`

THE EFFECT OF THINKING MAPS® ON THE READING ACHIEVEMENT OF MIDDLE SCHOOL STUDENTS: AN EX POST FACTO CAUSAL COMPARATIVE STUDY

by

Karen Ogden Woodford

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

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ABSTRACT

The purpose of this study was to determine what, if any, relationship existed between Thinking Maps® instruction used as a school-wide strategy and student achievement in middle school students in the area of reading as reported by the Virginia State Standards of Learning Test scores. The association was tested through full implementation and instruction of Thinking Maps® as a school-wide strategy. Using a quantitative design, this ex post facto, causal comparative included a comparison of sixth, seventh, and eighth grade students' Virginia Reading SOL scores from 2011, 2012, and 2013 after schools implemented Thinking Maps® as a school-wide strategy compared to schools that did not. Scores obtained by middle school students who received Thinking Maps® instruction were examined for increases in overall mean scores, by gender, and by socio-economic status. These scores were compared to two middle schools that were not using Thinking Maps®.

Keywords: Thinking Maps®, reading achievement, middle school students, socio-economic status, gender, poverty

Dedication

This study is dedicated to my family. To my parents, Cary and Estelle Ogden, who have always challenged me to pursue my education. I love them for their unconditional love, patience, but most for providing a Christian home that focused on my Savior and His love. To my husband, Davie Woodford, for supporting me in my pursuit of higher education and for allowing me to do the things that bring me happiness. He is my best friend, partner, and the person I will love forever. Lastly, I dedicate this work to my children, Hunter and Makayla Woodford. They are the loves of my life and I adore them for their individual spirits and kind hearts. May they pursue their dreams for the future knowing that their parents support them always.

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Secondly, I would like to thank all of the wonderful teachers, principals, and school staff I have worked with over the years. I have benefited greatly from the knowledge I have gleaned from each of them. There is no harder job than that of an educator.

I appreciate Dr. Karla Swafford for being my Chairperson. She has been patient with me as I worked through this part of my journey. She has been supportive and positive at all times. I also appreciate the rest of my committee, Drs. Donna Jones and Dana Norman. I know you are as tired of reading and editing this paper as I am. Thank you to Dr. Yocum for his help as my research consultant. My entire committee has been so helpful and such a blessing.

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Analysis of Variance (ANOVA)

Differential Item Functioning (DIF)

Educational Testing Services (ETS)

Institutional Review Board (IRB)

Intelligence Quotient (IQ)

Institutional Review Board (IRB)

National Institute of Child Health and Human Development (NICHD)

Standards of Learning (SOL)

CHAPTER ONE: INTRODUCTION

Education is inundated with products that offer an assortment of strategies to improve academic performance in a variety of areas. Educators find some strategies that work better than others or that individual teachers like more in classroom instruction, but are these strategies really improving student achievement? As a current middle school principal and certified Thinking Maps® trainer, there is much research in the world of academia related to reading comprehension that supports the use of graphic organizers with students. However, there is very little research that looks specifically at Thinking Maps®, a graphic organizer program, as the direct cause of improvement in students' reading comprehension at the middle school level in grades six through eight. This study will look specifically at the possible connection between reading comprehension and the use of Thinking Maps® in the middle school classroom.

Background

In 1997, Congress asked the Director of the National Institute of Child Health and Human Development (NICHD) and the Secretary of Education to convene a national panel to assess the status of research-based knowledge on reading that would include the effect of various approaches to effectively teaching children to read (NICHD, 2000). The panel began their work based on the research from Snow, Burns, and Griffin (1998) detailed in *Preventing Reading Difficulties in Young Children.* In this publication, the researchers focused on alphabetics, fluency, and comprehension, and based on these three areas, the panel initiated their work. They began by offering regional public hearings to gather input from educators, parents, the business community, and any group or individual with concerns for reading in the nation. Upon

completion of these hearings, the panel reconvened and focused on the five areas of reading that are now commonly referred to as the five essential components of reading: Phonemic awareness, phonics, fluency, comprehension, and vocabulary. The panel also decided that more research was needed and "the Panel concentrated on the following areas: Alphabetics, including the issues of phonemic awareness and phonics instruction; fluency; comprehension, including vocabulary instruction, text comprehension instruction, and teacher preparation and comprehension strategies; teacher education and reading instruction" (NICHD, 2000, p. 5). Some of the results that the panel found were that these areas needed more research. Reading comprehension was the third essential reading component, but the subgroup assigned to evaluate the research on comprehension realized that the term reading comprehension was too broad a term and divided this component into three subcomponents: Vocabulary instruction, text comprehension instruction, and teacher preparation and comprehension strategy instruction (NICHD, 2000). The panel agreed that reading comprehension was the "essence of reading" (p. 228) and that comprehension entailed three important themes: (a) reading comprehension is a cognitive process that integrates complex skills and cannot be understood without the critical role of vocabulary learning and instruction and development, (b) active, interactive strategies are critically necessary to reading comprehension, and (c) teacher preparation is crucial to equip them to facilitate these complex processes.

Reading comprehension has just begun to receive scientific attention in the last 40 years. In 1978, Markman produced the first research that showed a positive connection between comprehension and explicit teaching strategies and inferred that reading was a thinking process (Markman, 1978). Durkin (1979) followed with research that provided additional proof that intentional thinking is present during reading because meaning was being constructed through

interactions between the reading and text. Durkin (1979) claimed, "when readers are given cognitive strategy instruction, they can make significant gains on measures of reading comprehension over students trained with conventional instruction methods" (p. 523).

Reading comprehension is the process by which a reader extracts and then constructs meaning through interactions and involvement with written language (RAND Reading Study Group, 2002). The National Reading Panel Report (NICHD, 2000) identified reading comprehension "as an active process that requires an intentional and thoughtful interaction between the reader and the text" (p.13). Research indicated that reading comprehension enhanced reading achievement (NICHD, 2000; Paris & Flukes, 2005; RAND Reading Study Group, 2002). In addition, research also revealed that a reading achievement gap existed when students were compared by socio-economic status and gender (Entwisle, Alexander, & Olson, 2007).

Therefore, reading comprehension instruction has been a major concern for educators and researchers (Pressley, 2000). However, teachers often assume that if good instruction occurs then comprehension automatically develops. Research indicates that there is a lack of specific reading instruction taking place in most classrooms (Pressley, Wharton-McDonald, Hampton, & Echevarria, 1998).

The subgroup of the National Reading Panel (NICHD, 2000) that focused on comprehension reported that they had seven strategies that were scientifically supported by research that could improve reading comprehension in children. These strategies included comprehension monitoring, cooperative learning, graphic and semantic organizers, question answering, question generation, summarizing, and multiple strategies used together. In

particular, this research action focused on graphic and semantic organizers to improve comprehension.

For The National Panel Report, eleven studies on graphic organizers were analyzed (NICHD, 2000). All eleven studies were focused on students in grades four through six in content areas such as history or science. Inferential connections were made that these same skills could be improved in reading and math. The main effect of graphic organizers appears to be on the improvement of the reader's memory for the content that is learned.

Explicit instruction in comprehension can help students understand their own metacognitive processes, which can increase comprehension and achievement. Ritchhart, Church, and Morrison (2001), claim that when "thinking is made visible; there is a window into what students' understand and how they understand it" (pg. 27). Research indicates that the ultimate goal of teaching reading comprehension strategies is for students to learn self-regulation and appropriate usage (Bahr & Dansereau, 2005). Graphic organizers are one strategy that is often used by teachers to help students organize their thinking.

Graphic organizers are visual representations that provide a framework for students to construct meaning from text (Alvermann & Boothby, 1986; Hyerle, 2000). Research indicates that if graphic organizers are used effectively and consistently then comprehension can be increased. Graphic organizers are "words on paper that are arranged to represent an individual's understanding or the relationship between words" (Hyerle, 2008, p. 37). The name itself, graphic organizer, implies that the forms are used to organize information rather than provide a scaffold for thinking and learning.

Thinking Maps®, a type of graphic organizer, are tools that provide the support and structure of a visual map with conciseness and consistency to aide students in making their

thinking and understanding visible. Thinking Maps® are eight visual tools that are based on the eight fundamental cognitive skills: defining, cause and effect, sequencing, whole to part relationships, analogies, describing, classifying, and comparing and contrasting. The program intends for Thinking Maps® to be implemented as a school-wide program to ensure fidelity.

Problem Statement

While educators have agreed that teaching reading comprehension in school is necessary for life-long learning, often little time is actually spent teaching students specific strategies for comprehension (Durkin, 1978; Pressley et al., 1998). Research has indicated graphic organizers have a positive impact on students' ability to recall, retrieve and transfer information, make connections, and increase comprehension across all content areas (Hoffman, 2003). Studies have also supported that graphic organizers, when used as a reading strategy, have served to highlight important ideas, organize materials, and represent relationships among key concepts (Crawford & Carnine, 2000). In addition, the use of graphic organizers has been useful in increasing student achievement and comprehension for students with learning disabilities (Bahr & Dansereau, 2005). However, while research has established the positive impact of graphic organizers in general, additional studies are needed to determine which visual mapping and comprehension strategies are the most effective.

Purpose Statement

Recognizing that research has indicated the importance of teaching reading comprehension strategies, the purpose of this study is to determine the impact of a specific strategy, Thinking Maps® (Hyerle, 2000), on reading achievement in middle school students with whom the strategy has been implemented as a school-wide program. In addition, the impact of reading comprehension of students compared by socio-economic status and gender was

studied because these factors have been identified as predictors of student success. For the purpose of this study, the Virginia Standards of Learning (SOL) reading test scores were used as a measurement of reading achievement. The expectation in each of the schools was that all teachers, core, special education, and resource teachers would use the maps on a weekly basis. This was monitored through lesson plans, observations, and follow-up training with teachers.

Significance of the Study

Thinking Maps® is an expensive proposition for any school or school division that may be looking into its purchase. On average it costs approximately $300.00 per teacher in a school for the prescribed training, materials, and follow-up training. Therefore, it is important to have solid evidence that this graphic organizer strategy has positive effects on academic performance.

Literacy instruction has been a major area of concern for educators (Pressley, 2000). With the implementation of No Child Left Behind (2001), awareness to the public regarding the need for literacy competency for all students was increased. Huey (1968) discussed reading as both a perceptual and mental process. He believed reading was a natural process and that meaningful text enhanced comprehension. Thorndike (1917) was an early advocate of the complex job of reading and comprehension. He emphasized the importance of reading comprehension and the need to explicitly teach comprehension.

While there is a strong history of literacy research, there exists a need for additional research in the area of effective strategies for teachers to teach comprehension (Anders, Hoffaman, & Duffy, 2000; RAND Reading Study Group, 2002). An improved understanding of how to teach reading comprehension will improve literacy for diverse student populations and prepare students for increased academic expectations. There is agreement that reading comprehension involves a set of complex and multi-layered interactions that lead to meaning

(Guthrie, Wigfield, Perencevich, Taboada, & Barbos, 2008). This study explores the impact of a specific set of graphic organizers on the reading comprehension achievement of students over a three-year period and further analyzed the impact on the reading achievement of students when compared by socio-economic status and gender.

