Improving Long-Term Memory in Students in Early Childhood Education Through The Use of Multi-Sensory Interventions

By Angelique Bullock

Submitted in Partial Fulfillment of the Requirements for the

Degree of Master of Education

April 2021

Graduate Programs in Education

Goucher College

Table of Contents

List of Tables

Abstract

Elementary school teachers across the country spend a portion of their instruction time teaching their students high frequency sight words. However, students have a very hard time remembering the words they learn due to complexity, difficulty, or words no longer being familiar to them. Memory has long been viewed as a key aspect of learning, but as the emphasis in educational standards has shifted away from rote memorization and toward the knowledge and skills needed to process new information, working memory is increasingly taking center stage. There is considerable research on several theoretical aspects of working memory. These aspects include the role of the different components of working memory in early childhood learning, ways in which working memory is assessed in children, how working memory difficulties manifest in children, and ways in which working memory can be improved. The 35 participants in this study were evaluated using a list of high frequency sight words and five different types of multi-sensory strategies. This study was experimental, and this paper will discuss the functions of working memory in children and strategies that can be used to improve the retention rate for students in early childhood education.

CHAPTER I

INTRODUCTION

Memory is essential to learning, but it also depends on learning because the information stored in one's memory creates the basis for linking new knowledge by association. It is a symbiotic relationship which continues to evolve throughout our lives. Having a great memory can help children do better in school, perform well on tests, and achieve better grades. Working memory helps kids hold on to information long enough to use it. Working memory plays an important role in concentration and in following instructions. Weak working memory skills can affect learning in many different subject areas including reading and math.

Finding different teaching strategies to improve students' performance is a subject of great relevance to education (Ballarini et al., 2013). Intervention strategies in the classroom are important because it helps teachers identify each student’s need as individuals and place students in groups to help them collectively on different levels. Instructional intervention strategies also help students get into the routine of a daily schedule. Students are able to memorize what they should be doing at a certain time, keeping that memory muscle going.

Although memory is still developing in students at this age (7-8 years old), the early childhood period, it is important in building and acquiring the development of memory. Looking at long-term working memory development provides a new way to think about and plan for children. In order to be fluent readers, students need to be able to recognize sight words quickly and accurately as these words make up between 50-70% of the words we encounter in text (Ballarini et al., 2013). With the use of multi-sensory interventions to teach scholars sight words, students are found to be more engaged and learn to memorize certain words to facilitate their fluency as a reader.

Statement of Problem

Each year children in the second grade are presented with the task of learning 40+ sight words and high frequency words. Students often become discouraged and develop low self-esteem when not being able to learn and retain sight words. The purpose of this study is to see how multi-sensory interventions will assist in improving long-term memory in students in early childhood education.

Hypothesis

The directional hypothesis for this study is that while using multisensory strategies every day, for the same groups of students, to improve their memory, the researcher will see a change in students' memory post intervention which will cause an increase for sight words memorized on the post test.

Limitations

This study has potential limitations due to COVID and technology. With the transitions from virtual to in-person, some student data might take longer to retrieve than others. Participants may not always be in group when they need to be. Also, while being connected to the Baltimore City Public School System network, technology has the potential to not work or fail while an intervention group is in session. Times may need to be changed and some retests given due to these issues.

Operational Definitions

For the purposes of this study, the following terms will be used and defined as they are used in this paper.

- Long-Term Memory - the phase or type of memory responsible for the storage of information for an extended period of time.
- Working Memory - a cognitive system with a limited capacity that can hold information temporarily.
- Multi-sensory Interventions – helps students learn through more than one sense, usually done using sight, movement, touch, and hearing.
- Sight Words - words that do not fit standard phonetic patterns and must be memorized.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

Through daily observations, recapping information from previous lessons, and assessing them on what they have learned, it is clear that students do not retain the information that is being taught to them. There are many factors that inhibit students from retaining information, including distractions from peers, home life, and mental capacity, to name a few (Craik & Jennings, 1992). Using interventions to improve the long-term memory of students in early childhood education is what this literature review seeks to explore.

Section one provides information on long-term memory and defines what it is, the types of long-term memory, when memory develops in children, what working memory is, and its role. Section two takes a deeper look into the brain and its short-term vs. long-term memory functions. This section will also discuss why students forget, the forgetting curve, and the persistence of memory. The third section gives detail on what some of the problems are that students have with memory, the problems with working memory, and long-term memory storage and retrieval. The fourth and final section of the literature review examines the interventions and strategies for improving long-term memory. Descriptions will be given, as well as some benefits and outcomes.

