking. Providing students with a guided version of doodles removes the possibility of too much cognitive requirement and transitions the task into a mindless activity. Nayar and Koul (2019) found that students who participated in structured doodling had similar recall ability to those who did note-taking. They theorized that structured doodling and note-taking provided similar stimulation to prevent mind-wandering and daydreaming.

Wammes et al. (2017) discovered that students who drew the meaning of words had similar results on a memory test as students who paraphrased the meaning of the words. Both practices required encoding strategies. They discussed how the process of drawing the meaning of a word requires students to transform that definition into a different form, enhancing the encoding process and increasing memory. Other studies have supported this explanation. Huang et al. (2021) found that video notes enhanced memory because students were reformatting the learned material. The researcher provided the participants with a guideline or structure for their notes, and the results supported using this educational strategy.

Summary

Dual coding theory explains how visual and verbal learning impact memory. Developed by Allan Paivio (1974), the theory answers the question of how the brain stores information in memory. The theory provides an important foundation for connecting the verbal and non-verbal aspects of learning to enhance memory (Clark & Paivio, 1991). The use of both verbal and visual stimuli, such as with doodle note-taking, provides students with a stronger coding process and enhances the likelihood of the material being stored in their long-term memory (Nayar & Koul, 2019; Paivio, 2014).

Understanding dual coding is just one part of the puzzle when trying to understand the way the brain stores information. One must gain a deeper understanding of learning processes as well. Learning occurs when students move information from their short-term memory to their long-term memory and form neural connections (Schunk, 2020; Willis & Willis, 2020). Educators must appeal to the three cognitive processes and find a successful balance when attempting to maximize learning and student engagement (Clark & Mayer, 2016).

Learning material, however, relies on memory and the student's ability to store information in their long-term memory. The working memory, or short-term memory, is a smaller bank where students must make sense of the information before they can move the material into their long-term memory (Schunk, 2020). The idea that working memory can be overloaded is something that educators must take into consideration when planning learning experiences. Students who are experiencing cognitive overload are more likely to become frustrated, hindering their learning process (Clark & Mayer, 2016). The cognitive overload results in a higher stress level, creating an increase in cortisol in the body, causing impairment in the ability to store information in long-term memory (M. Marin et al., 2019; McManus et al., 2022).

Offloading information helps when processing what information is coming in and what information needs to be stored in long-term memory. Offloading strategies, such as note-taking, are used to lessen the cognitive load when presenting new information (Dong et al., 2022). Note-taking can be used to help students maintain a reasonable level of information in their short-term memory as well as utilize multiple cognitive skills and build stronger neural connections (Boggs et al., 2017; Makany et al., 2009; Nayar & Koul, 2019). Note-taking strategies are tried and confirmed in the world of education to increase recall and memory in students (Boggs et al., 2017; Makany et al., 2009; Nayar & Koul, 2019; Sundararaman, 2020; Wong & Lim, 2021). This strategy has also been shown to increase reading comprehension (Brunfaut et al., 2021).

However, students must be taught how to take notes for that strategy to be successful. Note-taking requires a handful of cognitive skills that may be difficult for students to process while also attempting to learn the material presented (İlter, 2019). Research has shown that students will often take notes that are incomplete or are not representative of the material being

taught (Ponce et al., 2020). Free note-taking requires students to differentiate between relevant and non-relevant information, resulting in notes that consist of arbitrary words or phrases that do not make sense (Rusdiansyah, 2019).

Providing students with outlines or guidance during note-taking has shown to be effective when teaching students how to take notes (Colliot et al., 2021; Ward & Vengrin, 2021). Students who are provided with guided notes have also been shown to be more engaged with the material (Biggers & Luo, 2020). Guided notes can be presented in verbal or visual forms. Visual guided notes, or graphic organizers, help outline the information and provide a structure for the note-taking process (Allen et al., 2020; Colliot & Jamet, 2020).

Graphic organizers are a type of generative learning strategy. Generative learning strategies are designed to support learning through the integration of new material and the promotion of active engagement (Clark & Mayer, 2016). Graphic organizers have been shown to increase student memory when compared to other generative learning strategies (Ponce et al., 2020). Students who are encouraged to engage in generative learning strategies are more likely to comprehend and synthesize new information (Brod, 2020).

Doodling can be considered a form of graphic organizer. Doodling while taking in information also results in an increased recall of that information (Andrade, 2010; Farley et al., 2014; Lewis & Moffett, 2020; Nayar & Koul, 2019; Schunk, 2020; Sundararaman, 2020; Tadayon & Afhami, 2017; Wammes et al., 2017). Structured doodling has been studied and shown to be a good strategy for increasing memory and recall in student learning (Ali et al., 2021; Nayar & Koul, 2019; Sundararaman, 2020). Structured doodling allows more focus on the material being taught than non-structured doodling because of the concept of cognitive load (Nayar & Koul, 2019; Sundararaman, 2020; Wammes et al., 2017). Supported drawing, or the

generation of drawings from instructor-provided elements, is recommended as to not overwhelm the learner's cognitive load (Clark & Mayer, 2016). Teachers can use this information to provide another option for their students when deciding how they will take notes (Ali et al., 2021).

The literature available suggests future research on the combination of learning tools, including doodling and note-taking, specifically in the humanities courses that provide more opportunities for this blending to be successful (Nayar & Koul, 2019; Zeyab et al., 2020). Creating patterns in doodling, such as guided doodle notes, is recommended (Sundararaman, 2020; Tadayon & Afhami, 2017). It is also recommended to study the impact of doodle note-taking on younger students (Ali et al., 2021). The use of these doodling techniques in a real-world setting rather than a lab has also been suggested (Boggs et al., 2017; Meade et al., 2019). The present study explored the gaps presented by researching middle school students in their natural learning environment using pre-made guided doodle notes during class sessions.

CHAPTER THREE: METHODS

Overview

The purpose of this quantitative, quasi-experimental nonequivalent control-group study was to explore the impact of guided doodle note-taking strategies on student reading comprehension. The chapter begins by introducing the design of the study, including full definitions of all variables. The research questions and null hypotheses follow. The participants and setting, instrumentation, procedures, and data analysis plans are presented.

Design

This study used a quantitative, quasi-experimental nonequivalent control-group design. This design was chosen due to the nonrandomized nature of the group selection as well as the use of pre- and post-tests (Gall et al., 2007). Similar studies have been conducted using a format of this design, such as a quasi-experimental, pretest-posttest-delayed posttest design used in Chen et al. (2017). This study utilized the same non-equivalent comparison groups as Chen et al. (2017) as well.

Table 1

Nonequivalent Control-Group Design

	Pre-Test	Treatment	Post-Test
Written Notes	O	X_1	O
Doodle Notes	O	X_2	O

Limitations of this design were considered. Utilizing a nonrandomized experimental design presents concerns regarding the validity of the study. Existing differences between the two treatment groups could lead to results that are not attributed to the treatment (Miller et al.,

2019). The implementation of the pre- and post-tests was used to counteract the potential concerns to internal validity. This allowed for the treatment to maintain the focus of the study (Gall et al., 2007). Other procedures implemented to maintain validity include utilization of one grade level and the use of a tested, reliable, and valid instrument.

This design falls under the causal-comparative research design category. The cause being considered is the independent variable, or the note-taking strategy, while the effect is the dependent variable, or the student reading comprehension skills. Due to the uncontrollable differences in students involved in the study, a pre- and post-test design will be utilized to attempt to control the covariates (Gall et al., 2007). These covariates include academic ability and previous knowledge. These covariates are unable to be controlled by the researcher during the study.

The group that received the guided verbal notes served as the control group. This was selected because the teachers at the school being studied utilized guided verbal notes regularly. Guided verbal notes are partially completed note pages assigned to students during class to increase note-taking skills and provide students with quality material for future studying (Chen et al., 2017; Feudel & Panse, 2021). The students involved in the research were familiar with this concept. The group who received the guided doodle notes served as the treatment group. The guided doodle notes were a new concept to the students; they did not have any prior experience with this strategy. Guided doodles notes are similar guided verbal notes, with the addition of pre-made doodles printed on the page. Doodles are defined as drawings that are dissimilar to the task at hand (Meade et al., 2019; Sundararaman, 2020).

Other studies utilized an experimental pre- and post-test design and were able to randomize the group assignments (Ali et al., 202; Boggs et al., 2017). Due to the setting of this

study, randomization of the groups was not possible. This limitation resulted in the use of the quasi-experimental design (Gall et al., 2007). However, the use of the pretest-posttest design was utilized to mitigate the threats of internal validity (Gall et al., 2007). The independent variable was the note-taking strategy. Two groups were studied. The first group utilized a traditional guided note-taking strategy using verbal notes, while the second group utilized the guided doodle note-taking strategy. Guided notes are partially completed note pages assigned to students during class to increase note-taking skills and provide students with quality material for future studying (Chen et al., 2017; Feudel & Panse, 2021). The guided notes used were provided by the researcher to allow for consistency. The dependent variable was the students' reading comprehension, or the students' abilities to create meaning from the text through personal interactions and other engagement (Frankel et al., 2019), as measured by the Reading Comprehension Scale.

Research Questions

This study was designed to answer the following research questions:

RQ1: Is there a difference in the self-reporting of reading comprehension skills between all students who complete guided doodle notes during lecture and those who complete guided written notes during lecture, when controlling for academic ability and previous knowledge?

RQ2: Is there a difference in the self-reporting of reading comprehension skills between female students who complete guided doodle notes during lecture and those who complete guided written notes during lecture, when controlling for academic ability and previous knowledge?

RQ3: Is there a difference in the self-reporting of reading comprehension skills between male students who complete guided doodle notes during lecture and those who complete guided written notes during lecture, when controlling for academic ability and previous knowledge?

Hypotheses

This study examined the impact of doodle note-taking strategies on student reading comprehension. Past studies have concluded mixed results on the use of doodle note-taking strategies. There are claims that unstructured or unguided doodling results in significantly worse comprehension (Boggs et al., 2017). Other studies found that structured doodling and traditional notetaking are similar in reading comprehension (Nayar & Koul, 2019). This study considered the differences between a commonly used tool in education, guided written notes (Hamilton et al., 2000; Konrad et al., 2011; Lefki et al., 2019) and the experimental treatment of guided doodle notes.

The null hypotheses for this study were:

$H_0$1: There is no significant difference in the self-reporting of reading comprehension skills, as measured by the Reading Comprehension Scale, between all students who complete guided doodle notes during lecture and those who complete guided written notes during lecture, when controlling for academic ability and previous knowledge.

$H_0$2: There is no significant difference in the self-reporting of reading comprehension skills, as measured by the Reading Comprehension Scale, between female students who complete guided doodle notes during lecture and those who complete guided written notes during lecture, when controlling for academic ability and previous knowledge

$H_0$3: There is no significant difference in the self-reporting of reading comprehension skills, as measured by the Reading Comprehension Scale, between male students who complete

guided doodle notes during lecture and those who complete guided written notes during lecture, when controlling for academic ability and previous knowledge.

Participants and Setting

This section details the participants and setting of the research study. The selected population, location, and grouping are explained.

Population

The population studied was middle school students in the Piedmont of North Carolina. The participants for the study were drawn from a convenience sample of middle school students during the spring semester of the 2023- 2024 school year. The school was in a larger school district, and this school had a high population of students living in poverty. The sample of students was selected due to the accessibility of the researcher. The students were enrolled in different classes at the same grade level. Each class was a seventh-grade English language arts class. The student grouping was considered average, with all students falling within a normal distribution of each other.

Participants

For this study, the number of participants sampled was 101, which exceeded the required minimum when assuming a medium effect size. The sample size required for the analysis of covariance is 94, for experimental studies when assuming a medium effect size with statistical power of 0.80 at the .05 alpha level (Bujang et al., 2017; Faul et al., 2009). The sample came from one of 15 middle schools in the district. Students were selected from one grade level. This means that every student in the study had been taught the same specific standards. All students involved in the study were enrolled in the selected school's seventh-grade English language arts classes.