There is much research (Alvermann & Boothby, 1986; Ausubel, 1960; Dicecco & Gleason, 2002; Horton & Bergerud, 1990; Hyerle, 2008; Marzano, Pickering, & Pollock, 2001) to support the use of visual maps with students. However, Dicecco & Gleason's (2002) research is the only one that looks specifically at Thinking Maps® as the possible cause of improvement in students' reading comprehension of middle school students.

Currently, there have been four dissertations written on the effectiveness of Thinking Maps® at the elementary level, completed by Leary (1999), Hickie (2006), Russell (2010), and Edwards (2011). Three of the four studies were quantitative and two of these showed no significant difference between students that used Thinking Maps® and students that did not use them. However, the third study showed positive academic improvement for fifth graders in reading but not math. All three researchers noted that implementation and consistency of use could be the crippling factor if not done properly. The fourth dissertation was a qualitative study completed by Edwards (2011). Edwards (2011) surveyed students and teachers in multiple urban schools about the effect that Thinking Maps® had on a student's motivation to read. Her study yielded results that suggested that teachers and students felt that Thinking Maps® encouraged the use of higher level thinking skills. Students reported feeling very confident about their ability to organize information using the visual tools.

The Thinking Maps® company has generated some data on the effectiveness of using the maps, but none that are based in empirical research. They provide this data on their website for

promotional purposes, along with the two dissertations listed above that provided positive notes on their use. Very little research exists on the effectiveness of Thinking Maps®, and what is available is internal and focused at the elementary level. Therefore, the purpose of this study is to add to the base of research and provide an independent external research study into the impact of Thinking Maps® instruction on student reading achievement at the middle school level.

While DiCecco and Gleason's (2002) research established the importance of comprehension for student success and the positive impact of instruction utilizing effective comprehension strategies research is still needed. In particular, DiCecco and Gleason's (2002) study focused on the impact of the utilization of Thinking Maps®, a visual tools program, on student achievement when compared by socio-economic status and gender and when compared to other similar schools not receiving three years of instruction in the Thinking Maps® program.

Therefore, this study has the potential to enhance the research base regarding the use of specific strategies to improve comprehension and increase student achievement. Success in reading can allow students to become independent thinkers for achievement at any level in life.

Research Questions

The National Reading Panel identified graphic organizers as one of four researched-based strategies that had the potential to improve reading comprehension (NICHD, 2000). Graphic organizers are based on Ausubel's (1962b) research and provide an organizational scaffold for the learning of new content.

Thinking Maps®, a specific type of graphic organizers, were developed by Davie Hyerle in the early 1980s to use with his own students in an inner-city middle school (Hyerle, 2000). The premise of this research is to take a strategy, such as the use of graphic organizers that is researched-based and supported in reading comprehension research, and narrowly focus on a

specific kind of organizer to see if they enhance comprehension even more. The list that follows provides the research questions that will guide this study.

RQ 1: What is the effect of the use of Thinking Maps® visual tools on Standards of Learning reading test scores versus the non-use of Thinking Maps® visual tools for middle school students as measured by mean test scores?

RQ 2: What is the effect of the use of Thinking Maps® visual tools on Standards of Learning reading test scores versus the non-use of Thinking Maps® visual tools for economically disadvantaged middle school students as measured by mean test scores?

RQ 3: What is the effect of the use of Thinking Maps® visual tools on Standards of Learning reading test scores for middle school students based on gender as measured by mean test scores?

Hypotheses

H_1: Middle school students using Thinking Maps® visual tools will have statistically significant greater mean test scores on the 2011, 2012, and 2013 Standards of Learning reading test than middle school students that did not use Thinking Maps®.

H_2: Economically disadvantaged middle school students using Thinking Maps® visual tools will have statistically significant greater mean test scores on the 2011, 2012, and 2013 Standards of Learning reading test than middle school students that did not use Thinking Maps®.

H_3: Female middle school students using Thinking Maps® visual tools will have statistically significant greater mean test scores on the 2011, 2012, and 2013 Standards of Learning reading test than male middle school students using Thinking Maps® visual tools.

Null Hypotheses

$H_0$1: There is no significant difference in the mean test scores on the 2011, 2012, and 2013 Standards of Learning reading test of middle school students using Thinking Maps® visual tools and middle school students that did not use Thinking Maps®.

$H_0$2: There is no significant difference in the mean test scores on the 2011, 2012, and 2013 Standards of Learning reading test of economically disadvantaged middle school students using Thinking Maps® visual tools and middle school students that did not use Thinking Maps®.

$H_0$3: There is no significant difference in the mean test scores on the 2011, 2012, and 2013 Standards of Learning reading test between female and male middle school students using Thinking Maps visual tools.

Research Plan

A causal comparative design will be used in this research project. Ex post facto scores from the Virginia Standards of Learning reading test will be used to compare the mean scores of the treatment group versus the non-treatment group during the 2011, 2012, and 2013 school years. This design was chosen in an effort to determine if there is a cause and effect relationship between the use of Thinking Maps® and improved academic performance on the statewide reading test. This research design is an ex post facto study, as the implementation of the Thinking Maps® as a school-wide strategy program already occurred at the two schools being studied, and testing of the non-control and control group already occurred using the same assessment. The study reviewed data by overall scores, socio-economic status, and gender.

The research design will be used to determine if there is a significant difference in the mean scores on the Virginia Standards of Learning Test for reading overall, by gender, and by

socio-economic status. The treatment group is made up of students in School A and School B. All of the students in these two groups have been exposed to Thinking Maps® for at least one year as part of a school-wide strategy. The non-treatment group is made of students in School C and School D. None of these students have been exposed to the Thinking Maps® strategy as a school-wide strategy. All of the data will be analyzed using an Analysis of Variance (ANOVA). This will determine if the independent variable, Thinking Maps®, caused a difference in the dependent variable while controlling for test results. The ANOVA was used because intact groups were used and control for extraneous variables was not possible.

Identification of Variables

The dependent variables of this study include the scores from the Virginia Standards of Learning reading assessment. The independent variables of this study are the presence or non-presence of the Thinking Maps strategy as measure in the test scores of students receiving instruction using the Thinking Maps® strategy, and those students that did not receive instruction using Thinking Maps®. In addition, the socio-economic status and gender of the students are independent variables.

Assumptions

In quantitative research, there are basic assumptions that must be tenable. The research data must be measured objectively and the researcher must remain independent of the study and not let personal beliefs and values enter into data analysis. Variables must be clearly defined and the researcher must make hypotheses based on information gathered before the experiment begins (Howell, 2011).

Tests to determine normality and variance will be used on the data sets collected to test the tenability of the data. Control for variance will be sought through accurate data collection.

Limitations

The following are limitations of the study that were beyond the control of the researcher:

- The study was limited by the individuality of the delivery of Thinking Maps® instruction by various classroom teachers.
- The study was limited by teacher competency and experience and the impact this competency has on student growth.
- The study was limited by the interventions or remediation that each student may have received and the impact it may have had to student performance.
- The study was unable to account for parental support at both home and school that can influence student performance.
- Some students that have been taught the Thinking Maps strategy may have been using it for varied amounts of time. The study is looking for students that have been using it at least one year, but students may have been using for more than a year. Therefore, there may be variance in the amount of instruction each student has had in Thinking Maps.

The following delimitations were imposed by the researcher as a part of the study:

- The study was limited to middle schools in which teachers have been trained in the Thinking Maps® as a school-wide initiative.
- The study was limited to students that were enrolled in the school for at least one year of the three years data was collected.

Even though the subjects of the research design will be selected based on the attendance of the schools being studies, there is no way to attribute success completely to the treatment and no other external factor (Gall, Gall, & Borg, 2007).

Definitions

1. *Brace Map* - One of the eight Thinking Maps® that creates a visual picture of the comprehension skill of breaking concepts into smaller pieces. A sample of this visual map is found in Appendix A (Hyerle, 1996).

2. *Bridge Map* - One of the eight Thinking Maps® that creates a visual picture of the comprehension skills of relationships and analogies between concepts. A sample of this visual map is found in Appendix B (Hyerle, 1996).

3. *Bubble Map* - One of the eight Thinking Maps® that creates a visual picture of the comprehension skill of describing a concept. A sample of this visual map is found in Appendix C (Hyerle, 1996).

4. *Circle Map* - One of the eight Thinking Maps® that creates a visual picture of the comprehension skill of defining a concept. A sample of this visual map is found in Appendix D (Hyerle, 1996).

5. Double Bubble Map - One of the eight Thinking Maps® that creates a visual picture of the comprehension skill of comparing and contrasting concepts. A sample of this visual map is found in Appendix E (Hyerle, 1996).

6. *Flow Map* - One of the eight Thinking Maps® that creates a visual picture of the comprehension skill of sequencing events. A sample of this visual map is found in Appendix F (Hyerle, 1996).

7. *Economically disadvantaged* - Students identified as disadvantaged based on their participation in the free or reduced lunch program in public schools (Jenson, 2009).

8. *Graphic Organizer* - Visual representation of text to enhance text connections and understanding (Hyerle, 2008).

9. *Multi-Flow Map* - One of the eight Thinking Maps® that creates a visual picture of the comprehension skill of identifying the causes and effects of an event. A sample of this visual map is found in Appendix G (Hyerle, 1996).

10. *Non-linguistic representation* - This idea refers to a picture representation of a word or concept. When applied to the dual coding theory, it is one way the brain stores information. When information is encoded in the brain in a linguistic and non-linguistic form it can be retrieved more easily (Cohen & Johnson, 2010).

11. *Phonemic Awareness* - This is the ability of listeners to hear, identify and manipulate phonemes, which are the smallest units of sound that can differentiate meaning. The National Reading Panel has found that phonemic awareness improves children's word reading and reading comprehension, as well as helping children learn to spell. Phonemic awareness is the basis for learning phonics (NICHD, 2000).

12. *Phonemes* - The smallest units of sound that can differentiate meaning (NICHD, 2000).

13. *Phonics* - A process of teaching reading explicitly and systematically that instructs the student on the acquisition of letter-sound correspondences and their use to read and spell words (NICHD, 2000).

14. *School-wide strategy* - A school-wide strategy is a comprehensive reform tool or idea implemented to improve the academic achievement of all students in the school. School-wide strategies grow out of research about what makes schools work for students and is intended to be used by all teachers (Conway & Abawi, 2013).

15. *Subsumption Theory* - Ausubel's theory that new information enters the consciousness and is directed or organized to fit within an already existing larger category (Ausubel, 1962a).

16. *Text Structure* - The way text is structured or organized to develop meaning. (Hyerle, 2011).

17. *Thinking Maps®.* - "A language of visual-verbal-spatial cognitive patterning tools that help organize abstract concepts and conceptualize thinking" (Hyerle, 2008, p. 116).

18. *Tree Map* - One of the eight Thinking Maps® that creates a visual picture of the comprehension skill of putting concepts into categories. A sample of this visual map is found in Appendix H (Hyerle, 1996).

19. *Visual mapping* - This strategy adds a visual component to word mapping. Word maps are not a foreign concept for teachers when thinking about vocabulary instruction. Word maps that include an illustration section use the research related to dual coding and the positive correlation between verbal and non-verbal codes working at the same time (Cohen & Johnson, 2010). The information processing theory hypothesizes that the brain has a visuospatial sketchpad that retains the definition of a word with an image in the mind (Miller, 2011).