Introduction to Improving Long-Term Memory

Long-term memory performs a crucial role in our lives. It helps people construct a firm foundation of memory and information that enables them to live a productive life. While it can be compared to files on a computer, studies have shown that long-term memory is not only enduring but prone to error if you don't improve it. It is most important in children because it is

an important part of building a solid foundation for learning, both in the classroom and beyond. Having a great memory can help students perform better in school, perform well on tests, and achieve better grades. Our minds decide to keep data or not to keep data, and after a decision is made to keep the data, it is forwarded to different parts of the brain and sorted by smell, color, shape, and so forth (Craik & Jennings, 1992). Emotion plays an important role in this process: the stronger the feelings caused by the memory, the easier it will be recalled later. Reinforcement by practicing or drilling also strengthens long-term memory, which matters because if the ability to store and retrieve information is poor, wrong conclusions and wrong answers will result (Tulving, 1985).

Traditionally, the construct of memory has been divided into a number of different types, defined largely in terms of the length of time over which information is retained or stored. For example, memory is divided into a very brief (on the order of milliseconds) sensory store for visual or acoustic properties of a stimulus; short-term or working memory, in which information can be stored and manipulated for about twenty seconds, and long-term memory, in which information can be stored virtually permanently (Craik & Jennings, 1992). Long-term memory can be further divided into storage of procedures or skills, such as how to tie a shoe, and storage of explicit or declarative memories, such as memories of personal events or of general knowledge about the world.

What is Long-Term Memory?

Long-term memory is anything you remember that happened more than a few minutes ago. Long-term memories can last for just a few days or for many years (Tulving, 1985). Long-term memories are not all of equal strength. A six-year-old, for instance, can remember events from before her first birthday, but by adolescence, she has probably forgotten that celebration. In

other words, young children can likely make long-term-like memories, but these memories typically fade after a certain age or stage of brain development (Tulving, 1985). Theoretically, the capacity of long-term memory could be unlimited, the main constraint on recall being accessibility rather than availability.

Our conscious mind may not be aware of the information stored in long-term memory. But this information can be recalled with ease and accuracy. Examples of long-term memory are the recollection of an important event in distant past or bicycle riding skills someone learned in childhood. Some things easily become part of long-term memory while others may need continuous practice to be stored for a long time (Tulving, 1985). It also varies from person to person. Some people can remember complex things with little or no difficulty while others may struggle in remembering easier and daily life information. A number of researchers have shown that different types of long-term memories are stored in different parts of the brain.

Types of Long-Term Memory

Long-**t**erm memory is divided into two main parts, with other sub-divisions to follow. The two parts are explicit memory and implicit memory. Explicit memory usually refers to all the memories and information that can be evoked consciously (Roediger, Marsh, & Lee, 2002). The other name used for explicit memory is declarative memory. Implicit memory is the opposite of declarative memory and refers to the movement of the body in using objects. An example of implicit memory would be how to ride a bicycle. Writing, riding, driving, and swimming are all examples of implicit memory because they are non-declarative. Explicit or declarative memory is divided into two types: episodic and semantic memory.

1. **Episodic Memory**

- Episodic memory stores information about events that happen in a person's life. It refers to knowing the time and place and details of events. Some examples of episodic memory would be the memory of first day of marriage, or memory of a tour to another country and all the events that happened there (Roediger, Marsh, & Lee, 2002).

2. **Semantic Memory**
    - Semantic memory is responsible for the storage of factual information such as the meaning of words or general knowledge of things. An example of semantic memory would be knowing that Jupiter is the biggest planet of the solar system (Roediger, Marsh, & Lee, 2002). Semantic memory involves conscious thought. Very few differences have been seen in the encoding of semantic information in adults and younger people.