The groups were selected using convenience sampling due to the researcher's inability to control class assignments (Gall et al., 2007). The control group was enrolled in two teachers' classes, while the treatment groups were enrolled in one teacher's classes. Each class ranged from 19-31 students. The school utilized a block schedule with class periods were around ninety minutes each. Due to the researcher's inability to control the class schedules, the sample was predetermined and participated in the study at the predetermined time of their class. These limitations were considered in the data analysis.

All students were considered of low socio-economic status and have similar backgrounds. The sample consisted of 51 males and 50 females between the ages of 11 and 14 who were enrolled in a seventh-grade class. The students had a variety of cultural backgrounds. See Table 2 for a breakdown of student race and ethnicity of the entire school population. The school had a total of 760 students, with 256 of those being placed in the seventh grade (National Center for Education Statistics, 2022). The students ranged in ability level, from students identified with learning disabilities to those who have been identified as gifted and talented. The sample groups provide a well-rounded representation of the population being studied.

Table 2

Race and Ethnicity of School

	American Indian/Alaskan Native	Asian	Black	Hispanic	Native Hawaiian/Pacific Islander	White	Two or more races
Students	1	36	246	254	3	146	77

Setting

The study was conducted in a public K-12 setting. The participants were selected based on class assignments of one grade level. The control and treatment groups were enrolled in different periods for the course, but the course was the same for all classes. The courses were taught face-to-face with no hybrid option. The students had access to one-to-one Chromebooks during class. Each course ran throughout the entire 2023-2024 school year. The pre- and post-tests took place during the assigned class time.

The school was situated in what is considered a larger suburban area, but locally considered a smaller city. The middle school considered was one of 15 in the district. The school had 763 students total in grades 6 through 8. Minority groups made up 81% of the school's population. There were roughly equal amounts of female and male students, with the percentages being 49% and 51%, respectively. The school did not meet expectations for reading. The reading proficiency of the students was 30%, which was lower than the district's average (U.S. News, n.d.).

Instrumentation

This study utilized the reading comprehension scale as the instrument for review. The instrument is described, and the development is discussed. The reliability and validity of the instruments is provided.

Students were given the Reading Comprehension Scale for the pre- and post-tests (Velasco & Villanueva, 2022). The Reading Comprehension Scale is a 13-item self-report instrument that measures the reading comprehension skills of middle school students. See Appendix B for the instrument. The instrument utilizes a Likert scale model with choices ranging from 1, representing never, to 4, representing every time. The scale was scored by adding the

selected answers to result in a total. The subsections, advanced and basic dimensions, of the instrument are scored separately (Velasco & Villanueva, 2022). The purpose of this instrument was to determine if students recognized appropriate reading comprehension skills following the lecture.

The Reading Comprehension Scale was developed to fill the gap of valid and reliable reading comprehension measures for middle school students. Velasco and Villanueva (2022) developed the scale using eighth grade students, resulting in an instrument that was well designed for this study's population. The scale utilizes four themes usually considered in reading comprehension: applied, interpretive, affective, and lexical. The researchers recommended the use of the tool in English classes and with the Department of Education (Velasco & Villanueva, 2022). Due to the instrument's age, the tool had not been utilized in many studies. However, the reliability and validity of the instrument provided reassurance of the instrument's appropriateness of use.

This instrument was tested and statistically confirmed as reliable and valid. Cronbach's alpha and the Kaiser-Meyer-Olkin Measure of Sampling Adequacy are used to determine validity and reliability of an instrument (Gall et al., 2007; McCoach et al., 2013). Cronbach's alpha is 0.639 for the advanced dimension and 0.569 for the basic dimension. See Velasco and Villanueva (2022) for the breakdown of each item's results. The average of these two scores is 0.610, which falls between the suggested range of 0.60 and 0.70. The Kaiser-Meyer-Olkin Measure is 0.734 for the instrument. A good value ranges between 0.70 and 0.80, showing that this instrument is considered to have appropriate sampling (Velasco & Villanueva, 2022).

The researchers also utilized Bartlett's Test of Sphericity to ensure that the variables considered were related. This test ranges from 0 to 1, with 0 being highly related (Shrestha,

2021). The researchers used a Chi-Square test with degrees of freedom. The Chi-Square score is listed as 1408.237 and the Degrees of Freedom are listed as 465. This resulted in a Bartlett's Test p-value < 0.001. This is highly significant when considering a 0.01 level of significance (Velasco & Villanueva, 2022).

The development of the instrument was detailed in Velasco and Villanueva's (2022) article. They discussed the elimination of items to ensure construct validity. The researchers administered their original scale to 476 students and interviewed a sample of 15 students to get more information about their scale items. The researchers narrowed the scale down to 31 items, then followed the same procedure. Finally, the scale was brought down to the final 13 items. The researchers used the Lawshe method to compute the content validity ratio of each item (Velasco & Villanueva, 2022).

The Lawshe method utilizes a range, similar to a Likert scale, that allows for expert raters to determine the essential components of an instrument. The developers then use a formula to determine the content validity ratio for each of their items (Baghestani et al., 2017). The researchers used five experts to rate the items. Each item was scored as an excellent fit or essential by four out of five of the experts (Velasco & Villanueva, 2022).

The Reading Comprehension Scale was scored digitally using the online tool and provided a sum of student choices. Higher sums meant that students had a higher reading comprehension while lower sums indicated students had less reading comprehension. This eliminated the need for tester training and increased inter-tester reliability (Gall et al., 2007). The use of the online tool prevented careless errors as well as mistakes made by students. The online tool was created by the researcher and checked by the research committee before implementation to ensure that no errors were made. The instrument administration took approximately 10-15

minutes each time. Permission to utilize the instrument and implement using online tools had been obtained (See Appendix B).

Procedures

IRB Permission was sought from Liberty University. See Appendix C for complete IRB permission. Due to the participants being minor children, permission was needed from their guardians. Permission was sought from the school district and guardians of the students involved using parental consent form. See Appendix D for forms of consent from the guardians of the participants.

The classroom teachers were the sole administrators for the pre-test, the lecture, and the post-test. All parts that required student input and participation took place in their regularly scheduled class period. Make-up testing for the pre- and post-tests was discussed prior to administration of the instrument. Students who are absent during the lecture period were removed from the data.

The classroom teacher was prepped for implementation prior to students being involved. The teacher received training regarding how to include the link to the pre- and post-tests on their learning management system page. They were also provided a pre-made video lecture slideshow of reading comprehension strategies to utilize. The video lecture slideshow was used to ensure as much continuity as possible between classes. See Appendix E for slideshow.

Students were assigned a numerical code to ensure anonymity. The teacher provided each student with their specific code. The researcher was not provided the identifying information, such as names of students, but instead only received the information with the code as the identifier. Students were instructed to enter their numerical code instead of one's name when taking the pre- and post-tests.

Students completed the pre-test in regularly scheduled classes. The researcher provided the teachers with both the control group's guided written notes and the treatment group's guided doodle notes. The teachers taught the selected reading comprehension skills to all classes in the same manner using the provided video lecture. Students took notes using their prescribed treatment. The lecture took place one day following the administration of the pre-test.

Two formats of guided notes were used in this study. The traditional version of guided notes utilized a fill-in-the-blank method of teacher provided notes and served as the control group note option. This format of guided notes is supported by research and has been shown to increase the accuracy of student notes (Chen et al., 2017; Konrad et al., 2011). The second version of the guided notes was the doodle notes and served as the experimental treatment. These doodle notes were structured, similarly to Andrade (2010) and Sundararaman (2020) but consisted of information related to the topic being taught. See Appendix A for the guided notes.

The guided notes consisted of typical strategies for reading comprehension. These skills were researched and determined to increase reading comprehension. Skills include understanding best practices for reading, such as making predictions and considering the title as a method of determining the main idea (Velasco & Villanueva, 2022). The notes correlated with the lecture presented by the video lecture.

The post-test occurred two days after the lesson was taught. This provided students with time to make up any material if there were absences and provided the teacher with time to prepare the post-test link on the learning management system. The students took the post-test in their regularly scheduled English language arts class time. They utilized their previously assigned numerical code to identify themselves rather than by name. The researcher received their post-tests with their numerical code in order to match it with their pre-test results to

compare.

Both pre- and post-tests were given using Google Forms. The information was worded exactly as the Reading Comprehension Skills inventory was printed, with the options 1-4 being provided for the students to select. The instructions for the assessment were provided in print on the online form and verbally by the teacher. The results of both pre- and post-tests were seen only by the researcher and the committee members. The researcher kept the data in a password protected file on her personal computer. No data was sent to the researcher with identifying student information. See Appendix F for screenshots of the online tool.

Data Analysis

The data was analyzed using an analysis of covariance or ANCOVA. This test is considered because the research compares two groups and determines the impact of a treatment, but may involve covariates (Gall et al., 2007). Having two covariates, academic ability and previous knowledge, requires the use of a factorial ANCOVA (Boslaugh, 2012). There was no true control group since the students all needed some form of note-taking in a classroom setting. The group assigned the guided verbal notes served as the control group since the students were familiar with this note-taking strategy already. The study was compared using the conventional alpha α level of .05. It is recommended that an analysis of covariance (ANCOVA) is conducted to maintain the internal validity of the quasi-experimental nonequivalent control-group design. This analysis helped lessen the impact of outside variables on the study (Gall et al., 2007).

The use of ANCOVA requires certain assumptions to be met. The variables being considered were independent of each other and create linear models. The groups considered were equal in size and assumed a multinormal distribution. These factors allowed for the integrity of

the analysis to be maintained (Backhous et al., 2021). The assumption of homogeneity of regression was also considered (Gall et al., 2007).

Data screening included visual screening for missing and inaccurate entries. Outliers were checked using a box and whisker plot. The Shapiro-Wilk test was used for the assumption of normality. This was selected due to the smaller sample size (Laerd Statistics, 2017). Scatter plots were used for the pre- and post-tests to check for linearity and bivariate normal distribution. Levene's Test of Equality of Error Variance was used to check for assumption of equal variance. The null hypothesis was rejected at the 95% confidence level. A partial eta square test was used to determine the effect size of the final participant count.

Various descriptive statistics, including mean, median, and standard deviations, were calculated. Post-hoc analyses were conducted as necessary. Confidence intervals were analyzed to determine a true difference between the intervention and the control group. The means of the pre-tests were compared to those of the post-tests to confirm statistical differences. These were compared using *F* ratios. A series of *t* tests were conducted to compare multiple data points for significant differences (Gall et al., 2007).

CHAPTER FOUR: FINDINGS

Overview

This chapter contains the results of the quantitative, quasi-experimental nonequivalent control-group study conducted to answer the research questions listed. The research questions and null hypotheses are listed to provide context. Included in this information are the descriptive statistics and results of the one-way ANCOVA analysis performed.

Research Questions

RQ1: Is there a difference in the self-reporting of reading comprehension skills between all students who complete guided doodle notes during lecture and those who complete guided written notes during lecture, when controlling for academic ability and previous knowledge?

RQ2: Is there a difference in the self-reporting of reading comprehension skills between female students who complete guided doodle notes during lecture and those who complete guided written notes during lecture, when controlling for academic ability and previous knowledge?

RQ3: Is there a difference in the self-reporting of reading comprehension skills between male students who complete guided doodle notes during lecture and those who complete guided written notes during lecture, when controlling for academic ability and previous knowledge?

Null Hypotheses

$H_0$1: There is no significant difference in the self-reporting of reading comprehension skills, as measured by the Reading Comprehension Scale, between all students who complete guided doodle notes during lecture and those who complete guided written notes during lecture, when controlling for academic ability and previous knowledge.