CHAPTER TWO: REVIEW OF LITERATURE

Theoretical Framework

Research has documented that reading comprehension is one of the strongest indicators of student success. Studies have shown comprehension exists when there is an interaction between the reader and the text in which the reader is extracting and constructing meaning (NICHD, 2000). Therefore, comprehension impacts student achievement.

Reading is a vital skill for all content areas. During the early phases of reading, teachers are focused on the basics of word decoding. Once decoding is mastered and students begin to read more fluently, teachers begin to focus on reading comprehension. Reading to learn is an essential skill for middle school students; however, reading for understanding remains a challenge for many students at this level (Solis et al., 2012). Students often leave elementary school with the basic skill of decoding, but lack the strategies needed for fluency and comprehension. Upon entering middle school, these students are all expected to read and understand at grade level. Reading comprehension is a skill that requires students to decode, read, interact with text, and then extract meaning from the text. However, teachers often make the assumption that if a student can read well, that comprehension will come naturally. Research supports the fact that fluency in reading is very important in aiding comprehension, but that alone will not cause reading comprehension to automatically take place in the classroom (Anders et al., 2000).

In 1979, Durkin completed a study that would become the catalyst for research studies into reading comprehension (Durkin, 1979). His study uncovered the instructional weaknesses related to the teaching of reading comprehension. Teachers began to understand that even if a student was a strong reader, or decoder of words, did not mean they would naturally acquire

strong reading comprehension skills. During this time period in the late 1970s, reading comprehension moved to the forefront of reading instruction. Twenty years later Pressley et al. (1998) completed an observational study that concurred that while comprehension was regularly assigned and assessed, there was actually little time devoted to teaching strategies that aide in comprehension. Paris and Flukes (2005) further established that when students are provided explicit instruction of individual comprehension strategies they can begin to understand their own metacognitive processes and can increase comprehension and improve student achievement. In the early 2000s, educators began to question the performance of subgroups in reading. To further complicate reading comprehension, research indicated that when compared by socio-economic status and gender, achievement gaps existed in the reading achievement of students from specific subgroups (Entwisle et al., 2007; McCollin, O'Shea, & Algozzine, 2005).

When students have a problem with reading comprehension they may have issues with one or more of the following skills

- decoding text,
- reading text with adequate fluency,
- understanding vocabulary,
- relating content read to prior knowledge,
- applying comprehension strategies, and
- monitoring understanding (Carlisle & Rice, 2002; National Institute for Literacy, 2001).

Therefore, secondary teachers need to be aware of these barriers and prepare to teach students appropriate strategies to overcome any of these deficit areas that may be affecting student

performance. The National Reading Panel (NICHD, 2000) and Vaughn and Edmonds (2006) have suggested four strategies to assist with reading comprehension deficits-

- teaching students to monitor comprehension and make adjustments when their understanding begins to falter,
- providing graphic organizers to assist with drawing relationships from text,
- providing support for questioning strategies, and
- teaching students to write important ideas about what they have read and summarize these ideas after reading longer passages.

Even though reading comprehension is multifaceted, to narrow the focus of this research study, the researcher will specifically be looking at graphic organizers to improve overall comprehension. The use of these graphic organizers can enhance other areas of comprehension deficits and needs, such as summarizing, looking at text features, understanding vocabulary, and assessing prior knowledge.

The use of graphic organizers to enhance meaning dates back to Ausubel's theory of learning, known as subsumption. According to Ausubel (1962a), "subsumption is the process by which new information enters the consciousness and is directed or organized to fit within an already existing learning category" (p. 215). Ausubel introduced the concept of advanced organizers for learning. The use of an advanced organizer provided not just a preview of the material that would be learned, but it provided the context to which new information would be anchored (Ausubel, 1960). Ausubel (1960) adhered to Piaget's theory of cognitive development and ascribed that students gain knowledge through their interactions with the world and how they connect new learning to existing schema. In particular, Ausubel felt that the transition between

concrete to abstract knowledge was immensely important for students, as they needed visual representation of thinking to aide their understanding of abstract concepts.

The following literature review provides support for this theoretical framework. The review is presented in the following sections- impact of reading comprehension on reading achievement, teaching practices and reading comprehension, diverse student populations, graphic organizers, and Thinking Maps®.

Impact of Reading Comprehension on Reading Achievement

National Reading Panel Findings

In 1997, Congress asked the Director of the National Institute of Child Health and Human Development in consultation with the Secretary of Education to convene a national panel, known as the National Reading Panel, to assess the strength of programs to assist students in reading and to study the effectiveness of varying approaches to teaching reading (NICHD, 2000). The intended outcome was to ensure high quality, researched-based strategies for ensuring all students could read and recommendations for further research that was needed in this area. The National Reading Panel made it clear that the best approach to reading is one that incorporates all of the following: (a) explicit instruction in phonemic awareness, (b) systematic phonics instruction, (c) methods to improve fluency, and (d) ways to enhance comprehension (NICHD, 2000).

In addition the National Reading Panel found that a combination of techniques is effective for teaching reading. These include phonemic awareness, phonics, fluency, guided oral reading, teaching vocabulary, and reading comprehension strategies (NICHD, 2000). These findings would later be highlighted in several education movements including No Child Left Behind and The Reading First Initiative. The work of the National Reading Panel would provide

the framework for reading initiatives throughout the United States and provide the foundation for reading research that continues today. These five components of reading were researched further by the National Reading Panel subcommittees to provide in depth understanding of the process of learning to read.

The first technique highlighted in the report was phonemic awareness. Phonemic awareness "focuses on the ability to focus on and manipulate phonemes in spoken words" (NICHD, 2000, p. 20). Phonemic awareness is one of the best indicators of reading readiness (Adams, 1990). Phonemic awareness focuses on the phonemes within words and the ability of the student to isolate, identify, categorize, blend, segment, and delete phonemes orally.

The National Reading Panel subgroup looking at the phonemic awareness research had stringent guidelines for research that was acceptable to their analysis. They only looked at research in which one group of students was given phonemic awareness instruction compared to a control group of students not receiving this instruction. All students had to be receiving the exact same instruction throughout the day with no additional interventions and they specifically looked at reading, spelling, and phonemic awareness outcomes (NICHD, 2000). Ninety-six research studies met the criteria and were included in the meta-analysis.

The results of the meta-analysis revealed phonemic awareness instruction was very effective and provided positive effect sizes for the short and long term in phonemic awareness, reading, and spelling (NICHD, 2000). Research also indicated that students from economically disadvantaged backgrounds had the same positive effect size as students from middle or high socio-economic backgrounds. One concerning research finding was that students identified with a reading disability showed no benefit with phonemic awareness instruction (NICHD, 2000).

The important connection that was also made in the report was that phonemic awareness was the first developmental step in teaching reading. It was important that educators connect the oral manipulation of phonemes to letter identification and written phonemes. The connections would bridge the connections to the second technique highlighted in the National Reading Panel Report, which was phonics instruction (NICHD, 2000).

Phonics instruction "is the process of teaching reading that stresses the acquisition of letter-sound correspondences and spelling patterns and their use to read and spell words" (Harris & Hodges, 1995, p. 98). The subgroup assigned to this area of reading study followed the same stringent research guidelines as outlined above in the phonemic awareness section. There were thirty-eight studies from which sixty-six treatment-control group comparisons were taken.

Overall results from the analysis of compared research studies indicated that phonics instruction provided to students in kindergarten had a greater effect on reading, but not spelling, than instruction offered in first grade (NICHD, 2000). Results indicated that students taught in small groups rather than large classes or one-on-one, had a larger effect size (NICHD, 2000). This is probable because students get more attention from the teacher in a small group, but have other students to model learning and understanding if they are not being instructed alone. Even though there was not a significant effect size through research, the National Reading Panel encouraged a systematic rather than embedded phonics approach (NICHD, 2000). The first approach teaches specific phonetic skills explicitly to students while the second approach allows students to learn skills as they encounter them in text but in not specific order or program.

The third area of importance identified in the National Reading Panel report was fluency. Readers that have mastered fluency can read text with speed, accuracy, and expression. Students that are good decoders and know sight words do not automatically develop fluency, it is a skill

that is developed with practice because "the ability to obtain meaning from print depends so strongly on the development of word recognition fluency and reading fluency, both of which should be assessed frequently and should be addressed if a delay is evident" (Snow et al., 1998, p. 7).

The National Reading Panel (NICHD, 2000) made it clear from their analysis of research that fluency should be taught through guided timed oral reading practice and meaningful feedback. Comprehension is aided by the fluency of the reader and fluency should be assessed as much as decoding and comprehension. The National Reading Panel found ample research in the area of guided oral practice and repeated reading practice. However, there was much less research on the long-term effect of fluency for students and little research on how to motivate students to read more (NICHD, 2000).

Another area examined by The National Reading Panel was teacher education and reading instruction. The National Reading Panel realized during their analyses that "reading instruction involves four interacting factors: students, tasks, materials, and teachers" (NICHD, 2000, p. 385). The National Reading Panel concluded that appropriate teacher education does produce higher achievement in students. In the analyses of studies on the effect of teacher education, the group believed it was important to separate the education of pre-service teachers and professional development for current educators. An issue with pre-service education is there is no way to correlate later student achievement, specifically with a course a pre-service teacher may have had in college (NICHD, 2000). This was not as large an issue with reading professional development given to current teachers as the education was given to teachers that would be immediately transferred to classroom instruction.

Ultimately the subgroup of The National Reading Panel (NICHD, 2000) was able to answer five questions dealing with reading instruction. The first question was, "How are teachers taught to teach reading?" The panel determined that there was no one method of how pre-service teachers learned to teach reading that was the most beneficial to student success. It appeared that teachers using mixed-methods of instruction had the best results (NICHD, 2000).

The second question the National Reading Panel wanted to answer was "What do studies show about effectiveness of teacher education?" The majority of the studies demonstrated an improvement in teaching effectiveness with additional knowledge for new strategies and techniques (NICHD, 2000). Teachers can learn to improve strategies throughout their careers in education.

The next question was, "How can research be applied to improve teacher development?" The National Reading Panel did not suggest specific interventions for improved reading but did suggest that more money and research should be focused on the strategies that could improve achievement and noted that all of the research into professional development had positive effects on teachers (NICHD, 2000).

"What findings can be used immediately?" was the fourth question answered by the panel. The National Reading Panel subgroup suggested that teachers learn interventions that were fully based on research and demonstrated positive effects on student performance. The most important conclusion for the panel was that professional development was necessary for all teachers to continue their improvement in teaching (NICHD, 2000).

The final question related to the future recommendations for teacher education asked, "What important gaps remain in our knowledge?" The National Reading Panel suggested that more non-experimental research be conducted in this arena to truly see how teachers felt about

knowledge and improvement over time. The other was sustainability for teachers in long term education which is time consuming and expensive (NICHD, 2000). The National Reading Panel suggested that the improvements coming in the use of technology to enhance learning would be helpful for teachers as they will begin to learn in more online environments.