The four types of Implicit Memory are as follows:

1. **Procedural Memor**y
    - Procedural memory is the memory of motor skills, and it is responsible for knowing how to do things. This memory is automatic; it works at an unconscious level. Procedural memories are non-declarative and retrieved automatically for in procedures that involve motor skills (Roediger, Marsh, & Lee, 2002). For example, riding a bicycle is a type of procedural memory.
2. **Associative Memory**
    - Associative memory usually refers to the storage and retrieval of specific information through association. The acquisition of this type of memory is carried out with two types of conditioning. One is classical conditioning and the other is

operant conditioning. Classical conditioning refers to the learning process in which stimuli and behavior are associated (Craik & Jennings, 1992). On the other side, operant conditioning is a learning process in which new behaviors develop according to the consequences.

3. **Non-associative**
    - Non-associative memory refers to the learning of new behaviors mainly through repeated exposure to a single type of stimuli. The new behavior is classified into habituation and sensitization. Habituation is the decrease in response to repeated stimuli while sensitization is an increased response to repeated stimuli (Craik & Jennings, 1992).
4. **Priming**
    - Studies have shown that exposure to certain stimuli influences the response of a person to stimuli that are presented later. This effect of previous memory on new information is what we call priming.

When Does Memory Develop in Children?

Children begin forming explicit memories around the two-year mark, but the majority are still implicit memories until about seven years old. This is what researchers, like Carole Peterson from Canada's Memorial University of Newfoundland, call “childhood amnesia” (p. 52). Remembering begins with understanding, and children learn about memory by talking with others and by experiencing life events within their environments. If children experience events that they do not fully understand, they are less likely to remember the event (or to recall events correctly).

Although memory is not fully developed in infancy, the early childhood period (birth through age eight) is important in building and acquiring the development of memory (Giedd et al., 1999). Looking at memory development provides a new way to think about and plan for children. Memory development not only takes you back to experiences that hold meaning, but it is a complex cognitive ability that is important in many aspects of thinking and learning, such as language and literacy, planning, following directions, problem solving, reflecting, imagining, and the overall ability to form a positive sense of self (Giedd et al., 1999).

From the first breath of life, the opportunity to think backwards, or to develop memory, begins. It is important that we understand memory and memory capacity. A child's memory capacity isn't necessarily the size of their memory, but rather how much children can do with their memory (Giedd et al., 1999). Although young children are extremely capable in many ways, their memory capacity is limited in early memory development.

What is Working Memory and its Role?

Working memory is one of the brain's executive functions. It is the ability to hold on to new information, so we can turn around and use it in some way. Working memory allows us to hold information without losing track of what we're doing. Children need this ability to perform well in school. Researchers believe working memory is central to the functioning of the mind. It correlates with many more general abilities and outcomes—things like intelligence and scholastic attainment—and is linked to basic sensory processes (Cockcroft, 2015).

There are a number of products and services, such as CogMed and Play Attention, that one can use to help train their brain and improve working memory. Other research has shown that brain training delivers significant improvements in working memory if a person commits to sticking with it. There are at least two types of memory problems, with working memory and

long-term memory, which can lead to difficulties in learning. Problems in working memory can lead to difficulties in learning because the individual may have less space in working memory for organizing and integrating new skills or knowledge (Cockcroft, 2015). Teaching kids ways to visualize thoughts can help improve their working memory. Card games and other fun activities can help build working memory. Finding ways to connect information can help you're a child with long-term memory as well as working memory.

The Brain and its Functions

Many scientists believe that the entire brain is involved with memory. However, other scientists have been able to look more closely at the brain and memory. They have argued that memory is located in specific parts of the brain, and specific neurons can be recognized for their involvement in forming memories (Wagner et al., 1998). The main parts of the brain involved with memory are the amygdala, the hippocampus, the cerebellum, and the prefrontal cortex. The hippocampus, for example, is essential for memory function, particularly the transference from short- to long-term memory and control of spatial memory and behavior. The hippocampus is one of the few areas of the brain capable of actually growing new neurons, although this ability is impaired by stress-related glucocorticoids (Wagner et al., 1998). The amygdala also performs a primary role in the processing and memory of emotional reactions and social and sexual behavior, as well as regulating the sense of smell.

It is thought that long-term memories differ from short-term memories in the aspect of their longer duration. But the difference between these two types depends upon their definition by someone. Defining both types of memories in clear terms is the first step of differentiating between them. Long-term memory has a duration of months and years while short-term memories are thought to stay only a few seconds (Cockcroft, 2015). There is also a difference in

capacity. Short-term memory stores only a tiny bit of information. On the other hand, the capacity of long-term memory is thought to be unlimited.