$H_0$2: There is no significant difference in the self-reporting of reading comprehension skills, as measured by the Reading Comprehension Scale, between female students who complete guided doodle notes during lecture and those who complete guided written notes during lecture, when controlling for academic ability and previous knowledge

$H_0$3: There is no significant difference in the self-reporting of reading comprehension skills, as measured by the Reading Comprehension Scale, between male students who complete guided doodle notes during lecture and those who complete guided written notes during lecture, when controlling for academic ability and previous knowledge.

Descriptive Statistics

The data was separated into three sets to allow for analysis to reflect the specific requirements of each research question. The first set, looking to answer RQ1, considered all the data collected. The second set, looking to answer RQ2, considered only the data collected from female students. The third set, looking to answer RQ3, considered only the data collected from the male students. The results are presented by each research question in the sections below. Data was unadjusted mean ± standard deviation, unless otherwise stated.

RQ1

Participants were separated into two groups, control and experimental, based on their classroom assignment. One teacher was given the doodle notes sheet for their students to complete during the lecture while the other two teachers were given the guided written notes sheet for their students to complete. Forty-five students completed the doodle notes and 56 students completed written guided notes. The doodle notes group scored higher on the post-test on average (M = 40.22, SD =4.77) than the guided notes group (M = 39, SD = 5.34). The doodle notes group had a smaller range of numbers, spanning 19 points (range: 30-49), with an IQR of

7. The guided notes group had a larger range, spanning 25 points (range: 25-50), and an IQR of 8.

RQ2

The total number of female participants was 50, with 22 students completing doodle notes and 28 students completing guided notes. The female group had an average of 39.38 points (*SD* = 5.49). The doodle notes group scored higher on the post-test on average (*M* = 40.68, *SD* = 5.0) than the guided notes group (*M* = 38.36, *SD* = 5.72). The doodle notes group had a smaller range of numbers, spanning 18 points (range: 30-48), with an IQR of 6. The guided notes group had a larger range, spanning 25 points (range: 25-50), and an IQR of 8.

RQ3

The total number of male participants was 51, with 23 students completing doodle notes and 28 students completing guided notes. The male group had an average of 39.72 points (*SD* = 4.75). The doodle notes group scored similarly on the post-test on average (*M* = 39.78, *SD* = 4.6) as the guided notes group (*M* = 39.64, *SD* = 4.95). The ranges of the groups were also similar, with the doodle notes group range spanning 19 points (range: 30-49) with an IQR of 7 and the guided notes group range spanning 18 points (range: 31-49) with an IQR of 8.

Results

The data was separated into three sets to allow for analysis to reflect the specific requirements of each research question, as in the descriptive statistics section above. The results are presented by each research question in the sections below.

RQ1 Results

RQ1 considers data collected from all students. The null hypothesis for this question states that there is no statistically significant difference between the self-reported reading

comprehension skills of students who completed guided written notes compared to students who completed doodle notes when controlling for academic ability and previous knowledge. An ANCOVA was used to analyze the data and determine the significance.

Assumptions for the ANCOVA test were run. The assumption of a linear relationship between pre- and post-intervention self-reporting scores for each note-taking type was met, as assessed by visual inspection of a scatterplot (see Figure 1). The assumption for homogeneity of regression slopes was met, as the interaction term was not statistically significant, $p = .254$. Standardized residuals for the interventions were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). The assumption of homoscedasticity was met, as assessed by visual inspection of the standardized residuals plotted against the predicted values (see Figure 2). The assumption of homogeneity of variances was met, as assessed by Levene's test of homogeneity of variance ($p = .434$). One outlier was identified using the standard deviation of ±3, with the outlier being exactly 3.00. Despite the violation of this assumption, the researcher determined that the outlier was important to include in the data. It represented a true score from a participant who scored much less on the post-test compared to their score on the pre-test. This event is not unusual when considering the population; therefore, it was determined that the outlier should be included. The outlier was not visually represented on a box and whisker plot, nor did it impact the linearity of the data. Steps were taken to address this violation, including a reflect and square root transformation of the data and consideration of nonparametric analyses. However, neither of the options appropriately represented the data and it was determined that continuing with the ANCOVA analysis was the best option. After adjustment for pre-intervention academic ability and previous knowledge, there was not a statistically significant difference in post-test reading comprehension scores, $p = .233$, partial $\eta 2 = .014$ (see Table 3). The researcher failed to reject

the null hypothesis, meaning there was no significant difference in the self-reporting of reading comprehension skills, as measured by the Reading Comprehension Scale, between all students who complete guided doodle notes during lecture and those who complete guided written notes during lecture, when controlling for academic ability and previous knowledge.

Figure 1

Scatterplot of Pre-Test Scores and Post-Test Scores with Regression Lines for RQ1

Figure 2

Scatterplot of Standardized and Predicted Residuals of Post-Test Scores by Notes for RQ1

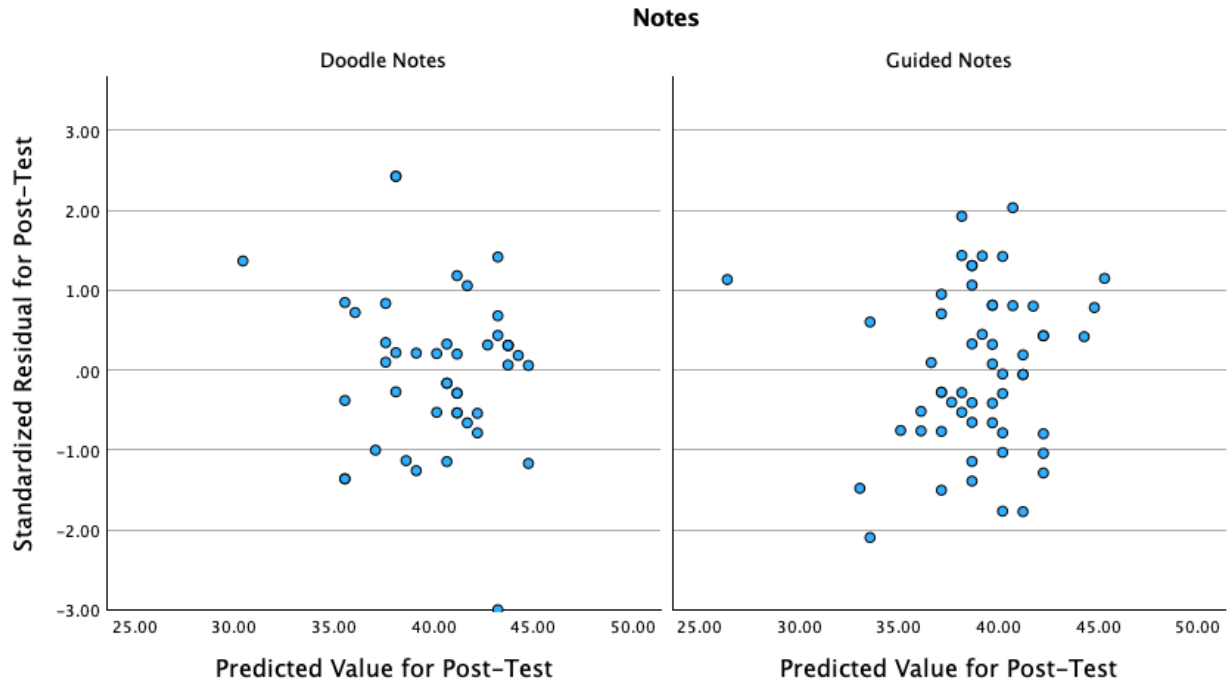

Table 3

ANCOVA Results for H_01

	Type III Sum of Squares	*df*	MS	*F*	Sig.	Partial Eta Squared
Notes	23.939	1	23.939	1.441	.233	.014

RQ2 Results

RQ2 considered data collected from female students. The null hypothesis for this question states that there is no statistically significant difference between the self-reported reading comprehension skills of female students who completed guided written notes compared

to female students who completed doodle notes when controlling for academic ability and previous knowledge. An ANCOVA was used to analyze the data and determine the significance. Assumptions for the ANCOVA test were run. The assumption of a linear relationship between pre- and post-intervention self-reporting scores for each note-taking type was met, as assessed by visual inspection of a scatterplot (see Figure 3). The assumption for homogeneity of regression slopes was not met, as the interaction term was statistically significant, $p = .021$. The violation of this assumption led to several procedures considered to best address the violation. Transformations were run to test if the data was best displayed using a reflect and square root transformation and nonparametric analysis options were considered. Despite the violation of the assumption, the researcher determined that the ANCOVA was still the appropriate analysis to run. The difference between the groups was small, and the groups were relatively equal. The whole group ANCOVA for RQ1 did not violate the assumption of homogeneity of regression slopes. Also, the scatterplot (see Figure 3) shows that the regression lines are all showing a positive slope and are visually similar. These considerations resulted in the researcher's decision to continue with the ANCOVA analysis (Kirk, 2013). Standardized residuals for the interventions were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). The assumption of homoscedasticity was met, as assessed by visual inspection of the standardized residuals plotted against the predicted values (see Figure 4). The assumption of homogeneity of variances was met, as assessed by Levene's test of homogeneity of variance ($p = .720$). The assumption that there were no outliers was met, as assessed by no cases with standardized residuals greater than ±3 standard deviations. After adjustment for pre-intervention academic ability and previous knowledge, there was not a statistically significant difference in post-test reading comprehension scores of female participants, $p = .441$, partial $\eta 2 = .013$ (see Table 4).

The researcher failed to reject the null hypothesis, meaning there was no significant difference in the self-reporting of reading comprehension skills, as measured by the Reading Comprehension Scale, between female students who complete guided doodle notes during lecture and those who complete guided written notes during lecture, when controlling for academic ability and previous knowledge.

Figure 3

Scatterplot of Pre-Test Scores and Post-Test Scores with Regression Lines for RQ2

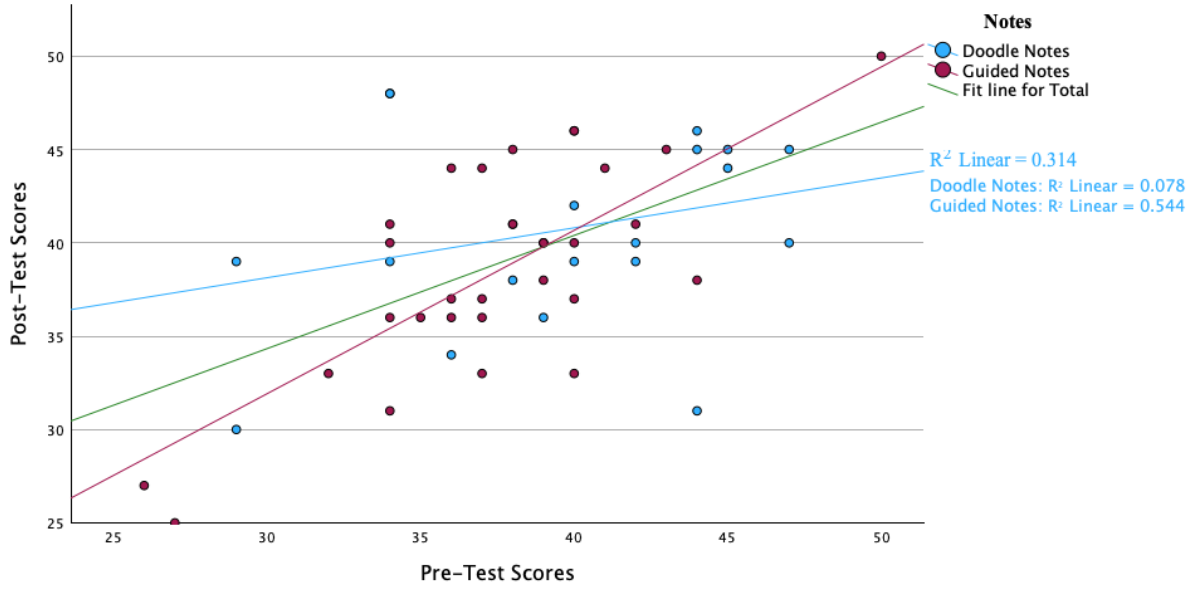

Figure 4

Scatterplot of Standardized and Predicted Residuals of Post-Test Scores by Notes for RQ2