The National Reading Panel identified one more indicator of reading that much of this research study is based on, and that is reading comprehension. The National Reading Panel Report's largest section of research is based on the various aspects of reading comprehension. Reading comprehension is a strong predictor of a student's academic achievement (NICHD, 2000). There were three categories of comprehension focused on in the study: (a) vocabulary instruction, (b) text comprehension instruction, and (c) teacher preparation and comprehension strategies instruction. Within the second subcategory of text comprehension instruction, the team noted that understanding of story structure and graphic mapping were important to text comprehension (NICHD, 2000).

Reading Comprehension and Student Achievement

Educators and researchers have long equated comprehension with student achievement (Berkant, 2009; RAND Reading Study Group, 2002). Although the knowledge base for reading comprehension has expanded in recent years through research, there still exists a need to improve reading comprehension outcomes and better meet the needs of students' increasing academic challenges at the secondary level. With the ever present focus on subgroup performance on standardized testing, the awareness of students in poverty or identified as disabled has been given increased attention.

Graves and Liang (2008) describe two approaches to teaching comprehension, direct explanation of strategies and transactional strategies instruction. The direct explanation of

strategies is an explicit, step-by-step teaching approach. This direct approach includes "teaching of the strategy, teacher modeling, collaborative use, guided practice with the strategy, and independent use of the strategy" (Graves & Liang, 2008, p. 41). The second approach described by Graves and Liang (2008) was the transactional strategy. This approach also includes direct teaching of strategies, but only in response to a student need for the strategy in reading. Typically, the transactional approach is less structured and the period for direct teaching is much shorter.

A research agenda was developed in 1999 on reading comprehension as a method to improve student success by the Office of Educational Research and Improvement of the U.S. Department of Education for the RAND Reading Study Group. The study was motivated by the fact that high school graduates were facing an increased need for a high degree of literacy and that students in the United States were performing poorly in comparison with students in other countries. The RAND Reading Study Group proposed that little direct attention is given to developing teachers' skills in building comprehension. In addition, programs intended to improve reading comprehension had uncertain and unresearched results (RAND Reading Study Group, 2002). This report from the RAND Reading Study Group focused primarily on reading comprehension for students in grades first through third. This study concluded that teacher quality, instruction, teacher preparation, and assessments were the areas of highest priority for educators and that reading programs needed to be evaluated for these elements.

Many felt like the RAND Reading Study Group's findings were only the first step to reading comprehension and that there needed to be more research in the area of comprehension for older students. In 2002, there was a call for more research related to instruction in metacognitive strategies and explicit instruction in such strategies to increase student text

understanding. Many educators were beginning to tie the lack of instruction related to comprehension skills to the lack of performance in later grade levels. Manzo (2002) claimed that educators have often referred to the "fourth grade slump" as something that all students go through when they transition from learning to read to reading to learn. This slump is caused by the "lack of attention to comprehension in the early grades. Large numbers of students have mastered the initial skills of reading but are challenged by the more complex tasks of comprehension" (Manzo, 2002, p. 6).

Literacy is a lifelong skill that develops as a person ages. There have been massive amounts of money and research invested in primary grades literacy instruction while neglecting the literacy development of later grade levels (Snow & Moje, 2010). Literacy instruction does not end in third grade, or even in high school. "There is a fallacy that early instruction of reading protects permanently against reading failure" (Snow & Moje, 2010, p. 67). Teachers often spend so much time on the over learned skills of previewing texts, predictions, and self-monitoring that students can employ these strategies without any help (McKeown, Beck, & Blake, 2009). Teaching strategies out of context is less helpful than helping them develop these necessary skills for comprehension in the context of "why" we need to use this strategy (Snow & Moje, 2010).

> Activities that model comprehension through discussion and that give students practice analyzing text, using academic language, formulating and critiquing arguments, and trying on perspectives of others get closer to the heart of what is hard about real comprehension and real writing and teaching isolated strategies (Snow et al., 2009, p. 339).

These activities are necessary for advanced readers as they learn to comprehend text. Students with experience in fluent reading may come by some of these strategies naturally, but for true

analytical analysis of text and analytical writing, teachers must model for students to practice these strategies in text.

In 2006, Almasi, Garas-York, and Shanahan published research that questioned the National Reading Panel's lack of qualitative research data in their findings. When the National Reading Panel set their standards for research review and findings, they limited their review to studies that were quasi-experimental or experimental research. Almasi, et.al. (2006) argued that there was substantial qualitative research that would have added to the base of knowledge that has influenced reading instruction and funding over the last decade.

Two major areas identified by Almasi et al. (2006) were prior knowledge activation and visual mapping of understanding. In the review of qualitative studies, there were a substantial amount of studies that targeted these two areas as enabling students to be successful in comprehension of text. However, these two areas were briefly mentioned in the National Reading Panel report due to a lack of experimental or quasi-experimental research in these areas.

Therefore, Almasi et al. (2006) added the findings of qualitative research to the National Reading Panel report findings and identified the essential elements in a learning environment that fosters text comprehension for students. An environment must provide opportunities for students to verbalize cognitive processing, it must provide students with the tools to identify text structure and to organize thoughts, and the teacher must provide explicit instruction on multiple strategies for comprehension (Almasi et al., 2006).

Reading Comprehension and Teaching Practices

The importance of strong teaching practices related to reading comprehension cannot be ignored since understanding is the ultimate goal of reading. "Approximately 8 million students in grades 4-12 read well below grade level and of those struggling readers, nearly 70% struggle

with reading comprehension" (Ness, 2009, p. 143). The complexities of teaching comprehension are often one of the hardest jobs for an educator. However, research studies have agreed that when a teacher fully comprehends the interactions between the reader, text, and context, the teacher could more easily teach students to comprehend material (Pardo, 2004). They further asserted that comprehension begins with the decoding of words and includes fluency, learning of vocabulary, building and activating prior knowledge, and personal engagement in text. Text comprehension can be encouraged through risk-free environments and engagement in text.

Middle school students are especially vulnerable when it comes to text comprehension as they begin to shift from "learning to read" to "reading to learn" (Hyerle, 2000, p. 56). "Many students have not received sufficient instruction for reading expository text to adequately prepare them for the tasks this type of reading requires" (Blanton, Wood, & Taylor, 2007, p. 76). According to Solis et al. (2012), middle school students are "expected to read greater amounts of information across subject areas compared to student in upper elementary grades, but often do not receive effective instruction on how to read for understanding" (p. 327). Reading classroom skills are very different from the skills needed to comprehend content area texts. Texts in content areas have "different structures, language conventions, vocabularies, and criteria for comprehension" (Snow, Lawrence, & White, 2009, p. 330). Students and content area teachers need explicit instruction on how to understand this complex text structure.

Bahr and Dansereau's (2005) three quasi-experimental studies and one experimental study demonstrated the need for students to receive explicit instruction of individual comprehension strategies. The studies further indicated that through explicit instruction, students developed the ability to self-regulate their learning and it enhances comprehension of text. Justification when introducing a strategy enabled the teacher to give the student rationale for its

usage. During this explicit instructional time, the need to model strategy and give multiple opportunities for both guided and independent practice was also necessary (Nuefeld, 2005; Pardo, 2004).

Pressley (2000) asserted that the ultimate goal in teaching specific strategies was for students to learn self-regulation and usage, which would consequently enhance comprehension. He further stated, "Comprehension instruction can be enhanced by long-term instruction that fosters development of the skills and knowledge articulated by very good readers as they read" (Pressley, 2000, p. 557). Darling-Hammond's (2007) explorations of effective and ongoing staff development indicated that it was necessary to properly equip teachers with the knowledge and understanding of research-based strategies to increase reading comprehension.

In 2006, the International Reading Association published a guide for administrators on effective reading instruction entitled, *Understanding and Implementing Reading First Initiatives.* Cummins (2006), a contributing author, stated that three types of comprehension questions need to be explicitly taught to students. These are literal, inferential, and metacognitive comprehension. Literal comprehension involves the understanding of exact words or information the author wrote. Inferential comprehension requires students to gather meaning from the text when the exact answer is not present. The most complex comprehension is metacognitive, which requires students to think about their own thinking before, during, and after reading. "Research has firmly established that many students cannot develop these types of comprehension processes unaided" (Cummins, 2006, p. 76). Research from the National Reading Panel (NICHD, 2000) found that the most effective reading comprehension instruction must contain direct instruction, teacher explanations, strategy instruction, graphic depictions of understanding, and monitoring of student applications of strategies. Research also indicates that

even students from challenged backgrounds need the same instruction with additional time or direct instruction.

Graphic Organizers

One of the seven research-based strategies identified by the National Reading Panel was the use of graphic organizers (NICHD, 2000). This strategy helps to bridge the gap between brain-based learning research and application in the classroom. A graphic organizer is a visual representation that successfully aids students and teachers to recall, retrieve, and transfer information; make connections; and increase reading comprehension (Hyerle, 2000). Graphic organizers are closely aligned with the schema theory (Monroe & Pendergrass, 1997). Schema theory explains that when the brain encounters new information it either fits it into existing patterns of knowledge or modifies existing structures to make sense of the new information. A graphic organizer is a visual representation, or picture, of the way the information is organized in the brain (Bucko, 1997).

Graphic organizers were developed as a result of Ausubel's (1960) research into the potential benefits of using an advanced organizer as a pre-reading tool to connect prior knowledge and enhance the acquisition of new knowledge. Graphic organizers were originally called structured overviews and were used to develop the learners' readiness prior to reading (Horton, Lovitt, & Bergerud, 1990). The first graphic organizers were simple and encouraged students to brainstorm everything they knew about a subject. Within twenty years, research fine-tuned the graphic organizer into content specific tools, such as Venn Diagrams for math, plot diagrams for reading, and time lines for history (Hyerle, 2000).

In the primary grades, students are focused on becoming successful in learning to read. However, when students reach the elementary grade levels, their focus shifts to reading to learn.

In prior reading experiences, connections and relationships are often explicit. Content texts are written in a way that requires the reader to make connections with their prior knowledge and be able to make inferences, understand relationships that may be unclear, and distinguish the main ideas from the insignificant details (DiCecco & Gleason, 2002). The graphic organizer provides an organizational scaffold that visually displays these difficult skills.

Research has validated the use of graphic organizers in increasing student achievement and reading comprehension (Hyerle, 2000). Studies have further supported that the effective use of graphic organizers required explicit teacher instruction, modeling, and regular use before a student could successfully and independently generate them and facilitate their own comprehension (Merkely & Jeffries, 2000; Hyerle, 2000). Therefore, it is important that teachers fully comprehend the instructional needs of their students and receive the tools necessary for successful implementation of graphic organizers.

Students with disabilities often have great difficulty with the comprehension of fiction and non-fiction text. This may be due to struggles with the fluent reading of grade level text or with the higher level, abstract work that must be done to be successful when reading. In 2002, DiCecco and Gleason researched students with disabilities and compared them to students without learning disabilities to measure the improvement of reading comprehension with the use of graphic organizers. These researchers offered three specific conclusions that support the use of organizers and some suggestions for more success. The first was that students need intense instruction on the graphic organizer itself. Second, focus on the organizer as a facilitator of domain knowledge. Lastly, ensure that the design of the organizer cues the thought process involved in the retrieval of information (2002). In addition, Baxendell (2003) states that graphic

organizers must be "coherent, consistent, and creative" (p. 46) in order to stimulate student understanding and retention of content material.