Why Students Forget

Forgetting is normal under certain circumstances, but in school, forgetting leads to low grades and sometimes dismissal. Some reasons why students forget are interference, mind overcrowding, negative thinking, under learning material, effort and intention lacking, and disuse, to name a few. Learned material interferes with recall of previously learned material. Too much input at one time into the senses inhibits learning and remembering (Wagner et al., 1998). That is why it is normal to experience poor learning and recall when studying with the stereo on, TV going, talking in the background, and worrying about personal problems, etc. Students who believe that they cannot remember are the ones most likely to forget. They must be able to believe they can remember, before a teacher believes they can (Wagner et al., 1998)
Learning is a process that takes time and repetition for humans to move information from short-term memory toward long-term memory (Craik, 1992). This explains why when material is reviewed once or twice; it is difficult to remember for quizzes and exams. With the tight schedules of today's school, for students and those who have not yet mastered the skills, sufficient review is critical to learning. Most forgetting takes place immediately after hearing or seeing new material. To address disuse, students must regularly recite and review material to be remembered until it is stored in long-term memory. Then it is less likely they will forget (Wagner et al., 1998).

Furthermore, people's minds do what they tell it to do, for the most part. If someone does not intend to remember something, they are telling their mind, indirectly, not to remember, so

they do not (Craik, 1992). Teachers should tell their students what they should remember, and students should also tell themselves what they should remember.

The Forgetting Curve

The forgetting curve shows how brains are different and how they can learn anything, which means they need to filter out the important from the trivial. Luckily, understanding how the curve works makes it easier to learn things that may not be necessary for survival but are deeply rewarding (Mayer, 2017). Today, the kinds of things humans want to learn are rarely focused on survival. The forgetting curve is a mathematical formula that describes the rate at which something is forgotten after it is initially learned (Mayer, 2017). The idea is over 100 years old. It originates in the late 19th century, with German psychologist Hermann Ebbinghaus, who was among the first scientists to perform experiments to understand how memory works. Another way of putting it is that the forgetting curve is initially very steep.

Problems Students have with Memory

Many students have memory problems and those problems have lasting effects on them both in school and out of school. Students who have deficits in registering information in short-term memory often have difficulty remembering instructions or directions they have just been given, what was just said during conversations and class lectures and discussions, and what they just read. Problems in working memory can lead to difficulties in learning because the individual may have less space in working memory for organizing and integrating new skills or knowledge (Richardson, Longoni, & Masi, 1996). This can affect the individual's ability to follow directions, organize thoughts for speaking and writing, and learn multi-step procedures or process information quickly. Teachers and parents may see gaps in skills and lack of self-confidence for learning new things. It is common for teachers and parents to assume the student

is lazy or unmotivated. Meanwhile, the student feels inadequate and incompetent in their ability to learn.

When parents and teachers misinterpret the symptoms of a working memory problem, they may respond to the student in ways that lead the student to behave in a disruptive manner, withdraw from others, refuse to try to learn new things, and talk of hating school (Richardson et al.,1996). A long-term memory problem may affect what information is recalled, the time it takes an individual to recall information, or a person's ability to remember things in the correct order or sequence. The individual may be disorganized, confused, or disoriented when presented with a series of directions or steps in learning new material. He/she may confuse the order of syllables in a word or phrase. It may be the case that the student knows what he/she wants to say but cannot organize the ideas, find the right word, or communicate their thoughts in a clear manner. This difficulty may affect speech as well as writing skills.

Problems with Working Memory

Working memory difficulties often co-exist with other issues, such as dyslexia, dyspraxia and AD/HD but they can also be a stand-alone problem (Baddeley, 2002). It can be hard for people to get their head around what working memory actually is, let alone how to go about reducing the impact of a working memory problem on a child's learning. Working memory may be useful and flexible, but information held in working memory is easily lost through distraction or overload. There is also a substantial variation in working memory capacity between individuals. Those with poor capacities will therefore struggle to meet the heavy working memory demands of many situations, of which the classroom is a prime example (Baddeley, 2002). In children with poor working memory it is much like a bucket that has a hole in the

bottom. You can keep tipping in glasses of water (information/knowledge), but it continually drains out (Baddeley, 2002).