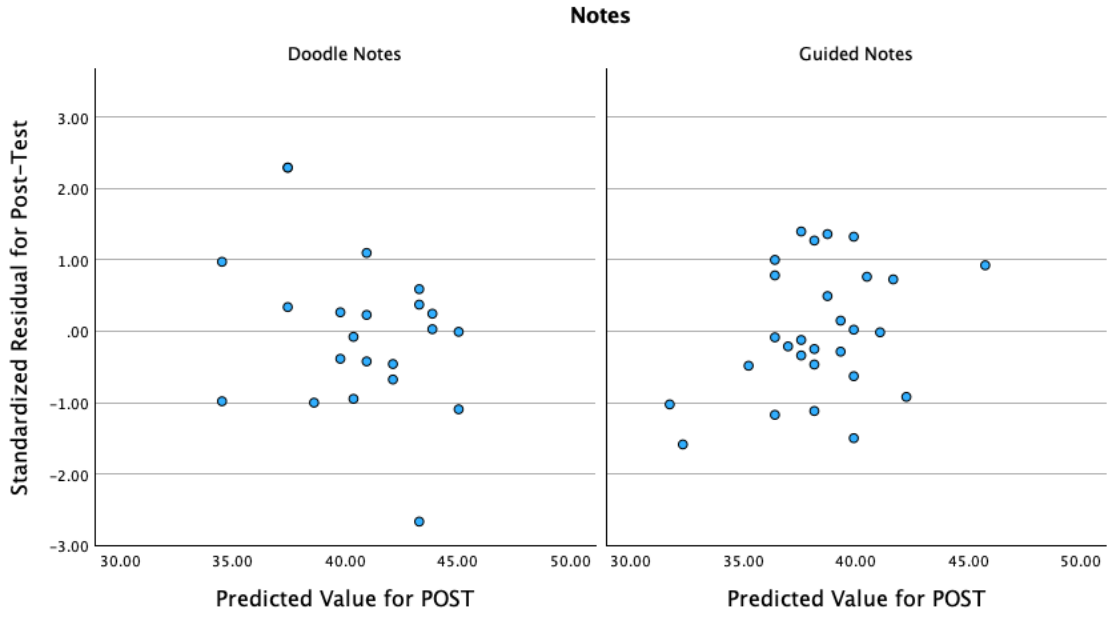

Table 4

ANCOVA Results for H_02

	Type III Sum of Squares	*df*	MS	*F*	Sig.	Partial Eta Squared
Notes	12.851	1	12.851	.605	.441	.013

RQ3 Results

RQ3 considers data collected from male students. The null hypothesis for this question states that there is no statistically significant difference between the self-reported reading comprehension skills of male students who completed guided written notes compared to male students who completed doodle notes when controlling for academic ability and previous knowledge. An ANCOVA was used to analyze the data and determine the significance.

Assumptions for the ANCOVA test were run. The assumption of a linear relationship between pre- and post-intervention self-reporting scores for each note-taking type was met, as assessed by visual inspection of a scatterplot (see Figure 5). The assumption for homogeneity of regression slopes was met, as the interaction term was not statistically significant, $p = .358$.. Standardized residuals for the interventions were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). The assumption of homoscedasticity was met, as assessed by visual inspection of the standardized residuals plotted against the predicted values (see Figure 6). The assumption of homogeneity of variances was met, as assessed by Levene's test of homogeneity of variance ($p = .184$). There were no outliers in the data, as assessed by no cases with standardized residuals greater than ±3 standard deviations. After adjustment for pre-intervention academic ability and previous knowledge, there was not a statistically significant difference in post-test reading comprehension scores of male participants, $p = .486$, partial $\eta 2 = .010$ (see Table 5). The researcher failed to reject the null hypothesis, meaning there was no significant difference in the self-reporting of reading comprehension skills, as measured by the Reading Comprehension Scale, between male students who complete guided doodle notes during lecture and those who complete guided written notes during lecture, when controlling for academic ability and previous knowledge.

Figure 5

Scatterplot of Pre-Test Scores and Post-Test Scores with Regression Lines for RQ3

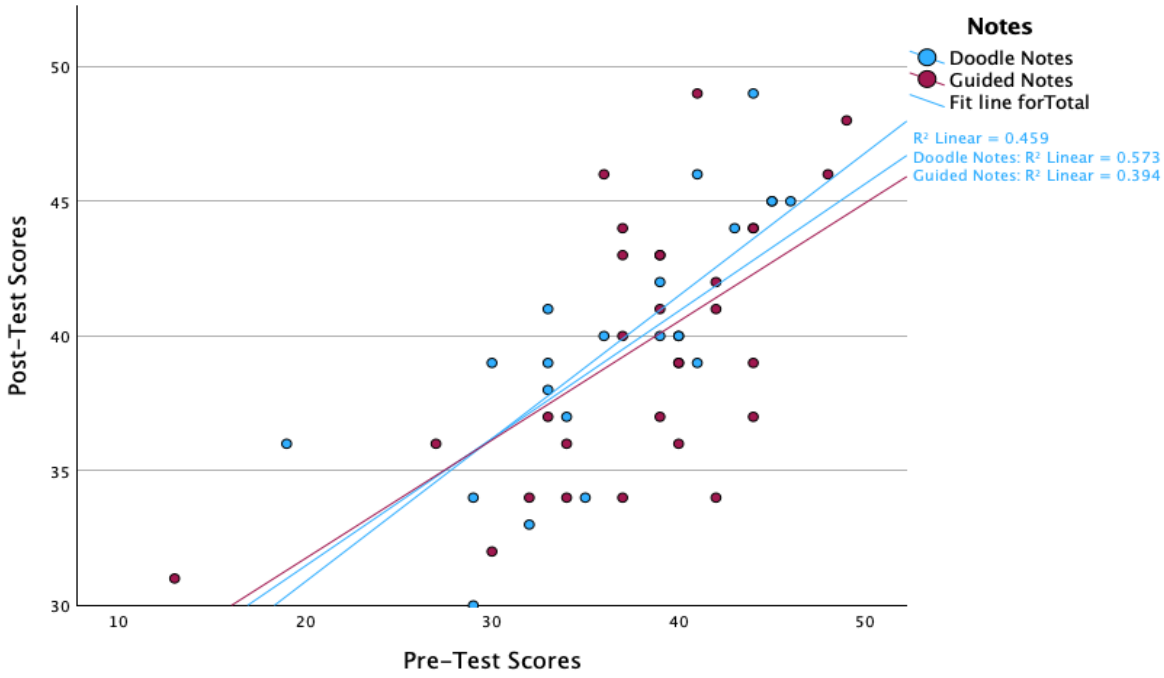

Figure 6

Scatterplot of Standardized and Predicted Residuals of Post-Test Scores by Notes for RQ3

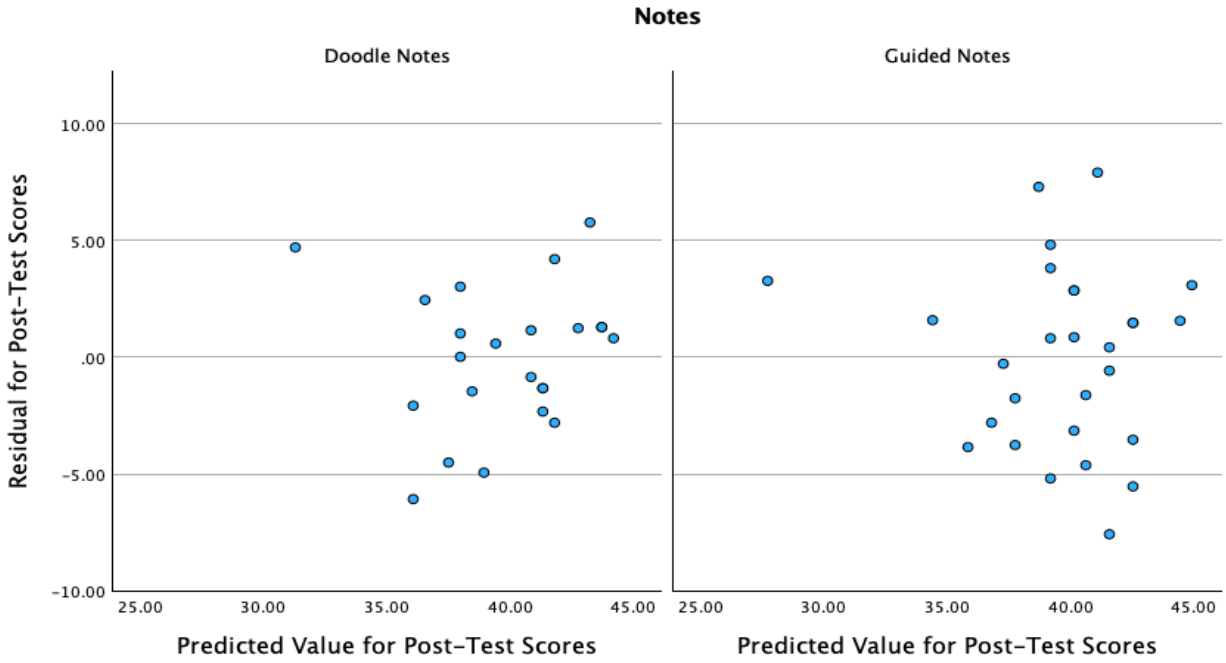

Table 5

ANCOVA Results for H_03

	Type III Sum of Squares	*df*	MS	*F*	Sig.	Partial Eta Squared
Notes	6.208	1	6.208	.493	.486	.010

CHAPTER FIVE: CONCLUSIONS

Overview

This chapter discusses the results of the findings. The researcher considers the existing literature and incorporates the findings of this study with what has been presented prior. The researcher provides information regarding the implications as well as details the limitations present. The chapter concludes with recommendations for future research.

Discussion

The purpose of this quantitative, quasi-experimental, nonequivalent control-group study is to explore the impact of guided doodle note-taking strategies on student reading comprehension. The researcher compared the results of a self-reporting tool from two groups, written guided note treatment and doodle note treatment. The researcher utilized a pre- and post-test model to control for previous knowledge and academic ability. The results were analyzed by gender, reflecting the specific research questions.

Null Hypothesis One

$H_0$1 considered if there was a difference in the self-reporting of reading comprehension skills between all students who completed guided doodle notes during lecture and those who completed guided written notes during lecture, when controlling for academic ability and previous knowledge. The researcher failed to reject $H_0$1. These results are like those found by Singh and Kashyap (2014) in that the use of doodle notes did not make a significant difference in reading comprehension when compared to guided notes. It also reflects similar findings to Nayar and Koul (2019), that showed a similar increase in reading comprehension skills in both note-taking treatments.

This study did not necessarily support the use of doodle note-taking as a better method of

note-taking in middle school. The results showed that both treatment groups resulted in a higher average scores on the post-test, creating the argument that any form of guided note-taking is beneficial (see Table 6). The study did not provide students with the opportunity to build an emotional connection with the doodles as mentioned in Lewis and Moffett (2020). The doodle notes were provided to the students pre-made without the opportunity to doodle on their own while listening. That connection piece was missing from the study which may have resulted in the lack of statistical significance.

Table 6

Post-test Scores per Note Form

	Mean	Minimum	Maximum
Doodle Notes	40.22	30	49
Guided Notes	30.00	25	50

The environment could have also impacted the findings. The teachers whose classrooms were utilized in the study were not interviewed before the experiment to determine the use of note-taking in their classrooms. The researcher cannot be certain that students were familiar with guided note-taking of any form prior to the study, nor could it be confirmed that students were skilled in notetaking procedures. The lack of understanding of how to properly take notes is a concern in the literature and could have impacted this study as well (Chen, 2021; Morehead et al., 2019). The researcher attempted to combat this issue by providing guided notes for both treatment groups based on the suggestions of existing literature, but this may have still had an impact on the success of the treatments (Colliot et al., 2021; Ward & Vengrin, 2021).