Graphic organizers have been used to enhance concepts by constructing visuals and linking prior knowledge to new learning, thereby deepening and extending student understanding. McCoy and Ketterlin-Geller's (2004) study indicated that students taught direct instructional strategies using graphic aids retained information for longer periods of time and were able to recall facts more easily. Graphic organizers can be divided into two different categories, author-provided or learner-generated. Stull and Mayer's (2007) research indicated that when learners create their own graphic model of understanding, then the student is "learning by doing rather than learning by viewing" (p. 808), and they have a higher retention rate. Higher retention rates are due to the fact that they are organizing information in a way that makes sense to their learning style.

Graphic organizer research also indicates that when graphic organizers are used as a school-wide strategy rather than in isolation in various classrooms, their effect on student learning increases (Barth et al., 2010). There are thousands of different graphic organizers that are designed by authors to enhance specific content knowledge. However, for learners to understand what the graphic organizer is arranging and how the organizer works takes the focus away from the content the student is trying to master. Based on research studies related to graphic organizers and their connections to student success, it has become important for educators to examine specific graphic organizers programs and expand their knowledge base. Thinking Maps® (Hyerle, 2000) is one such program that is available to schools.

Thinking Maps®

Thinking Maps® were designed by David Hyerle for the Innovative Learning Group (Hyerle, 2004). Hyerle created these visual maps when he was teaching in an inner-city middle school in California in the 1980s. His frustration with helping his students make connections to the content he was teaching influenced him to rely on visual mapping strategies to process information. When his school was asked to pilot a thinking skills program that included diagrams for the fundamental thinking processes, he began to formulate the series of graphic organizers that would later be marketed as Thinking Maps® (Hyerle, 1996). Examples of the eight Thinking Maps® can be found in Appendices A-H.

Hyerle (2011) describes Thinking Maps® as a visual language. The concept of language is that once learned by a group of people, communication is enhanced, and the group begins to communicate within the same framework. Hyerle (2011) describes Thinking Maps® as a synthesis of three types of visual tools that have been used for decades- brainstorming webs, graphic organizers, and thinking process tools, such as concept maps. Hyerle (2011) believes that the synthesis of the three tools can assist with the elimination of the weaknesses of each. Brainstorming webs of the 1970s facilitated a "dumping" of knowledge into a web, but lacked the structure and organization needed by students. Graphic organizers of the 1980s offered more structure but were isolated to the specific content being taught, such as Venn Diagrams for math, timelines for history, and plot diagrams for reading. This made the visual maps nontransferable between content areas. Finally, the thinking process maps delved into more complex thinking processes, but often become so complicated that they were daunting for students and teachers.

There are eight maps taught to students in the Thinking Maps® program. These eight maps are based on the eight fundamental cognitive processes-

1. circle map for defining in context (see Appendix D);
2. bubble map for description and characterization (see Appendix C);
3. double bubble map for comparison and contrast (see Appendix E);
4. tree map for theme, main idea, and details (see Appendix H);
5. brace map for physical parts (see Appendix, A);
6. flow map for sequence (see Appendix F);
7. multi-flow map for problem-solution and conflict (see Appendix G); and
8. bridge map- comparison by analogy (see Appendix B) (Hyerle, 2011).

Hyerle (2004) has identified five major qualities of Thinking Maps®- consistency, flexibility, developmental, integrative, and reflective. Each map has a consistent representation that visually reflects the cognitive skill being defined. This visual representation never changes despite the content or the teacher, if the strategy is being used school-wide. All of the maps can grow and be flexible in form to be configured in different ways to allow the learner to demonstrate their independent thinking. The learner and the content of the learning determine how the maps develop in complexity. All maps can be integrated and used together as well as used within and across content areas. Thinking Maps® are reflective of a student's thinking process and enable teachers to reflect upon and assess the content learning and thinking process of students.

One of the important aspects of Thinking Maps® is that there are only eight maps for students to learn. Since there are only eight maps, the learner can focus on the cognitive strategy that is connected to the map rather the potential complexity of what the map is asking students to do, as in a graphic organizer. In addition, Thinking Maps® are implemented as a school-wide strategy, rather than maps in isolation. When Thinking Maps® are used by everyone in the

school they provide a "common visual language" that all students learn and all teachers use to assist student thinking (Hyerle, 2008).

Traditional note taking only provides a linear pattern for students who are not reflective of the visual complexity of thinking. Thinking Maps® provide a structure that is flexible, student created, and used in combinations for complex thinking. A student is never given a Thinking Map® to fill in as a worksheet. Students are asked to decide what cognitive skill is being used in the text (i.e., define, describe, compare-contrast, cause and effect, seeing relationships, part to whole, classifying, or sequencing), and they create a Thinking Map® that helps them organize that thinking (Hyerle, 2008).

In *Classroom Instruction That Works: Researched-Based Strategies for Increasing Student Achievement*, Marzano et al. (2001) identified nine strategies that directly impact student achievement. The number one strategy for improving performance was the ability for students to identify similarities and differences, and the number five strategy was using non-linguistic representations. Both strategies are evident in all Thinking Maps®. The consistency of use throughout a school can increase overall student performance as it directly ties to higher-level thinking.

Since Thinking Maps® is grounded in the eight universal thinking processes, sequencing, classification, part to whole, causation, comparing and contrasting, describing, analogies, and defining in context, Thinking Maps® provides a visual picture of how the brain is organizing information. Much of Hyerle's (2011) work is grounded in brain research and the fact that the mind forms patterns that enable it to retain and file information for later recall. The better the pattern of storage, the easier it will be to retrieve later. "External events and

experiences cause a physical change in our brain; therefore, when a skill is reinforced over time (well-learned) then a permanent change occurs in our brain" (Hyerle, 2011, p. 21).

As new information is learned, the brain's hippocampus, a small structure located in the older part of the brain, determines if the information should be saved to recall at a later time. So how does the hippocampus determine which information is important and which is not? Hyerle (2008) indicates that emotions are the key to learning. Learners must have an emotional connection to an idea or class content or it will not be remembered. In the Thinking Maps® program, students create the map that connects to their personal thinking which gives the map personal meaning.

Thinking Maps® assist teachers in leveling the playing field for all students. They become the common language of instruction, organization of ideas, and a platform for storing thoughts and ideas until the student is ready to use them. "Disorganization is a common characteristic of a broad range of learning disabilities as well as general underachievement" (Hyerle, 2011, p. 38). As students and teachers talk about content, the language of thinking is used. Students identify their visual map by the thought process associated with the map; therefore, the language of the classroom uses terms such as, compare, contrast, classify, summarize, or define. When students have a small set of flexible thinking tools, they are less anxious and confused about class work, which gives them a sense of control over their learning and motivates them to participate, increases their learning, and gives them more success with academic tasks (Hyerle, 2008).

For Thinking Maps® to be effective in a school, they must be used by all teachers, in all content areas, with multiple maps together to layer in deep thinking in a consistent manner. The initial professional development is one day to share the research behind Thinking Maps®, to

learn the maps, and to practice using them in the classroom in multiple content areas. Then there are follow-up sessions that focus on specific content areas and to help the teachers take student thinking to deeper levels (Hyerle, 2011). One of the most powerful pieces of training for the maps is the training for a principal, entitled "Thinking Maps®: A Language for Leadership" (Alper, Hyerle, & Yeager, 2012). In this training, principals learn to examine school-wide practices with Thinking Maps® and monitor usage throughout the school. The key to success is that educators must be using the tools to provide students with the consistency necessary for Thinking Maps® to become a student's visual language of thinking (Hyerle, 2008).

Currently, there have been four dissertations written on the effectiveness of Thinking Maps® at the elementary level, completed by Leary (1999), Hickie (2006), Russell (2010), and Edwards (2011). Three of the four studies were quantitative, and two of these showed no significant difference between students that used Thinking Maps® and students that did not use them. However, the third study showed positive academic improvement for fifth graders in reading, but not math. All three researchers noted that implementation and consistency of use could be the crippling factor if not done properly. The fourth dissertation was a qualitative study, completed by Edwards (2011). She surveyed students and teachers in multiple urban schools about the effect that Thinking Maps® had on a student's motivation to read. Her study yielded results that suggested that teachers and students felt that Thinking Maps® encouraged the use of higher level thinking skills. Students reported feeling very confident about their ability to organize information using the visual tools.

The Thinking Maps® company has generated some data on the effectiveness of using the maps, but none that is based in empirical research. They provide this data on their website for promotional purposes, along with the two dissertations listed above that provided positive notes

on their use. Very little research exists on the effectiveness of Thinking Maps® and what is available is internal and focused at the elementary level. Therefore, the purpose of this study is to add to the base of research and provide an independent external research study into the impact of Thinking Maps® instruction on student reading achievement at the middle school level.

Diverse Student Populations

Effects of Poverty on Reading Comprehension

The diversity of student populations brings additional challenges to schools. Students from linguistically and culturally diverse backgrounds, as well as students that are considered economically disadvantaged, often come to school lacking basic literacy awareness (Entwisle et al., 2007). Factors such as, limited literacy exposure, limited literacy in native languages, and cultural disparities are strong contributors to student failure (McCollin, O'Shea, & Algozzine, 2005). Specific strategies derived from research-based interventions can often help improve their success. For students in poverty, there needs to be explicit instruction and modeling of how to look for answers to questions within text and how to draw conclusions based on personal knowledge and information from the story. In her book, *A Framework for Understanding Poverty* (2005), Payne states, "disadvantaged kids need to have the concrete translated to the abstract through mental models" (p. 51). These graphic displays of information can assist struggling students in making connections between concepts or ideas that they are unable to make without the help of a graphic image.

Studies have shown that explicit and systematic instructional materials and approaches that provided experiences and built on prior knowledge accommodated acquisition of individual literacy skills and promoted student success (Bahr & Dansereau, 2005). A variety of culturally relevant experiences and texts can promote and facilitate individual comprehension and increase

motivation. Researchers have also indicated that opportunities to retell stories, engage in meaningful dialogue and multiple writing experiences, and the use of specific instructional strategies helped students to make connections to text (Brimijoin, 2005). Research has additionally shown that male students, especially disadvantaged, perform lower on reading assessments and possess a lower self-efficacy than female students, and that this becomes even more apparent in fourth grade (Reed, Marchand-Martella, Martella & Kolts, 2007).

Jenson (2009) defines four primary risk factors for students in poverty, (a) emotional and social challenges, (b) acute and chronic stressors, (c) cognitive lags, and (d) health and safety issues. For disadvantaged students these risk factors add layer upon layer of stressors that have negative effects on academic achievement. Children in poverty are exposed to lower-quality health care, local services, and supports. They live in neighborhoods with higher crime rates and a higher risk of an unsafe home and neighborhood. Poor children are more likely to come from unstable homes that foster poor school attendance, lower grades, and a lower chance of attending college (Jenson, 2009). "Kids raised in poverty are more likely to lack a caring, dependable adult in their lives and they will often search out a teacher to fulfill their need for one" (Jenson, 2009, p. 11).