Problems with Long-Term Memory Storage

When information comes into our memory system (from sensory input), it needs to be changed into a form that the system can cope with, so that it can be stored. Of course, there are questions about where the information is stored, how long is it stored for, and what kind of information is held. The problem comes in when students do not understand why they have remembered the information; they may find it does not make sense to them (Wan, 2007). Because of their working memory problems, students' brains will not package it properly in the first place. If children learn information in a disjointed way, they have trouble using it later (Rohrer et al., 2005). Children who have experienced trauma will more than likely have problems remembering important information. Most will forget right before an injury occurs.

Problems with Long-Term Memory Retrieval

Memory-retrieval problems can range from "tip-of-the-tongue" struggles to an inability to describe a missing word or thought, to amnesia, or complete inability to access information (Rohrer et al., 2005). Other thoughts may intrude, information may be recalled incorrectly, or messages may be lost among other information. This can mean that the information is no longer stored or that there is some sort of internal or external interference with the memory. It is extremely important to note that retrieval can occur only if both registration (encoding) and storage have taken place (Rohrer et al., 2005). It is based on cues that trigger your memory of how the information was first registered. Smells, sights, sounds, and emotions, for example, are often linked to memories; this is why hearing an old song can momentarily take you back to the past.

Interventions and Strategies to Improve Long-Term Memory

It has been suggested that diverse interventions applied within children's everyday contexts have the potential to improve working memory (WM) and produce transfer to real-world skills, but little is known about the effectiveness for some of these approaches. The common ingredient across effective interventions is the executive-loaded nature of the trained task, including training on a task that taps into attentional and processing resources under executive control and not just the storage of information (Ballarini, Martinez, Diaz, & Moncada, 2013). There are several approaches one could take to improve the working memory in early childhood students. A few are listed below.

Interventions and their Descriptions

1. Focused Attention

   Attention is one of the major components of memory. In order for information to move from your short-term memory into your long-term memory, you need to actively attend to this information (Ballarini et al., 2013). Students should be encouraged to study in a place free of distractions such as television, music, and other diversions. Getting rid of distractions might be a challenge, especially if a person is surrounded by noisy children.

2. Directions in multiple formats

   Students benefit from being given directions in both visual and verbal formats. In addition, their understanding and memorizing of instructions could be checked by encouraging them to repeat the directions given and explain the meaning of these directions. Examples of what needs to be done are also often helpful for enhancing memory of directions.

3. Over-learning material

Students should be taught the necessity of "over-learning" new information. Often, they practice only until they are able to perform one error-free repetition of the material. However, several error-free repetitions are needed to solidify the information (Kienapple & Lange, 1979).

4. Visual images and other memory strategies

Another memory strategy that makes use of a cue is one called word substitution. The substitute word system can be used for information that is hard to visualize, for example, for the word occipital or parietal (Kienapple & Lange, 1979). These words can be converted into words that sound familiar that can be visualized. The word occipital can be converted to exhibit hall (because it sounds like exhibit hall). The student can then make a visual image of walking into an art museum and seeing a big painting of a brain with big bulging eyes (occipital is the region of the brain that controls vision) (Ballarini et al., 2013). With this system, the vocabulary word the student is trying to remember actually becomes the cue for the visual image that then cues the definition of the word.

Again, these are just a few interventions and strategies that one could use for the improvement of memory in early childhood students.

Outcome and Benefits of Interventions

Measurable and obtainable goals should be listed when trying any type of intervention. Performance can be measured by something as simple as total number of words recalled. Children who have working memory deficits are the ones who might benefit the most from the practice they may receive from an intervention (Kienapple & Lange, 1979). It is a matter of training the brain to do what you want it to do. The benefits can have long term effects which help them further down the line in middle school, high school, college and just life in general.

Other benefits include, but are not limited to, better grades on tests and examinations, higher self-confidence, since remembering facts and formulas will no longer be a problem, reduced anxiety and frustration since learning is made easier, improved sleep quality, and improved social interaction.

Routines, such as cleanup, can also help children form memory. By repeating behaviors, children's knowledge base increases and becomes more organized. Through repetitive routines, children can fully process information, and responses are remembered and become more automatic (Kienapple & Lange, 2013). It is suggested to keep routines simple and consistent and break activities into steps and introduce steps gradually.