The definitions regarding the concepts for the theory of dual-coding is also considered with these findings. The researcher cannot specify that doodle note-taking was more significant

that guided note-taking, contradicting the concept of Paivio's (1974) theory that imagery supports memory. However, the action of writing may fall into the category of a non-verbal stimulus that creates the connection between that and the verbal stimulus (Paivio, 2014). The non-verbal stimulus of physically writing the information from the lecture is present in any form of note-taking. The imagery associated with the doodle notes may be less important than the physical input of writing the information.

This concept supports the literature surrounding generative learning strategies as well. Either form of note-taking, guided written notes or doodle notes, provide students with the opportunity to actively engage with the information. They are connecting a physical input of writing with the information being presented and are required to process what information needs to be written down. By providing students with any opportunity to interact and engage with the information, teachers are creating an environment that supports learning (Brod, 2020; Ponce et al., 2020).

Null Hypothesis Two

$H_0$2 considered if there was a difference in the self-reporting of reading comprehension skills between female students who completed guided doodle notes during lecture and those who completed guided written notes during lecture, when controlling for academic ability and previous knowledge. The researcher failed to reject $H_0$2.

The results show that the female doodle note-taking group had a higher average score than the male group by almost 1 point. The doodle note-taking group scored over 2 points on average than the guided note-taking group. These findings do not support the existing literature. This study found that, despite not being statistically significant, the female students benefitted more from the doodle note-taking strategy than the male students. This contradicts the studies

stating that females learn and process using more verbal methods while males are more likely to use non-verbal connections (Bartlett & Camba, 2023; Hill et al., 2014). However, this could be attributed to the concept of the findings of Uppstad et al. (2021), stating that the gender differences tended to even out by second grade. The participants in this study were all middle school students, placed in the seventh grade by the district through age placement or, in rare cases, being held back in a grade before. These participants were well past the second grade age range, meaning that the gender differences may not have been as significant as they would have been when the participants were younger. Females have also been found to benefit from note-taking strategies more. Perhaps note-taking in general is a strategy best suited for the female brain while males would benefit from a different strategy.

Null Hypothesis Three

$H_0$3 considered if there was a difference in the self-reporting of reading comprehension skills between male students who completed guided doodle notes during lecture and those who completed guided written notes during lecture, when controlling for academic ability and previous knowledge. The researcher failed to reject $H_0$3.

The existing literature set up the thought that male students would benefit from doodle note-taking more than female students. Males tend to use more visual or non-verbal tools in memory while females utilize more verbal tools (Bartlett & Camba, 2023; Hill et al., 2014). The researcher theorized that male students would show a higher increase in reading comprehension scores than female students. Males are more likely to connect their reading to prior knowledge, raising the question as to whether guided notes are beneficial for male students or if they would benefit from free doodling while taking notes instead (Acar-Erdol & Akin-Arikan, 2022). Another consideration is that males have a lower working memory than females, meaning that

perhaps the lower score could be attributed to this difference (Bedyńska et al., 2020).

Implications

The results of this study did not provide enough support to consider doodle note-taking a best practice in teaching methods. However, it did provide some insight to the benefits of guided note-taking as a whole. Despite not being statistically significant in the differences between doodle and guided note-taking treatments, the statistical analysis does support the concept of note-taking in general. The treatments both resulted in higher average scores for both male and female students and as a whole group. The results support the implementation of some form of note-taking strategy in the middle school classroom.

These findings also provided insight to the definition of non-verbal stimulus as noted in Paivio's (2014) dual-coding theory. The researcher originally interpreted non-verbal stimuli to mean images and using imagery to build stronger mental connections. However, this study has led to the consideration that the physical act of taking notes of any form could be considered as non-verbal stimulus. The vestibular input of writing, coloring, or drawing provides the motion and sensory input needed to activate the non-verbal part of the brain, connecting that with the verbal input of the lecture. This understanding highlights the potential for various applications of dual-coding theory within the classroom.

The researcher also took the lack of student input on the doodle notes into consideration. As Lewis and Moffett (2020) theorized, the emotional connection of doodling is important to its success as a tool to increase memory. Other studies supported the use of structured doodle note-taking strategies (Meade et al., 2019; Sundararaman, 2020). However, this study did not find that structured doodling benefitted the students any more than guided written note-taking.

Consideration could be given to the idea of unstructured doodling and giving the students more input on what to include on their notes.

Limitations

This study did have a few limitations that may have impacted the results. The first and possibly the most influential limitation is the violation of the ANCOVA assumptions during the data analysis. There was an outlier present in the RQ1 analysis, violating the assumption of no outliers. The outlier was ultimately kept because it represented a true score from a participant and represented a tremendous growth between pre- and post-tests, assumingly due to the notes they took. This violation was considered and disclosed in the results section. Another violation was present in the RQ2 analysis. This data violated the assumption of homogeneity of regression slopes. However, further research allowed the researcher the confidence to continue with the ANCOVA analysis. All regression lines were trending in a positive direction and the population data did not violate this assumption, so it was determined that the violation did not fatally impact the data (Kirk, 2013). Steps were taken to address these violations, including transformations of the data and the consideration of nonparametric analyses. However, neither of the options appropriately represented the data and it was determined that continuing with the ANCOVA analysis was the best option.

Other limitations included uncontrollable situations with the participant selection process. The researcher was unable to randomly select participants due to the nature of the setting. The use of pre-populated classes was the only accessible way to collect data. Another limitation was the use of parent consent forms rather than opt-out forms. The district required parent consent forms to be used, leading to a smaller sample because many students did not return the form

signed by a parent or guardian. An opt-out form would have allowed more participants and provided a more well-rounded view of the data.

In addition to the smaller sample size, all the participants were from the same school in the same district in the same state. This created a limitation of access and background knowledge. Sample bias could impact the results. This limitation could not be avoided but could be considered as a focus of the study. The participants of the study were all residentially zoned for the research site, meaning they all lived in a similar area regarding culture and access.

Time could also be considered a limitation of this study. The experimental portion of the study took place over the span of a week, with active participation only spanning three days. The short time frame may have led to bias in the results. The goal was to provide the highest amount of access for all students by utilizing a week for the time constraint. However, a week may not have been long enough to provide a true picture of the success of the note-taking strategies.

Recommendations for Future Research

This study opened several doors when considering future research. Many of the aspects of this study could be changed to consider different settings in which doodle note-taking may be beneficial. This study took place in one subject area, in one grade level, in one school, in one district, and in one state. The population alone provides a plethora of options for future research, including spanning multiple states for different standards, considering different subject areas, including students from a range of socio-economic levels and backgrounds, and more. The framework of this study could be applied to different age groups as well.

The researcher believes that conducting a study that spans the entire school year could also provide a better picture for the results. Utilizing the doodle note-taking strategy all year and

then comparing the end-of-year test scores to classrooms that utilized other forms of note-taking could give more in-depth insight to the benefits of each type of note-taking.

There is a need for more research like this study that focused on middle school-aged students. The researcher struggled to find existing literature on middle school students for this study, showing that the gap in the literature for middle school students is large. Middle school teachers need more research to support best practices and provide guidance on how to provide their students with the best quality educational experiences.

Another research topic to be considered is whether the physical action of taking any form of notes is as beneficial as images being used in note-taking, such as doodle notes. Paivio (1974) theorized that memory has both verbal and non-verbal systems, which could be interpreted as images and words. However, there is research that supported actions as non-verbal stimuli (Paivio, 2014; Schunk, 2020). More in-depth research on the variation of non-verbal stimuli could be beneficial in understanding more about how memory works and how information is stored.

These recommendations support the expansion of knowledge regarding note-taking and doodle note-taking specifically. Educators must have access to an expansive library of data to support best practices within their specific classroom. Focusing on specific grades, areas of the world, genders, and subject areas can provide educators with the information they need to provide their students with educational opportunities that will increase learning in the most effective ways possible.

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APPENDICES

APPENDIX A1: WRITTEN GUIDED NOTES

Reading Comprehension Strategies

What is Reading Comprehension?

Reading comprehension is
_____

It helps you:

- _____
- _____
- _____

These strategies will help you as you read any text you read!

- _____
- _____
- _____
- _____
- _____

Re-Reading

You should read a text 3 times:

1. _____
2. _____
3. _____

Inferencing

Inferencing means to make an educated guess

_____ + _____ = _____

Predicting

Using your inferences to predict what will happen next in the story

- _____
- _____

Visualizing

Good readers make _____ in their minds.