Underachieving students must overcome the blocks between home and school literacy. The language of school and textbooks is much different than the language they use in everyday life. Text in school has a pattern, it has conflict and resolution, vocabulary that must be understood to comprehend the story, dynamic and static characters, foreshadowing, and setting changes; none of these come naturally just from reading fluently. Then teachers add content materials with technical vocabulary, a different structure, and non-fiction elements and students will begin to give up trying to comprehend any of what they are reading in class (Hyerle, 2011).

Strategies such as discussions, use of concrete organizers, clearly taught note taking, organization of content being taught, and instruction of inferential thinking is necessary for underachieving students.

A student's Intelligence Quotient (IQ) can be affected by a variety of factors associated with poverty, such as medical care, environment, and nutrition (Jenson, 2009). However, teachers can have a more positive effect on fluid intelligence. This is a "student's ability to adjust strategies and thought processes rapidly from one context to another" (Jenson, 2009, p. 53). Teachers can build this fluid intelligence by applying mind maps, brainstorming prior knowledge, and prewriting to their instruction. As Jenson (2009) states, "we must stop using low IQ as an excuse for giving up on children and instead provide positive, enriching experiences that build their academic operating system" (p. 65). Strategies for at risk learners are the same as for students that are not at risk. They must have explicit instruction in strategies that enhance comprehension.

Effects of Gender on Reading Comprehension

Gender is frequently used as a mode of analysis in the area of reading research (Prado & Plourde, 2011). Boys and girls have been shown to differ in their reading choices, frequency of reading, attitudes towards reading (Coles & Hall, 2002), motivation to read (Marinak & Gambrell, 2010) and reading skill (Mullis, Martin, Kennedy & Foy, 2007); girls, on average, read more frequently, have more positive attitudes towards reading, have a higher reading motivation, and have greater confidence in their reading skills.

Gurian and Bellew's (2003) research indicates that girls are approximately one and a half years ahead of boys in reading and writing. However, these researchers could not pinpoint why gender made such a difference for students in the area of reading and writing. Prado and Plourde

(2011) ascertain that explicitly taught reading strategies benefit both genders and that researchers see differences in achievement based on other factors that relate to teacher and parent interactions with boys and girls in early years. Much research has been done that indicates the boys and girls have varied reading abilities based solely on their sex. McGeown, Goodwin, Henderson, and Wright (2012) claim that adults feel reading is a more feminine activity and encourage reading with girls more often than boys. Therefore, gender stereotypes make more of an impact on reading achievement than an actual biological factor. Therefore, if boys tend to do worse in reading than girls due to environmental factors, then it is worth exploring the possibility that a more visual method of organizing information may be beneficial for their reading improvement.

Brain Research and Its Connection to Reading Comprehension

Early brain research related to education advocated for the need for an increase in right brained learning and educators developed programs that would enhance that hemisphere of the brain (Jensen, 1998). In the 1980s and 1990s, exciting new information began to unfold about the brain's influence on the way people learn.

> Technology paved the way for this paradigm shift: It changed the way we think, live, and learn. In the 1970s, 1980s, and 1990s, phrases like "superlearning" and "accelerated learning" became mainstream as the Information Age blossomed. "Brain scanners" like Magnetic Resonance Imaging (MRI) and Positron Emission Tomography (PET) gave us new ways to understand and see inside the brain. For the first time in history, we could analyze the brain while its owner was still alive. A new breed of "inner science" developed; neuroscience, which is an exciting interdisciplinary approach to questions about the brain. (Jensen, 1998, p. 2)

Brain research has increased in the last decade and educators are becoming more interested in its application to education practice. Understanding how the brain collects, processes, and interprets information can potentially help students with and without reading issues (Sousa, 1998 and Wolfe, 2010a). Kotulak (1996) claims that anything learned about the brain in the last two years is already old information because the field of neuroscience is exploding.

Brain research shows that the "brain is a pattern-seeking device in search of meaning and that learning is the acquisition of mental programs for using what we understand" (Wolfe, 2010b, p. 163). Therefore, the brain likes the consistency of structures. It also supports that structures used over and over will develop patterns. These patterns soon become automatic and can be done without thinking about them. Hence, the success of students using regular graphic organizers that are familiar to them and have become an automatic pattern.

Sousa (1998) described how changes in the learning environment that affect brain development have changed how learners approach the learning process. First, the multi-media-based culture has increased the rapid sensory needs of students and forces the brain to respond more readily to different activities. Secondly, students are dealing with a variety of factors influencing them each day, such as family patterns, lifestyle changes, lack of nutrition, drugs, and lack of sleep. Even though students today "live in a very different environment, the classroom has changed very little and they find it to be dull and non-engaging" (Sousa, 1998, p. 22).

When teachers ask students to think, what do they mean? Jenson (2008) claims that educators are asking a student "to use their brain to assess prior representations for understanding or create a new model when one does not exist" (p. 142). This model includes symbolic language, indirect knowledge, and direct sensations. Symbolic language includes pictures,

symbols, music, words, or communications. Indirect language includes mental models, procedural thinking, feelings, and implicit knowledge. Direct sensations include the five senses and what they bring to knowledge stored in the mind.

The brain has the job of sorting through important information. It must decide what information is stored for the future and which information can be forgotten. The brain sifts through incoming sensory stimuli and selects what is meaningful and relevant (Wolfe, 2010b). If the information entering the brain has no meaning or is nonsensical, then the brain will not store it. This often happens with information that a student may not understand. Therefore, it is important to organize and make "sense" of information entering the brain in order for it to retain the data. Thinking Maps can assist with this organization with visual tools that connect directly to natural ways of thinking to organize information that the brain will have to store for future use.

The brain involves mind, body, and feelings when it is working to develop structures for remembering and learning. Students from varying backgrounds can have any number of negative influences that can impede learning. The role of the teacher is to use their knowledge of how students learn to enhance instruction and make it engaging and meaningful.

Thinking Maps® and Habits of Mind

Costa and Kallick (2009) noted in their research that all people in all professions use sixteen Habits of Mind, whether consciously or unconsciously, during their work. These habits of mind are persisting, managing impulsivity, listening with understanding and empathy, thinking flexibly, thinking about thinking, striving for accuracy, questioning and posing problems, applying past knowledge to new situations, thinking and communicating with clarity and precision, gathering data through all senses, creating and imagining, responding with

wonderment and awe, taking responsible risks, finding humor, thinking independently, and remaining open to continuous learning.

When educators plan the teaching of curriculum they focus first on the content that must be taught. What understanding should the student leave with at the end of the unit? However, content is far from the end of the process. This content must be applied to thinking skills, and thinking must be embedded throughout the learning of new material. The next step is to take that learning of content and develop a rich task requiring planning, problem solving, creation, construction, and meaning that challenges the student to think using the content learned. Finally, the student should examine what habits of the mind were used to complete this task. Specifically, the student should examine what strategies were employed to solve the problem, how did thinking contribute to the solution, and what other situations can this learning be applied to outside of the school environment (Costa & Kallick, 2009).

Metacognition is one of the key Habits of the mind. It is the awareness of one's own learning (Hyerle, 2011). Teachers using Thinking Maps® have reported that as students can explain their own learning and understanding using a visual map, they slowly become aware of how their fellow students learn (Hyerle, 2011). This awareness helps them to see varying ways of thinking about organization of material. It is much like a student having a math problem and suddenly realizing there is more than one way to solve for the correct answer.

Habits of the mind help students recognize the behaviors of thinking that lead to success. When we weave thinking processes into direct instruction, we begin to model effective and successful problem completion for students (Costa & Kallick, 2009). Habits of the mind is not an add-on strategy for teachers; they are the skills needed by all to be successful. Thinking Maps® is intended to be a strategy that becomes part of a students' daily work. As the student

has to organize their thinking into visual maps, they naturally begin to organize all things they see into a visual. This modeling of thinking will lead to success in student achievement.

Summary

The review of literature indicated that while reading comprehension was a major indicator of student achievement, the actual teaching of specific reading comprehension strategies continued to be an area of instructional weakness. Research has also established that providing explicit instruction of individual comprehension strategies enabled students to better understand their individual thinking processes and take ownership for their learning. While reading comprehension is difficult for many students, it is especially difficult for students coming from language poor environments where students have little exposure to reading and complex vocabulary.

Additionally, research pointed to a reading achievement gap that exists when comparing students by socio-economic status and gender (Entwisle et al., Jenson, 2009). The use of graphic organizers is a specific strategy that acts as a visual framework for students in which meaning can be constructed and learning connected. While general graphic organizers are helpful for making the abstract become concrete for readers, the Thinking Maps® program is a specific group of eight visual organizers that could possibly assist students, including students from disadvantaged subgroups and varying gender groups, perform at higher levels.

The flexibility, consistency, and ease of use found in Thinking Maps® will help students because they are introduced to only eight maps, rather than the hundreds of graphic organizers available to teachers and students in schools today. The success of the Thinking Maps® program relies heavily on the fidelity to a school-wide strategy approach. It is vital to the success of the

program that all teachers, in all contents, at all grade levels use the maps in their classroom in a systematic way.

Recognizing that research has indicated the importance of teaching reading comprehension strategies, the purpose of this study is to determine the impact of a specific strategy, Thinking Maps® (Hyerle, 2000), on reading achievement in middle school students with whom the strategy has been implemented as a school-wide program. In addition, the impact of reading comprehension of students compared by socio-economic status and gender was studied because these factors have been identified as predictors of student success.

The following chapters describe the methodology used to study the effects of the Thinking Map® program on student achievement, analyze data collected, and discuss the implications and directions for future research.

CHAPTER THREE: METHODOLOGY

Introduction

The current practice in schools is a significant factor related to comprehension deficits. Best practice indicates that visual mapping, relationship connections between concepts, and students being exposed to strategies that are modeled and practiced are more effective to increasing comprehension (Hyerle, 2009). The purpose of this study was to provide a model of intervention and a research-based strategy for middle school students in the use of Thinking Maps® for comprehension. By providing systematic instruction in comprehension strategies using this tool, students will be provided a visual framework; connections to prior learning, non-linguistic representations and discussion of text will enhance learning, recall, and comprehension.

Research Design

The causal comparative design was used in this research project. The purpose of causal comparative research is to determine the cause of existing differences among groups (Gall et al., 2007). The reason this design was chosen was because the researcher did not control the independent variables in this study, but the absence or presence of the independent variable already naturally exists. This design is much more retrospective in attempting to determine the cause of the results that have been obtained (Gall et al., 2007). The independent variables in this study were gender, school, and socio-economic status. The treatment is instruction in using Thinking Maps® as part of a school-wide strategy. Schools identified as School B and School C were the treatment groups, while the non-treatment groups were School A and School D. These two schools were not using Thinking Maps® as an identified school-wide strategy.

Scores used for this study were gathered ex post facto, meaning the test had been given and scored before the research study began (Howell, 2011). Ex post facto scores were obtained from the Virginia Standards of Learning reading test and were used to compare the mean scores of students taught using the Thinking Maps® strategy and those that were not during the 2011, 2012, and 2013 school years. A sample copy of the 2011 grade seven Standards of Learning reading test can be found in Appendix B. In 2013, the Standards of Learning reading test added questions that contained more rigor. Test scores throughout the Commonwealth dipped.