Conclusion

In short, a look at memory development helps to provide intentional opportunities for children to begin to think backwards, to develop effective memory, and to acquire skills in all developmental domains. It also provides resources to grow meaningful life stories to share. Working memory involves the conscious storage and manipulation of information that is integral to the performance of complex cognitive tasks (Atkinson & Shiffrin, 1968). It is clear that working memory develops throughout childhood. Because working memory underlies so much of mental functioning, it is important to understand its development, as well as the sources and implications of individual differences in it. Memory is essential to learning, but it also depends on learning because the information stored in one's memory creates the basis for linking new knowledge by association (Shamsul & Penelope, 2010). It is a symbiotic relationship which continues to evolve throughout our lives. A good teacher always presents the information in multiple ways, so students learn which way works best for them. All student can learn, just not in the same way or on the same day.

CHAPTER III

METHODS

This study attempted to determine if using multisensory intervention strategies would improve the long-term memory of early childhood education students. The question being researched was this: Would students react positively or not at all to the interventions?

Design

The research methodology used in this study was an experimental approach through observation of the five groups using different multisensory interventions. This study used a pretest/posttest design, and the students in each group were observed before and after the intervention of varying multisensory memory activities. Observations of the student groups took place in a small group setting for 15 minutes a day. The interventions which were used in this study paired each group of students with a teacher from their classroom, working in a seven-to-one setting, on the skill of student retention of sight words when using certain multisensory interventions.

Participants

In this study, 35 elementary school age boys and girls participated, seven students each from five classes. All participants were second graders and ranged in age between seven and eight years old. These students were chosen at random and performed in the below and well below categories when assessed because the researcher wanted to determine whether a student's memory could be impacted by the use of different interventions in order to prepare for an assessment.

Instrument

There were five multisensory interventions given, one to each group of seven students. The computer-based interventions were music training, visual repetition, routines, sequencing, and reading and writing to build words. Using a computer-generated resource (Zoom breakout rooms), students were placed in five groups of seven. The rooms were titled using the names of the interventions. The multisensory room consisted of reading, building, and writing words, tapping out sounds, and shared reading using a virtual flip book. The music training room involved listening to songs containing sight words. Visual repetition used Google Slides that reviewed over sounds, CVC Words, and sight words. The students who werein the routine room practiced high frequency words by repeating basic daily routines. The students placed in the sequencing room worked on words and sounds by following specific directions and placing digital cards in their correct order. These are generalized interventions and were subject to change given new findings of intervention resources.

Procedure

The research study had to be adapted due to COVID-19 protocols and limited access to participants. The data collected in this study was composed during small group virtual sessions, on Zoom, in daily 15-minute intervals. The researcher wanted to observe the reaction of students when given the same daily intervention activities to help them remember instruction and then take an assessment based on that same instruction, in this case, high frequency words.

Upon the approval of the design, a pretest was administered to the 35 students in the study to collect the first set of data. This test consisted of a set of 130 words, and students were given one minute to see how many words they could say correctly. Once this data was collected, students began daily interventions. Group 1 was given the multisensory strategy, Group 2 the music

training, Group 3 the visual repetition strategy, Group 4 the different routines that would help them remember high frequency words, and Group 5 the sequencing strategy.

Students were observed for four weeks, after which a posttest was given. This test consisted of the same set of words from the pretest. Students were again given one minute to see how many words they were able to say. Data was collected and placed into a chart which can be viewed in Chapter IV.

CHAPTER IV

RESULTS

The researcher tested a group of 35 students. All participants were given a posttest, that was administered inside the school building due to COVID restrictions being changed. Each group was given a different intervention as listed below in the table. These interventions were done virtually via Zoom even though students were in the school building. All participants in the study showed increase in memorizing words by +2 words but no more than +11 words. Students who were in the Multisensory group, had a collective increase of 44 words remembered. Students who were using Visual Repetition, collectively increased by 59 words. The Music Training group had a collective increase of 50 words. The Sequencing Intervention group increased a total of 50 words, and the students who participated in the Basic Routine Intervention increased by a total of 53 words remembered.

Due to the use and repetition of several different interventions, the part of the brain where the long-term memory resides, was activated. Although all participants showed growth using these interventions, all interventions statistically performed similarly. With the constant change from virtual to in-person, other factors such as limited distractions, environmental changes have to be considered.