- _____
- _____

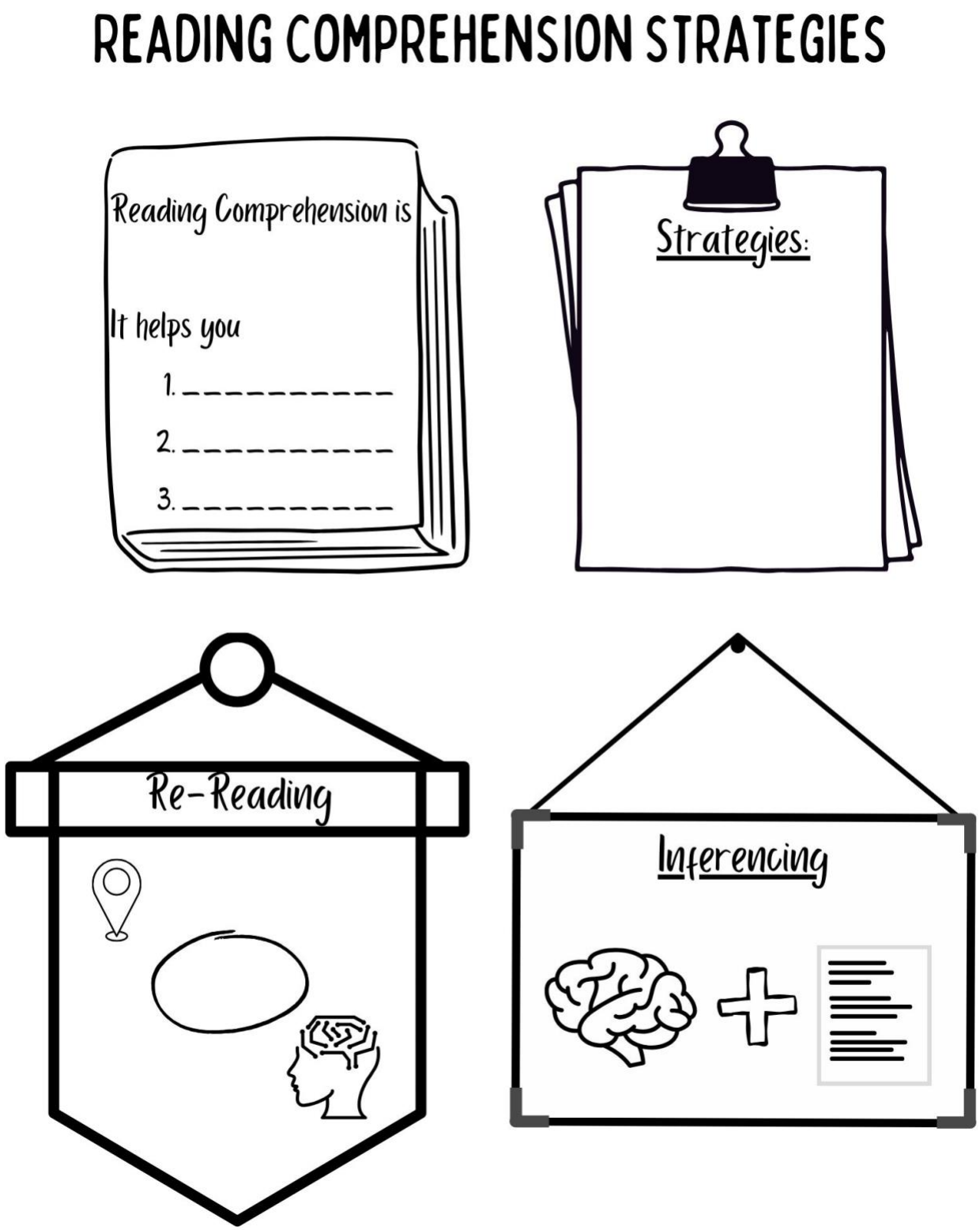
Summarizing

Being able to summarize what you've read means _____

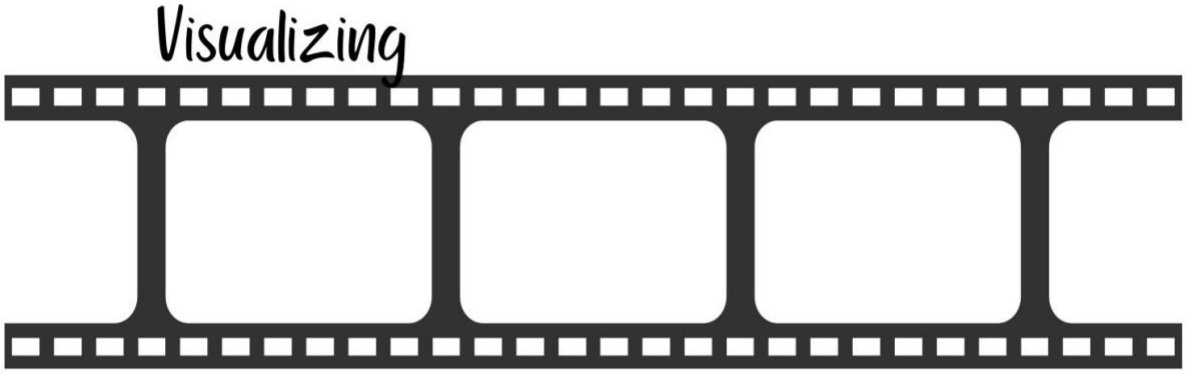
Can you tell me what you've read in _____ words?

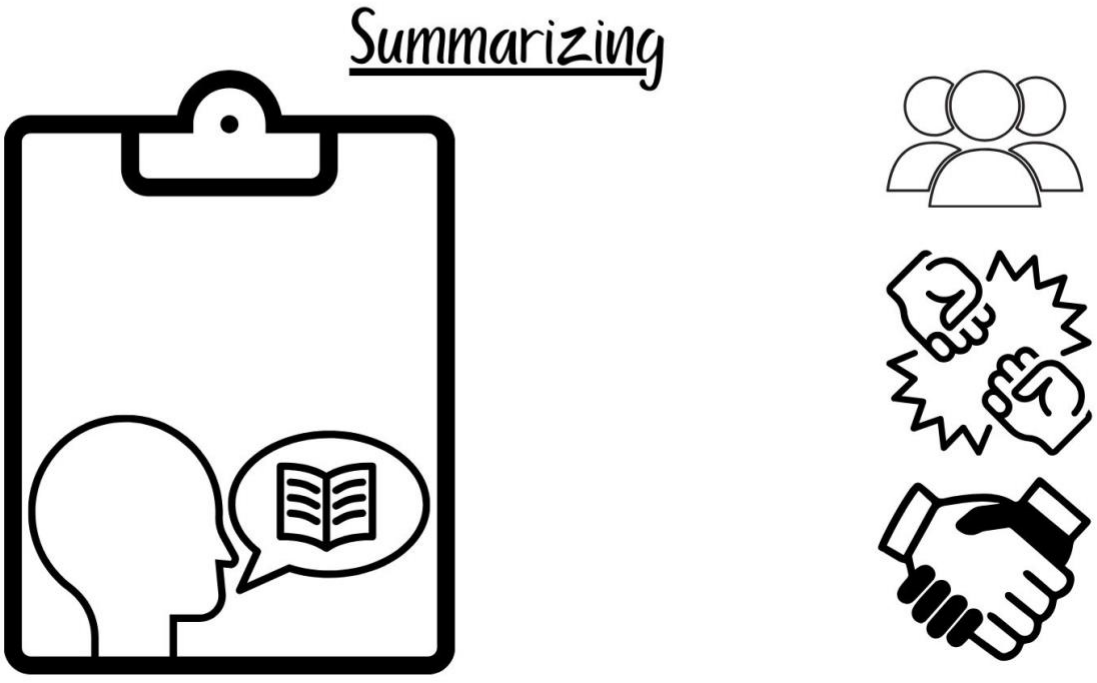
Consider the _____, the _____, and the _____.

APPENDIX A2: DOODLE GUIDED NOTES




Predicting


Visualizing


Summarizing

APPENDIX B: READING COMPREHENSION SCALE USAGE APPROVAL

From: Jasmin Villanueva <[redacted]
Date: October 23, 2023 at 4:51:24 AM EDT
To: "DeWald, Kayla Lorraine" [redacted]
Subject: [External] Re: Permission to Use Reading Comprehension Scale

---

[EXTERNAL EMAIL: Do not click any links or open attachments unless you know the sender and trust the content.]

Greetings!

Yes, you may. God bless and congratulations in advance!

On Mon, Oct 23, 2023, 7:17 AM DeWald, Kayla Lorraine [redacted] wrote:

> Hello Dr. Velasco and Dr. Villanueva,
>
> My name is Kayla DeWald, and I am a doctoral candidate at Liberty University. I am emailing to ask if you would allow me to use The Reading Comprehension Scale created by you both in 2022 as the instrument for my doctoral research. I am studying the impact of doodle notes on the reading comprehension of middle school students. Your instrument is a perfect measuring tool for my study.
>
> I'm looking forward to hearing back from you about this.
>
> Thank you,
>
> **Kayla DeWald, M.Ed.**
> Doctoral Candidate: Ph.D. Curriculum and Instruction
> Liberty University
> [redacted]

APPENDIX C: IRB APPROVAL

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

December 13, 2023

Kayla DeWald
Rebecca Lunde

Re: IRB Approval - IRB-FY23-24-813 THE IMPACT OF GUIDED DOODLE NOTE-TAKING ON READING COMPREHENSION: A QUASI-EXPERIMENTAL STUDY

Dear Kayla DeWald, Rebecca Lunde,

We are pleased to inform you that your study has been approved by the Liberty University Institutional Review Board (IRB). This approval is extended to you for one year from the following date: December 13, 2023. If you need to make changes to the methodology as it pertains to human subjects, you must submit a modification to the IRB. Modifications can be completed through your Cayuse IRB account.

Your study falls under the expedited review category (45 CFR 46.110), which is applicable to specific, minimal risk studies and minor changes to approved studies for the following reason(s):

7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects. 45 CFR 46.101(b)(2) and (b)(3). This listing refers only to research that is not exempt.)

For a PDF of your approval letter, click on your study number in the My Studies card on your Cayuse dashboard. Next, click the Submissions bar beside the Study Details bar on the Study Details page. Finally, click Initial under Submission Type and choose the Letters tab toward the bottom of the Submission Details page. Your stamped consent form(s) and final versions of your study documents can be found on the same page under the Attachments tab. Your stamped consent form(s) should be copied and used to gain the consent of your research participants. If you plan to provide your consent information electronically, the contents of the attached consent document(s) should be made available without alteration.

Thank you for your cooperation with the IRB, and we wish you well with your research project.

Sincerely,

G. Michele Baker, PhD, CIP
Administrative Chair
Research Ethics Office

APPENDIX D: PERMISSION FROM GUARDIANS

Dear Parent/Guardian,

As a doctoral candidate in the School of Education at Liberty University, I am conducting research as part of the requirements for a doctoral degree. The purpose of my research is to determine the impact of guided doodle note taking strategies on middle school student reading comprehension, and I am writing to invite your student to join my study.

Participants must be a seventh-grade student at Flat Rock Middle School. Participants will be asked to complete a 13-question pre-assessment, participate in a video lesson on reading comprehension, and then complete the 13-question assessment again. All classes will complete these exercises; however, while most classes will take guided written notes, one class will take guided doodle notes. It should take approximately 1 hour spread across three class periods in the span of one week to complete the procedure listed. Participation will be completely anonymous, and no personal, identifying information will be collected.

A consent document is attached to this letter and contains additional information about my research. For your student to participate, you will need to return the parental consent form to your student's ELA teacher.

Sincerely,

Kayla DeWald
IB/Magnet Coordinator – Flat Rock Middle School
[redacted]

Doctoral Candidate – Liberty University
[redacted]

Parental Consent

Title of the Project: The Impact of Doodle Note-Taking on Reading Comprehension: A Quasi-Experimental Study
Principal Investigator: Kayla DeWald, Doctoral Candidate, School of Education, Liberty University

Invitation to be Part of a Research Study

Your student is invited to participate in a research study. To participate, they must be a seventh-grade student at Flat Rock Middle School. Taking part in this research project is voluntary.

Please take time to read this entire form and ask questions before deciding whether to allow your student to take part in this research project.

What is the study about and why are we doing it?

The purpose of the study is to determine the impact of guided doodle note taking strategies on middle school student reading comprehension.

What will participants be asked to do in this study?

If you agree to allow your student to be in this study, I will ask them to do the following:

1. Complete a 13-question self-assessment on reading comprehension abilities. This should take 10-15 minutes in their ELA class.
2. Participate in a video lesson about reading comprehension strategies. One class will take guided doodle notes, while the other classes chosen for the study will take written guided notes. This should take about 30 minutes in their ELA class.
3. Complete the 13-question self-assessment again two days after the lesson was given. This should take 10-15 minutes in their ELA class.

All information will be de-identified meaning that your student's name and other information will not be included in the data. All students will receive the same educational information through the video lesson, but one class will be randomly selected to receive written guided notes as a control group.

How could participants or others benefit from this study?

The direct benefit participants should expect to receive from taking part in this study is a reinforcement lesson regarding best practices in reading comprehension.

Benefits to society include providing research-based evidence to support doodle notes in the classroom, informing K-12 teachers of best practices to use in the classroom, and allow for higher learning and retention rates in students.

What risks might participants experience from being in this study?

The expected risks from participating in this study are minimal, which means they are equal to the risks your student would encounter in everyday life.

How will personal information be protected?

The records of this study will be kept private. Published reports will not include any information that will make it possible to identify a subject. Research records will be stored securely, and only the researcher will have access to the records.

- Participant responses will be anonymous. No identifying information will be attached to the data collected.
- Data will be stored on a password protected computer that is only accessible by the researcher. After three years, all electronic records will be deleted.

Is the researcher in a position of authority over participants, or does the researcher have a financial conflict of interest?

The researcher serves as the Magnet Coordinator at Flat Rock Middle School. To limit potential or perceived conflicts, students will be assigned a numerical code , so the researcher will not know who participated. This disclosure is made so that you can decide if this relationship will affect your willingness to allow your student to participate in this study. No action will be taken against an individual based on her or his decision to allow his or her student to participate in this study.

Is study participation voluntary?

Participation in this study is voluntary. Your decision whether to allow your student to participate will not affect your or their current or future relations with Liberty University, Winston-Salem Forsyth County Schools, or Flat Rock Middle School. If you decide to allow your student to participate, they are free to not answer any question or withdraw at any time prior to submitting the survey without affecting those relationships.

What should be done if a participant wishes to withdraw from the study?

If you choose to withdraw your student from the study or your student chooses to withdraw, please have them exit the survey and close their internet browser. Your student's responses will not be recorded or included in the study.

Whom do you contact if you have questions or concerns about the study?