This design was chosen in an effort to determine if there is a cause and effect relationship between the use of Thinking Maps® school-wide and improved academic performance on the statewide reading test. This research design was an ex post facto study, as the implementation of the Thinking Maps® program had already occurred at the two schools being studied and testing of the non-control and control group have already occurred using the same assessment. The researcher looked at data by gender and disadvantaged subgroup. These groups were predetermined before research began and could not be altered by the researcher. This research design was used to look at the success of a program that had already begun implementation to determine if it was wise to invest more money and time into its implementation in other schools. The research design was used to determine if there is a significant difference in the mean scores on the Virginia Standards of Learning Test for reading by gender and socio-economic status.

Research Questions

The research questions that guided this study are listed below.

RQ1: What is the effect of the use of Thinking Maps® visual tools on Standards of Learning reading test scores versus the non-use of Thinking Maps® visual tools for middle school students as measured by mean test scores?

RQ2: What is the effect of the use of Thinking Maps® visual tools on Standards of Learning reading test scores versus the non-use of Thinking Maps® visual tools for economically disadvantaged middle school students as measured by mean test scores?

RQ3: What is the effect of the use of Thinking Maps® visual tools on Standards of Learning reading test scores for middle school students based on gender as measured by mean test scores?

Hypotheses

H_1: Middle school students using Thinking Maps® visual tools will have statistically significant greater mean test scores on the 2011, 2012, and 2013 Standards of Learning reading test than middle school students that did not use Thinking Maps®.

H_2: Economically disadvantaged middle school students using Thinking Maps® visual tools will have statistically significant greater mean test scores on the 2011, 2012, and 2013 Standards of Learning reading test than middle school students that did not use Thinking Maps®.

H_3: Female middle school students using Thinking Maps® visual tools will have statistically significant greater mean test scores on the 2011, 2012, and 2013 Standards of Learning reading test than male middle school students using Thinking Maps® visual tools.

Null Hypotheses

$H_0$1: There is no significant difference in the mean test scores on the 2011, 2012, and 2013 Standards of Learning reading test of middle school students using Thinking Maps® visual tools on and middle school students that did not use Thinking Maps®.

$H_0$2: There is no significant difference in the mean test scores on the 2011, 2012, and 2013 Standards of Learning reading test of economically disadvantaged middle school students

using Thinking Maps® visual tools on the 2011-2013 test and middle school students that did not use Thinking Maps®.

$H_0$3: There is no significant difference in the mean test scores on the 2011, 2012, and 2013 Standards of Learning reading test between female and male middle school students using Thinking Maps visual tools.

Participants

The students involved in this research were students in one of four middle schools chosen for this study. Two of the middle schools chosen had full training for their staffs in the use of Thinking Maps® and had been using the visual mapping strategy for the entire three years of study. These schools had implemented Thinking Maps® as a school-wide expectation, meaning all teachers within the school were to use the visual maps at least three times per week in their classes. The other two middle schools were chosen based on similarities in free and reduced lunch populations and ethnicity and had never been exposed to the Thinking Maps® strategy. Students were in grades six, seven, and eight at these schools between 2011 and 2013. Based on the Virginia School Report cards for the 2011, 2012, and 2013 school year (Virginia Department of Education, 2011a, 2012a, 2013), the four schools' free and reduced lunch rates range from 51 percent to 65 percent, and all schools have been awarded multiple federal grants to raise achievement due to low test scores on state assessments.

Students were selected through convenience sampling and non-random assignment and were preplaced in groups by non-controllable variables. A convenience sample is a study of subjects taken from a group that is conveniently accessible to a researcher (Howell, 2011). One advantage of this is that it is easy to access, but the disadvantage is that the sample may not be an accurate representation of the population (Howell, 2011). The sample was a non-random

selection because the researcher was looking to study groups of students that had been instructed in the Thinking Maps visual mapping strategy for at least one year. A non-random sampling is a group chosen for research based on a specific characteristic (Howell, 2011). The groups in this study included participants in grades six through eight, during 2011, 2012, and 2013, by all students tested, males, females, non-economically disadvantaged and economically disadvantaged. Parent permission slips were not needed since the data were collected ex post facto, and the students were participating in the treatment as part of a school strategy and not this study.

Setting

The four schools that participated in the study are all located in school divisions within Central Virginia school divisions that are in Region V of Virginia. School B and School C have implemented Thinking Maps® as a school program and all teachers, core, special education, and resources, have been given the full one day training and all of the follow-up trainings specific to their content. In addition, the administrators for both School B and School C have been trained in the leadership component of Thinking Maps®. School B and School C began training and implementation in January of 2010, began using the visual maps immediately, and are still using them consistently at this time. At the time of this study, School A and School D had never used the Thinking Maps® strategy as a school-wide strategy.

School B and School C were chosen because they have been in full Thinking Maps® implementation for at least three years. School A and School D were chosen because they have similar economically disadvantaged rates (based on free and reduce lunch numbers), enrollments, and demographics as noted in Table 1.

Table 1

Demographics of Schools in Study (2011-2013)

	School A	School B	School C	School D
Gender (%)				
Female	47	49	52	47
Male	53	51	49	53
SES (%)				
Disadvantaged	52	49	21	49
Non-Disadvantaged	48	51	79	51
Enrollment	715	511	952	1025

Note. Numbers indicate averages for all years (2011-2013).

Procedures

Prior to the start of data collection, the researcher submitted the research proposal to the Institutional Review Board (IRB) for approval. The application listed specific details on data acquisition with the addition of provisions minimizing risks to participants, keeping them well informed, and maintaining their privacy at all times.

The IRB application and approvals were completed. Throughout the study, all data were locked in a file cabinet in the researcher's office and was only worked on in the office. There was a codebook that listed the variables and what they meant. Each participant's name was replaced with a numeric identifier that corresponded with their information and the numbers were kept in the codebook separate from the research data. This book was locked in a desk drawer in

the office. The computer was password protected for all files, but an additional password was needed to access the Excel file with research data. Permission was sought from the school divisions with schools in the study in order for the researcher to have access to anonymous student data in reading grades six through eight for the years 2011, 2012, and 2013. School divisions were asked for Excel files with school name, grade level, gender, disadvantaged data, transfer information, and reading scores with no identifying student information. Each piece of student data was then assigned a number and the number was the only identifier to the data.

Instrumentation

All students in the study had taken the reading Standards of Learning (SOL) tests. A copy of a seventh grade reading Standards of Learning test can be found on the Virginia Department of Education website. The Virginia Standards of Learning test is given to all students in Virginia public schools in grades three-eight and again in grade eleven. Initial development of the tests began in 1996 with input from classroom teachers, curriculum specialists, and local educators from Virginia. A statewide field test of developed items took place in spring of 1997, with the first official test for student scores taking place in spring of 1998 (Virginia Department of Education, 2012a).

The Virginia Statewide Student Assessments Technical Report (2012b) gives the following specifics about item development, and reliability and validity of the test. Educational Testing Services (ETS) is responsible for the initial development of test items based on principles of quality item construction, universal design, fairness, and the Standards of Learning content. Each year over 300 items are created that will be field tested across the Commonwealth and will later appear on future tests if they pass through field testing and content review committees.

Once items are field tested, Virginia educators from across the state convene in Richmond annually to form Content Review Committees to review field test items. They look at "data from field tests, matching of content to standards, appropriateness of the content and difficulty level, and best practices for item construction" (Virginia Department of Education, 2012b, p. 14). Each committee member gets a vote on each item reviewed and items are kept or discarded based on this input.

During the Standards of Learning test development, descriptive statistics were gathered from each spring field test for each test item using classical, Rasch, and differential item functioning (DIF) item statistics (Virginia Department of Education, 2012b). The statistics calculated include (a) number of students tests, (b) traditional difficulties (*p*-values), (c) item-option response distributions for all students by gender and ethnic group, and (d) point-biserial correlations (2012b). Once the statistics are gathered on each field test item and test is created that contains a core of items that anchors the test to previously given tests and new field test items. For reading tests, the core anchor is usually passages placed in the same sequence of the test with about 30 items. Educational Testing Service psychometricians create the tests that will be used for each spring testing.

The Item Response Theory model that was used to develop, calibrate, equate, and scale the Virginia Standards of Learning tests was the Rasch (Virginia Department of Education, 2012b). The Rasch shows the probability that a correct response on an item is a function of the students' ability. Equating of the test occurs after all tests are given. Test equating ensures that all test forms given throughout Virginia are equally difficult and contain similar content to guarantee there is no advantage or disadvantage between test forms (2012b). The equating and

scaling of items is connected to the core items on all tests and the linking items placed on each test that connects them to a previous year's test.

Reliability is tested using the classical test theory (Virginia Department of Education, 2012b). The reliability coefficient can be simplified as the degree to which scores remain consistent over multiple forms of an assessment.

> Because the Virginia SOL is a secure test that should not be administered twice, an internal consistency method is used. In this method, a single form is administered to the same group of subjects to determine whether examinees respond consistently across the items of the test." (Virginia Department of Education, 2012b, p. 42)

Reliability coefficients for the reading SOL test by grade level are as follows: sixth grade- .88, seventh grade- .86, and eighth grade- .88. All scores above .80 are considered reliable.

Test validity is defined as the degree that test scores measure what was intended in the test (Howell, 2011). The Virginia SOL test relies mostly on content and construct validity. Validity measures on the Virginia SOL reading test ranged from .95-.97 on the 6^{th} through 8^{th} grade tests. This score is above the .80 mark for validity. It appears that validity and reliability for the Virginia Standards of Learning reading test are appropriate.

It is important to note that the Virginia Standards of Learning test changed in the spring of 2013 to add questions with more rigor. On average in the state of Virginia, reading scores dropped fourteen percentage points. Data in this study reflect this drop in scores that was recorded across the Commonwealth. For students in School B and School C, they must have been in a school with Thinking Maps® instruction for at least one year. The participants will be coded as to whether they are or are not disadvantaged and according their gender. This data was

not used to select students, but was used for some analysis of variance upon completion of the study.

Data Analysis

The researcher used an ex post facto causal-comparative research design to look at the impact on Virginia Standards of Learning reading test scores for students using Thinking Maps® as a school-wide strategy. Overall scores for students in grades six, seven, and eight were examined as well as groups identified by gender and socio-economic status. The treatment group was made up of students in School B and School C. All of the students in these two groups have been exposed to Thinking Maps® for at least one year. The non-treatment group is made up of students in School A and School D. The researcher knows that neither of these schools has implemented Thinking Maps® as a school-wide strategy. All of the data were analyzed using an Analysis of Variance (ANOVA), which is a "statistical technique for testing the differences between group means" (Howell, 2011, p. 407). This analysis will determine if the independent variable, Thinking Maps®, caused a difference in the dependent variable while controlling for test results. Each group in the study was tested to determine if there was a significant difference in the treatment and non-treatment that could have been caused by the use of Thinking Maps for instruction. The ANOVA was used because intact groups were used and control for extraneous variables was not possible.