Table I

Pre-Assessment/ Post-Assessment Data

The goal for each group was to read 36 or more words in one minute. Students were placed into these intervention groups after the pre-assessment data was obtained. When interventions are completed, a post-assessment will be given using the same set of words.

Multisensory Intervention	Pre-Score (words read)	Post-Score (words read)	Increase Amount (+/-)
Student 1	22	28	+6
Student 2	27	29	+2
Student 3	13	22	+9
Student 4	20	28	+8
Student 5	10	16	+6
Student 6	28	38	+10
Student 7	30	33	+3

Visual Repetition Intervention	Pre-Score (words read)	Post-Score (words read)	Increase Amount (+/-)
Student 1	7	17	+10
Student 2	18	25	+7
Student 3	21	30	+9
Student 4	18	29	+11
Student 5	25	34	+9
Student 6	29	34	+5
Student 7	12	20	+8

Music Training Intervention	Pre-Score (words read)	Post-Score (words read)	Increase Amount (+/-)
Student 1	31	33	+2

Student 2	28	33	+5
Student 3	14	24	+10
Student 4	16	27	+11
Student 5	9	19	+10
Student 6	22	27	+5
Student 7	24	31	+7

Sequencing Intervention	Pre-Score (words read)	Post-Score (words read)	Increase Amount (+/-)
Student 1	18	22	+4
Student 2	13	18	+5
Student 3	25	31	+6
Student 4	32	40	+8
Student 5	30	38	+8
Student 6	30	41	+11
Student 7	28	36	+8

Basic Routine Intervention	Pre-Score (words read)	Post-Score (words read)	Increase Amount (+/-)
Student 1	12	18	+6
Student 2	6	10	+4
Student 3	11	20	+9

Student 4	21	32	+11
Student 5	23	30	+7
Student 6	32	39	+7
Student 7	29	38	+9

Clearly, every intervention worked positively for student growth. The COVID situation makes absolute statistical analysis problematic. However, it is safe to conclude that all interventions had positive effects.

CHAPTER V

DISCUSSION

This study attempted to determine whether using multisensory intervention strategies would improve the long-term memory in early childhood education students. The question being researched was this: Would students react positively or not at all to the interventions? Analysis of the data indicated that the null hypothesis should be accepted because all participants in the study showed an increase for sight words on the posttest.

Implications of Results

The findings were statistically significant enough for the researcher to conclude that the null hypothesis should be retained due to all groups increasing in the number of words they were able to remember when using multisensory interventions. The results would indicate that participants engaging in extra practice with specific multisensory interventions, would achieve greater memory development and, with that, allowing sections of the brain to expand in how much information it can retain. Therefore, the results should be shared with individuals interested in achieving greater levels of long-term memory development that the quality of extra practice is more impactful than merely quantity of extra practice.

Threats of Validity

This study experienced multiple external threats of validity due to the ongoing effects of COVID 19 and having to adhere to the policies and restrictions, participants were not in the school building when the pretest and posttest were given. The researcher noted that this was the main threat and, because of this, had to reconstruct the study. Some other external threats consist of poor quality of the internet connection, participant laptops not being in good condition to allow for taking tests, home environment not being conducive to learning, and attendance.

Connections to Previous Studies/Existing Literature

This study on improving long-term memory in students in early childhood education through the use of multisensory interventions has numerous connections to the studies mentioned in chapter two. The research and this study both agree that there are many factors that inhibit students from retaining information, including distractions from peers, home life, and mental capacity, to name a few (Craik & Jennings, 1992). Children learn words better when there are established routines in place. Another similarity is reinforcement by practicing or drilling also strengthens long-term memory, which matters because if the ability to store and retrieve information is poor, wrong conclusions and wrong answers will result (Tulving, 1985).

The research and this study also supported the idea that the brain and its functions are key to what children can memorize long-term vs. short-term. Learning is a process that takes time and repetition for humans to move information from short-term memory toward long-term memory (Craik, 1992). Again, this explains why when material is reviewed once or twice it is difficult to remember for quizzes and exams.

Implications for Future Research

This particular study was conducted as an experiment and had the benefit of having a good number of participants to draw data from as well as having a nice sample size of data to analyze. The results of this research provide one with data that suggests extra practice with basic routines and strategical interventions offers a participant an increased chance of enhancing their long-term memory function. Incorporating these components in future research studies could either concretely substantiate the existing data which suggests that extra exercise with focused intervention groups enhances memory development or it would raise questions about whether quality extra practice is necessary for enhanced memory development.