The researcher conducting this study is Kayla DeWald You may ask any questions you have now. If you have questions later, **you are encouraged** to contact her at

[redacted] You may also contact the researcher's faculty sponsor, Dr. Rebecca Lunde at [redacted]

Whom do you contact if you have questions about rights as a research participant?

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the IRB. Our physical address is Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA, 24515; our phone number is 434-592-5530, and our email address is irb@liberty.edu.

Disclaimer: The Institutional Review Board (IRB) is tasked with ensuring that human subjects research will be conducted in an ethical manner as defined and required by federal regulations. The topics covered and viewpoints expressed or alluded to by student and faculty researchers are those of the researchers and do not necessarily reflect the official policies or positions of Liberty University.

Your Consent

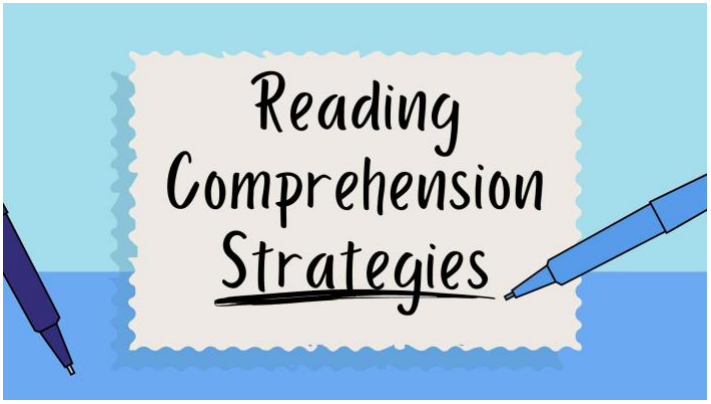
By signing this document, you are agreeing to allow your student to be in this study. Make sure you understand what the study is about before you sign. You will be given a copy of this document for your records. The researcher will keep a copy with the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

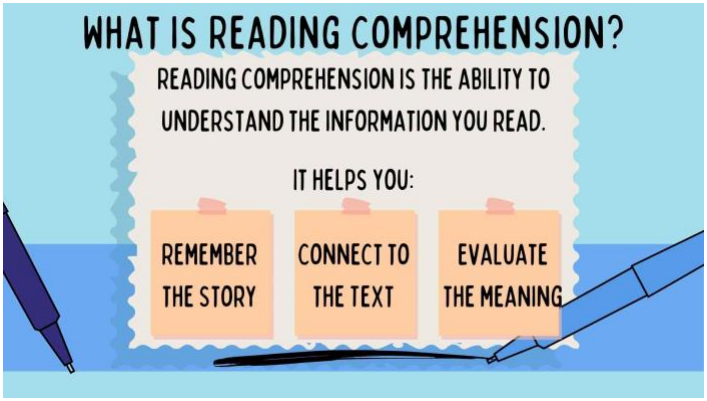
I have read and understood the above information. I have asked questions and have received answers. I consent to allow my student to participate in the study.

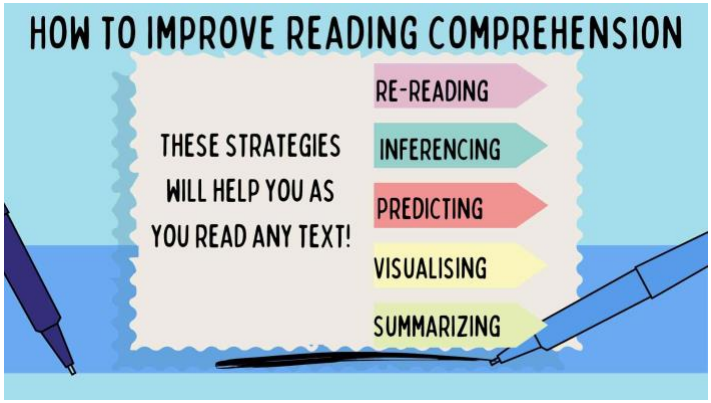
_____
Printed Child's/Student's Name

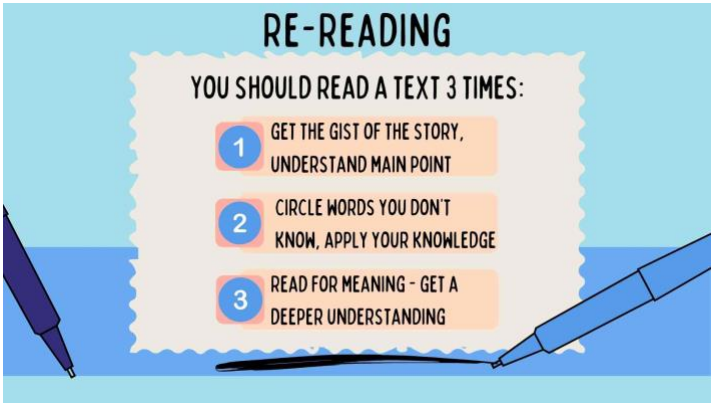
_____
Parent/Guardian's Signature Date

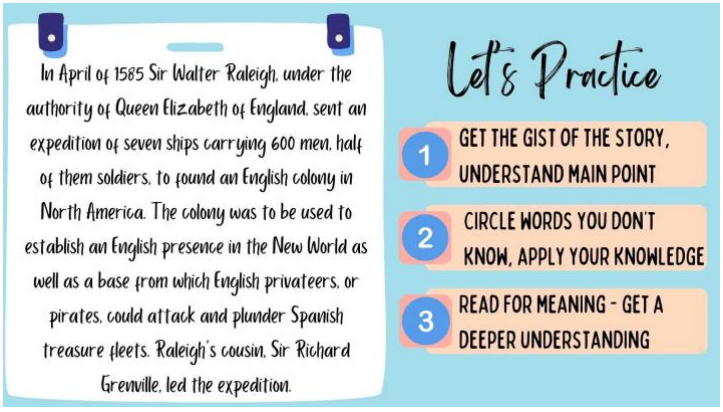
APPENDIX E: SLIDESHOW FOR INSTRUCTION

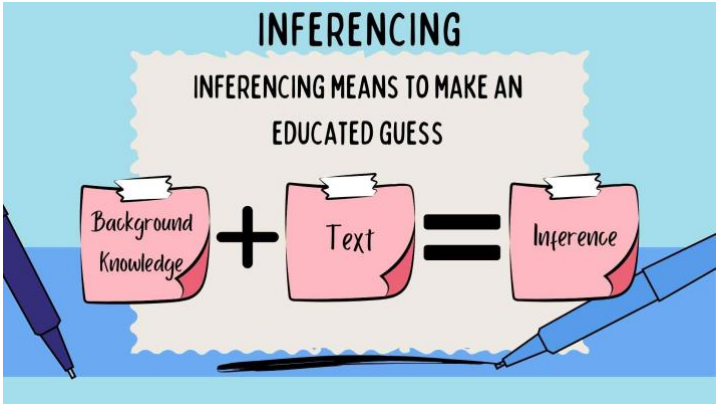


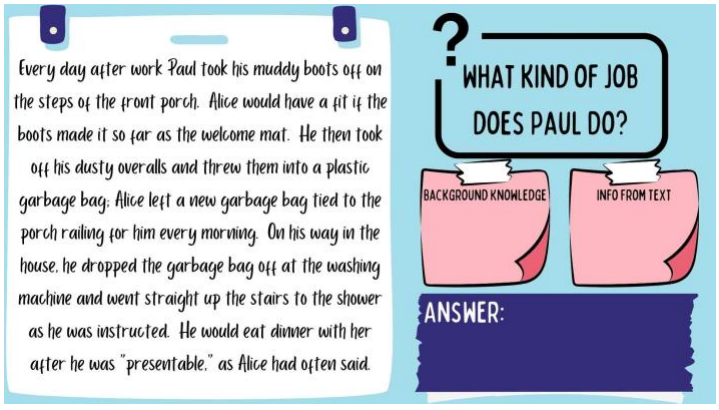


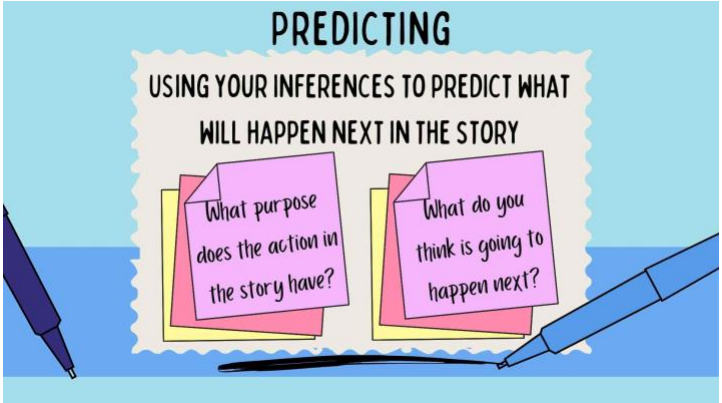


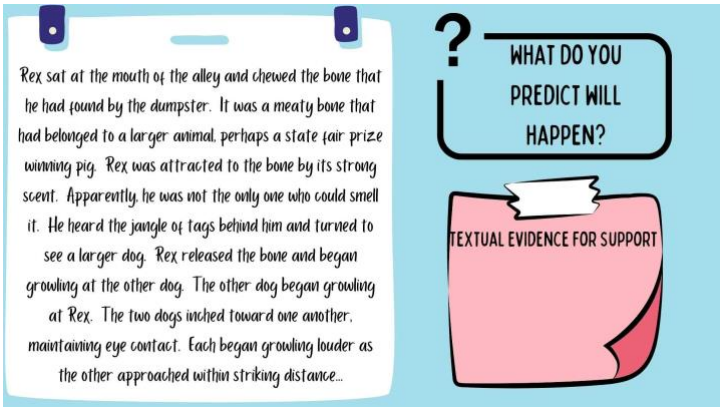


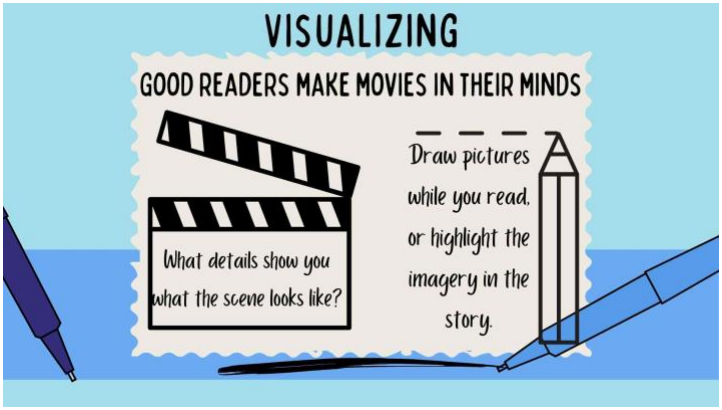


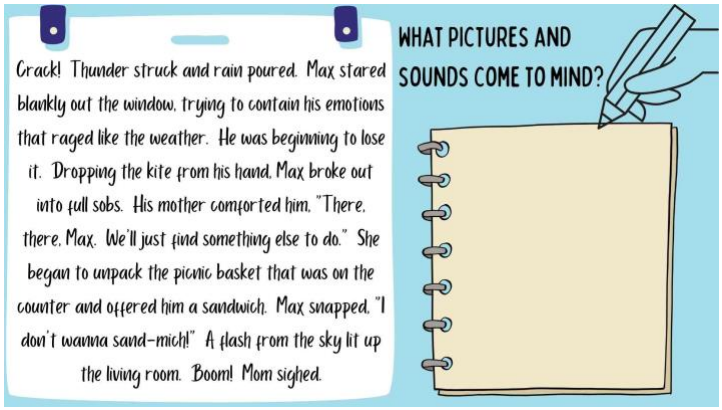


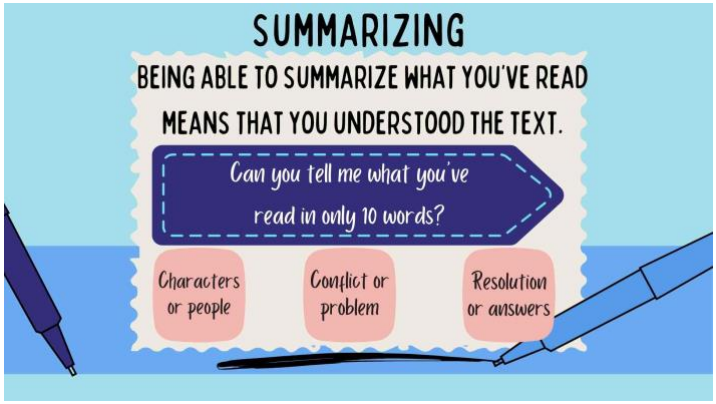


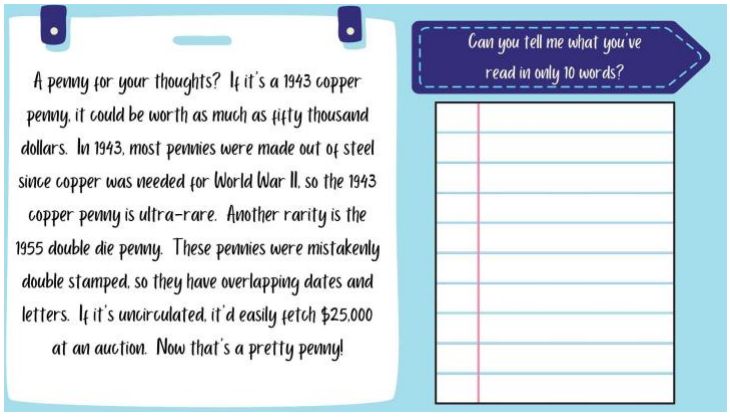



Rex sat at the mouth of the alley and chewed the bone that he had found by the dumpster. It was a meaty bone that had belonged to a larger animal, perhaps a state fair prize winning pig. Rex was attracted to the bone by its strong scent. Apparently, he was not the only one who could smell it. He heard the jangle of tags behind him and turned to see a larger dog. Rex released the bone and began growling at the other dog. The other dog began growling at Rex. The two dogs inched toward one another, maintaining eye contact. Each began growling louder as the other approached within striking distance...
WHAT DO YOU PREDICT WILL HAPPEN?
TEXTUAL EVIDENCE FOR SUPPORT

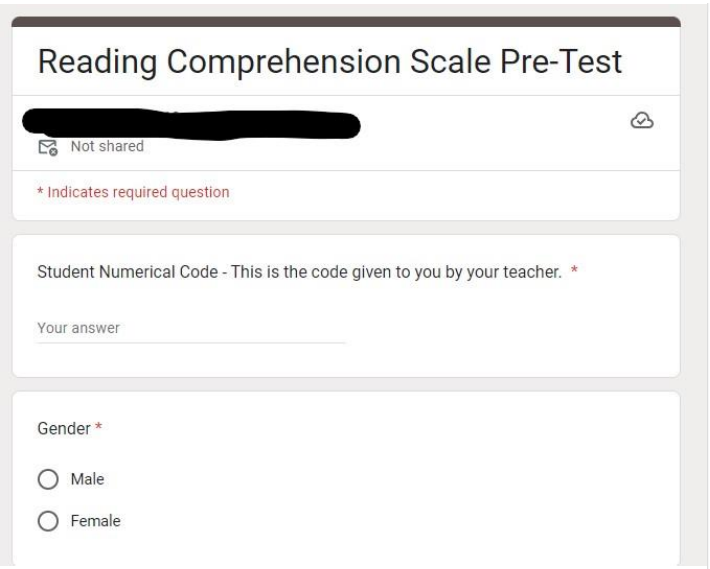

VISUALIZING
GOOD READERS MAKE MOVIES IN THEIR MINDS
What details show you what the scene looks like?
Draw pictures while you read, or highlight the imagery in the story.


Crack! Thunder struck and rain poured. Max stared blankly out the window, trying to contain his emotions that raged like the weather. He was beginning to lose it. Dropping the kite from his hand, Max broke out into full sobs. His mother comforted him. "There, there, Max. We'll just find something else to do." She began to unpack the picnic basket that was on the counter and offered him a sandwich. Max snapped, "I don't wanna sand-mich!" A flash from the sky lit up the living room. Boom! Mom sighed.
WHAT PICTURES AND SOUNDS COME TO MIND?


SUMMARIZING
BEING ABLE TO SUMMARIZE WHAT YOU'VE READ MEANS THAT YOU UNDERSTOOD THE TEXT.
Can you tell me what you've read in only 10 words?
Characters or people
Conflict or problem
Resolution or answers


A penny for your thoughts? If it's a 1943 copper penny, it could be worth as much as fifty thousand dollars. In 1943, most pennies were made out of steel since copper was needed for World War II, so the 1943 copper penny is ultra-rare. Another rarity is the 1955 double die penny. These pennies were mistakenly double stamped, so they have overlapping dates and letters. If it's uncirculated, it'd easily fetch $25,000 at an auction. Now that's a pretty penny!
Can you tell me what you've read in only 10 words?

APPENDIX FA: SCREENSHOTS OF ONLINE TOOL: PRE-TEST



Reading Comprehension Scale Pre-Test

[redacted]

Not shared

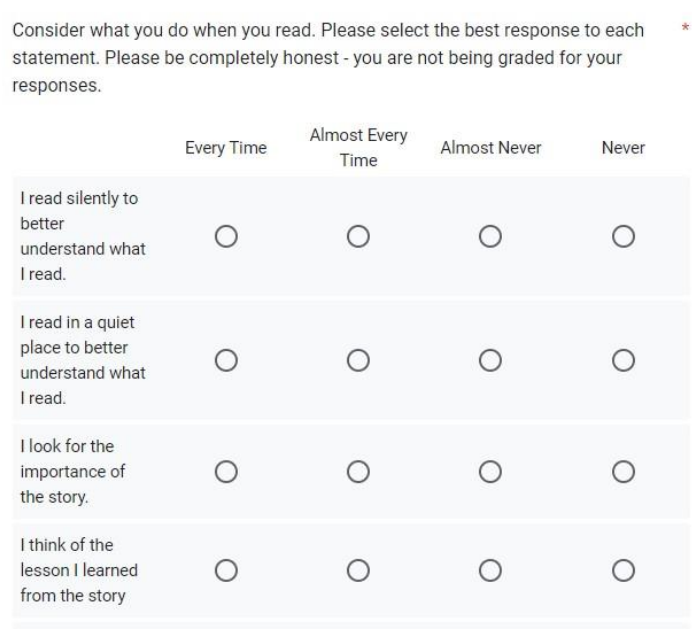
* Indicates required question

Student Numerical Code - This is the code given to you by your teacher. *

Your answer

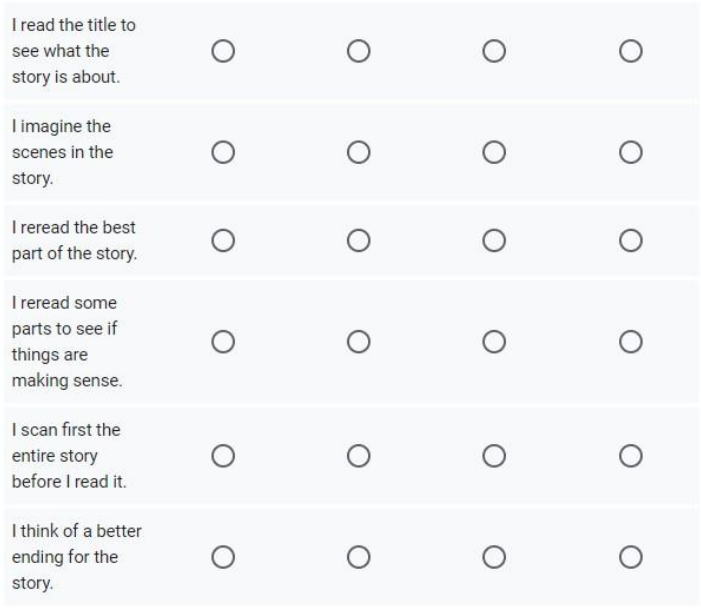
Gender *

- Male
- Female

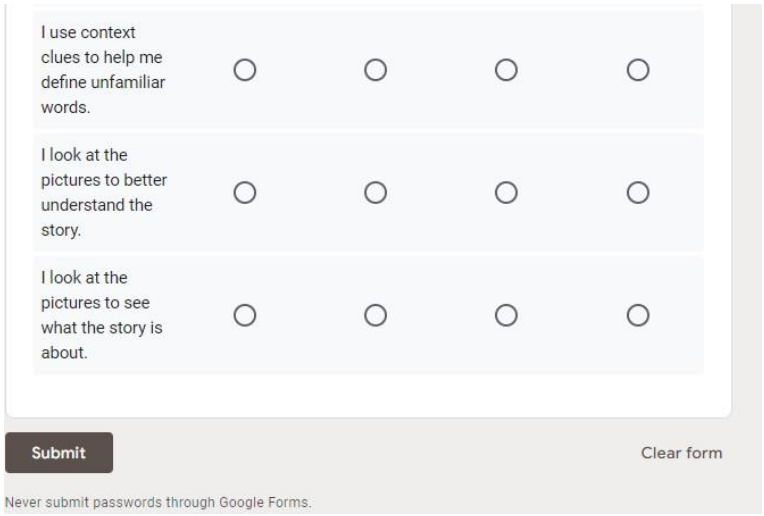


Consider what you do when you read. Please select the best response to each statement. Please be completely honest - you are not being graded for your responses. *

	Every Time	Almost Every Time	Almost Never	Never
I read silently to better understand what I read.	○	○	○	○
I read in a quiet place to better understand what I read.	○	○	○	○
I look for the importance of the story.	○	○	○	○
I think of the lesson I learned from the story	○	○	○	○



I read the title to see what the story is about.	○	○	○	○
I imagine the scenes in the story.	○	○	○	○
I reread the best part of the story.	○	○	○	○
I reread some parts to see if things are making sense.	○	○	○	○
I scan first the entire story before I read it.	○	○	○	○
I think of a better ending for the story.	○	○	○	○



I use context clues to help me define unfamiliar words.	○	○	○	○
I look at the pictures to better understand the story.	○	○	○	○
I look at the pictures to see what the story is about.	○	○	○	○

Submit

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Never submit passwords through Google Forms.

APPENDIX FB: SCREENSHOTS OF ONLINE TOOL: POST-TEST

Reading Comprehension Scale Post-Test

[redacted]

Not shared

* Indicates required question

Student Numerical Code - This is the code given to you by your teacher. *

Your answer

Gender *

- Male
- Female

Did your class do doodle notes or guided notes? *

If you were given colored pencils during the video, you will select "Doodle Notes." If you were given just the paper to write the notes on, you will select "Guided Notes."

- Doodle Notes
- Guided Notes

Consider what you do when you read. Please select the best response to each statement. Please be completely honest - you are not being graded for your responses. *

	Every Time	Almost Every Time	Almost Never	Never
I read silently to better understand what I read.	○	○	○	○
I read in a quiet place to better understand what I read.	○	○	○	○
I look for the importance of the story.	○	○	○	○
I think of the lesson I learned from the story	○	○	○	○
I read the title to see what the story is about.	○	○	○	○
I imagine the scenes in the story.	○	○	○	○
I reread the best part of the story.	○	○	○	○
I reread some parts to see if things are making sense.	○	○	○	○
I scan first the entire story before I read it.	○	○	○	○
I think of a better ending for the story.	○	○	○	○
I use context clues to help me define unfamiliar words.	○	○	○	○
I look at the pictures to better understand the story.	○	○	○	○
I look at the pictures to see what the story is about.	○	○	○	○

Submit

Clear form