Conclusion

It was the goal of the researcher to establish a connection between variability of extra practice using multisensory interventions and its impact on the functions of long-term memory. The results of the study indicated that quality routines and interventions are more beneficial to a participant and will likely have a positive impact on how a student retains the information being taught to them as well as the speed with which they are able to read sight words. This study and its results also show that it will be beneficial to have different focus groups to demonstrate the effectiveness of the quality of the multisensory interventions. Lastly, the majority of the strategies to teach sight words within the research were noted by the researcher that they truly do work. Students need explicit instruction, time for practice and repetition, and opportunities to use different learning modalities.

References

Atkinson, R.C., Shiffrin, RM. (1968). Human memory: A proposed system and its control processes. In K.W. Spence & J.T. Spence (Ed), *The psychology of learning and motivation: Advances in research and theory* (pp. 89–195). Academic.

Baddeley, A. D. (2002). Is working memory still working? *European Psychologist*, 7(2), 85–97. https://doi.org/10.1027/1016-9040.7.2.85

Ballarini, F., Diaz-Perez, M., Martínez, MC., Moncada, D., Viola, H. (2013) Memory in elementary school children is improved by an unrelated novel experience. *PLoS ONE* 8(6): e66875. https://doi.org/10.1371/journal.pone.0066875

Blumenthal, J., Castllanos, F., Evans, A., Giedd, J., Jefferies, N., Liu, H., Paus, T., Rapoport, J., & Zijdenbos, A. (1999). Brain development during childhood and adolescence: A longitudinal MRI study, *Nature Neuroscience*, 2: 861–863.

Buckner, R., Dale, A. M., Koutstaal, W., Maril, A., Rosen, B., Rotte, M., Schacter, D., & Wagner, A. (1998). Building memories: Remembering and forgetting of verbal experiences as predicted by brain activity. *Science*, 281: 1185–11190.

Cepeda, Nicholas J.; Pashler, Harold; Rohrer, Doug; Taylor, Kelli; Wixted, John T. (2005). The effect of overlearning on long-term retention (ED505637). *ERIC*. https://eric.ed.gov/?q=long+term+memory+storage&pr=on&ft=on&pg=2&id=ED505637

Cockcroft, Kate. (2015). The role of working memory in childhood education: five questions and answers (EJ1187243). *ERIC*. https://eric.ed.gov/?q=working+memory&pr=on&ft=on&id=EJ1187243

Craik, F. I. M., & Jennings, J. M. (1992). Human memory. In F. I. M. Craik & T. A. Salthouse (Eds.), *The handbook of aging and cognition* (p. 51–110). Lawrence Erlbaum Associates, Inc.

Di Masi, N., Longoni, A. M., & Richardson, J. T. E. (1996). Persistence of the phonological trace in working memory. *Cahiers de Psychologie Cognitive/Current Psychology of Cognition*, 15(6), 557–581.

Hasking, Penelope A., Shamsul, Haque. (2010) Life scripts for emotionally charged autobiographical memories: A cultural explanation of the reminiscence bump. *Memory* 18:7, pages 712-729.

Kienapple, K., Lange, G. (1979). What and how preschool children remember in early childhood education settings (ED172954). *ERIC*. https://eric.ed.gov/?id=ED172954

Lee, S. C., Marsh, E. J., & Roediger, H. L. III. (2002). Kinds of memory. In H. Pashler & D. Medin (Eds.), *Steven's handbook of experimental psychology: memory and cognitive processes* (p. 1–41). John Wiley & Sons Inc.

Mayer, Robert V. (2017). Assimilation and forgetting of the educational information: Results of imitating modelling (EJ1164019). *ERIC*. https://eric.ed.gov/?q=the+forgetting+curve&pr=on&ft=on&id=EJ1164019

Tulving, E. (1985). Memory and consciousness. *Canadian Psychology/Psychologie canadienne*, 26(1), 1–12. https://doi.org/10.1037/h0080017

Wan, Ming Wai. (2007). Long-term memory and school performance following cognitive transition at five to seven years (EJ815613). *ERIC*. https://eric.ed.gov/?q=long+term+memory+retreival&pr=on&ft=on&id=EJ815613