For hypothesis one, the researcher found the mean scores of all of the students that participated in the grade six, seven, and eight reading test for years 2011-2013. The mean test scores were found for the experimental and control groups. They were then compared using an ANOVA in an effort to compare the two groups for a statistical difference. Normality, linearity, and homogeneity of variance were checked using scatterplots and histograms. The assumption of

normality test ensures that scores in each group are normally distributed about the population mean (Howell, 2011). The test of linearity will show that regression trends are linear and equal. Finally, the assumption of homogeneity of variance will ensure that scores have the same natural variance indicating that differences between groups are unrelated to any group differences. Therefore, differences are possibly indicative of the treatment (2011). The sample size was stable as it was greater than 50.

For hypothesis two, the researcher will find the mean scores of all of the non-economically disadvantaged students and disadvantaged students that participated in the grade six, seven, and eight reading test for years 2011-2013. The mean test scores were found for the experimental and control groups. Then the scores were compared using an ANOVA in an effort to compare the two groups for a statistical difference. Normality, linearity, and homogeneity of variance were checked using scatterplots and histograms. The sample size was stable as it was greater than 50.

For hypothesis three, the researcher will find the mean scores of the female students and male students that participated in the grade six, seven, and eight reading test for years 2011-2013. The male and female mean scores were compared to check for a greater statistical difference for female than male. Then they were compared using an ANOVA in an effort to compare the two groups for a statistical difference. Normality, linearity, and homogeneity of variance will be checked using scatterplots and histograms. The sample size was stable as it was greater than 50.

CHAPTER FOUR: FINDINGS

Introduction and Procedures

The purpose of this causal comparative study was to determine the impact of a specific strategy, Thinking Maps® (Hyerle, 2000), on reading achievement in middle school students over a three-year period in which the strategy had been implemented as a school-wide program. In addition, the impact of reading comprehension of students compared by socio-economic status and gender was studied because these factors have been identified as predictors of student success. For the purpose of this study, the Virginia Standards of Learning (SOL) reading test scores were used as a measurement of reading achievement. The expectation in each of the treatment schools was that all teachers, core, special education, and resource teachers, would use the maps on a weekly basis.

Compilation of data from four middle schools in Virginia was used for this study. Two of the middle schools in this study have been using the Thinking Maps® visual maps program as a school-wide strategy since the fall of 2010. The other two middle schools did not implement Thinking Maps as a school-wide strategy during this study. Findings from this study add to the research on school-wide strategies that can affect student performance. The Virginia Standards of Learning reading data from spring of 2011- spring of 2013 was used for this study.

On October 7, 2014, the researcher successfully defended the dissertation proposal to the chair and committee members. Once the committee approved the research design, the researcher began working on various approvals. The Institutional Review Board (IRB) approval was given on November 14, 2014, (Appendix J) which allowed the researcher to contact the school divisions to receive Standards of Learning data for each school that included student numbers, reading SOL scores, gender, transfer status, and free and reduced lunch status for tests given

from 2011-2013. The researcher also used the Virginia Department of Education website to retrieve state and school report card information.

Upon receiving the data from school divisions, the researcher removed all transfer students from the data for the treatment schools. The reason for removal of student data was to ensure that students had been at the school for the entire year in order to receive the initial instruction in the Thinking Maps® technique. Non-treatment school data were not adjusted for transfer students because the schools were not using Thinking Maps® as a school-wide strategy. The data from all four middle schools was combined into one excel file. Students in the file that were exempt from the Standards of Learning testing were removed from the file. All data was entered into SPSS for data analysis.

Research Questions

The research questions that guided this study were:

RQ1: What is the effect of the use of Thinking Maps® visual tools on Standards of Learning reading test scores versus the non-use of Thinking Maps® visual tools for middle school students as measured by mean test scores?

RQ2: What is the effect of the use of Thinking Maps® visual tools on Standards of Learning reading test scores versus the non-use of Thinking Maps® visual tools for economically disadvantaged middle school students as measured by mean test scores?

RQ3: What is the effect of the use of Thinking Maps® visual tools on Standards of Learning reading test scores for middle school students based on gender as measured by mean test scores?

Hypotheses

H_1: Middle school students using Thinking Maps® visual tools will have statistically significant greater mean test scores on the 2011, 2012, and 2013 Standards of Learning reading test than middle school students that did not use Thinking Maps®.

H_2: Economically disadvantaged middle school students using Thinking Maps® visual tools will have statistically significant greater mean test scores on the 2011, 2012, and 2013 Standards of Learning reading test than middle school students that did not use Thinking Maps®.

H_3: Female middle school students using Thinking Maps® visual tools will have statistically significant greater mean test scores on the 2011, 2012, and 2013 Standards of Learning reading test than male middle school students using Thinking Maps® visual tools.

Descriptive Statistics

For sound measurement of the data, descriptive statistics on the data were calculated. A description of the study sample is given in Table 2 including subgroups identified for this study. Table 2 shows a study sample of 9,609 students over the three year of data that was reviewed. The school population, disadvantaged and non-disadvantaged totals, and gender totals are balanced and reflect an equalized study group.

Table 2

Description of Study Sample (N= 9,609).

Variable	Frequency	Percent
Gender		
Female	4631	48.2
Male	4978	51.8
Academic Year		
2011	3297	34.3
2012	3258	33.9
2013	3054	31.8
School		
A	2149	22.4
B	1529	15.9
C	2855	29.7
D	3076	32.0
SES		
Disadvantaged	3904	40.63
Non-Disadvantaged	5707	59.27
Treatment Group		
Yes	4384	45.6
No	5225	54.4
Total Outcome		
Failed	2389	24.9
Pass	7220	75.1

Note. Total sample sizes reflect cumulative number of scores for all years (2011-2013)

Table 3

Descriptive Statistics (2011-2013) and (N= 9,609)

Variable	N	μ	SD
Gender			
Female	4631	447.98	69.56
Male	4978	447.67	69.26
Academic Year			
2011	3297	450.99	69.92
2012	3258	466.90	72.08
2013	3054	424.04	58.07
School			
A	2149	433.20	67.50
B	1529	423.22	54.30
C	2855	439.91	67.27
D	3076	477.60	69.33
SES			
Disadvantaged	3904	450.38	70.38
Non-Disadvantaged	5707	446.06	68.67
Intervention Group			
Yes	4384	434.09	63.54
No	5225	459.34	71.98
Total Outcome			
Failed	2220	442.53	69.93
Pass	7409	449.39	69.17

The descriptive statistics given in Table 3 show that the male to female population, the non-disadvantaged to disadvantaged population, and the overall pass to fail rates by school are balanced. With these groups being equally balanced, the treatment and non-treatment populations are also balanced. There is a significant drop in scores for all schools in 2013 due to the change in the Virginia Standards of Learning reading test. School B, a treatment school, does have a smaller overall population, but the percentage of subgroups is balanced. The mean (μ) scores for overall test scores and each of the subgroups studied is given. Standard deviation scores for overall test scores and each of the subgroups studies is also given. Standard deviation scores indicate that scores have low variability with and average standard deviation 1 and -1 above and below the mean.

Assumption of normality is not violated based on sample size of each subgroup in study. All groups had more than 50 scores to use for comparison. To address the assumption test for normality, the skewness of the data was determined by histograms. Histograms were created with SPSS for overall scores, treatment and non-treatment groups, gender, and socio-economic status. Upon reviewing the histograms in Figures one, two, three, and four, the subjects appeared to be approximately normally distributed. Based on the assumption of normality tests, the researched concluded that normality existed. An ANOVA analysis was conducted for each of the hypotheses.

Assumption Tests

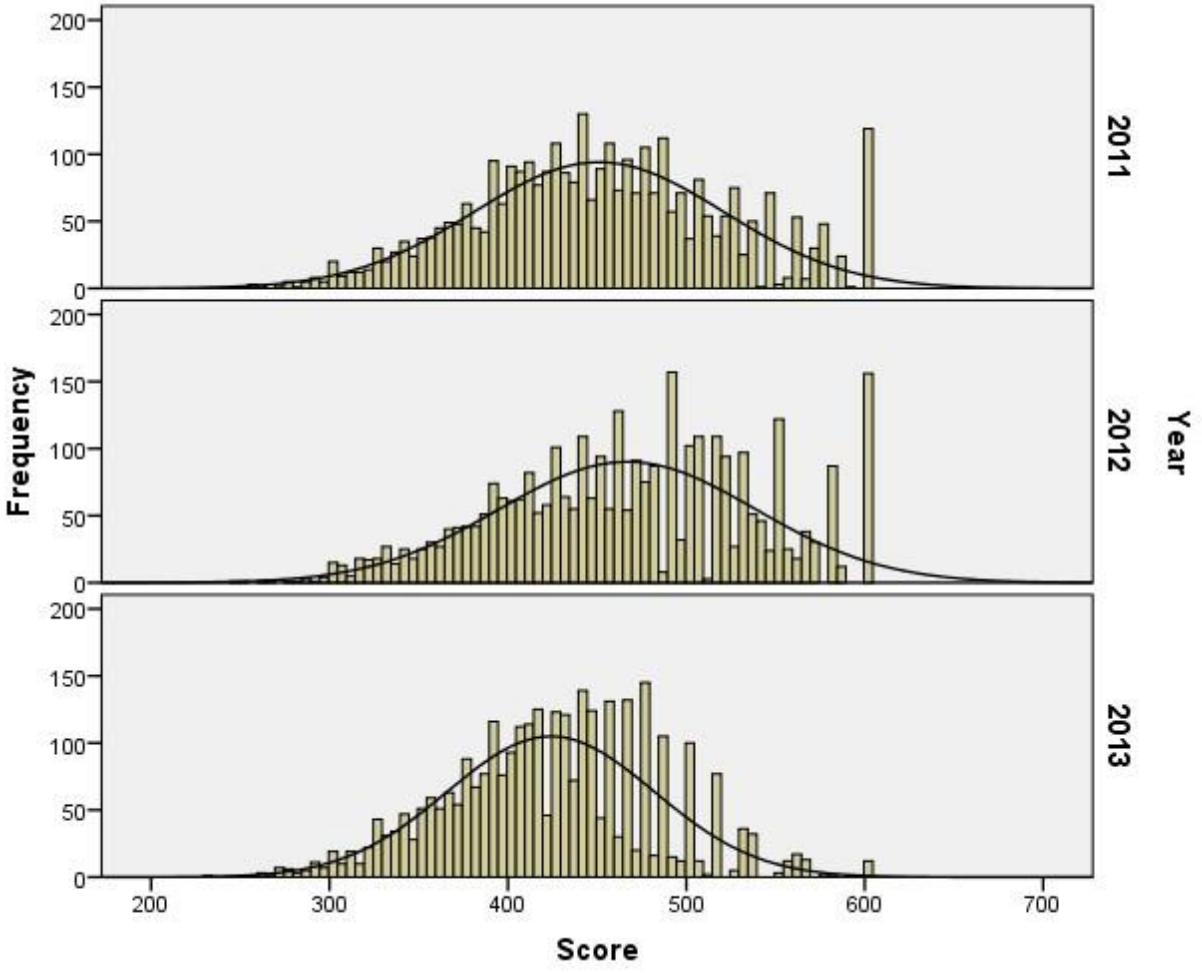

Figure 1. Virginia reading SOL scores. Histogram for 2011-2013 Virginia Reading Standards of Learning Scores for all four schools in study.

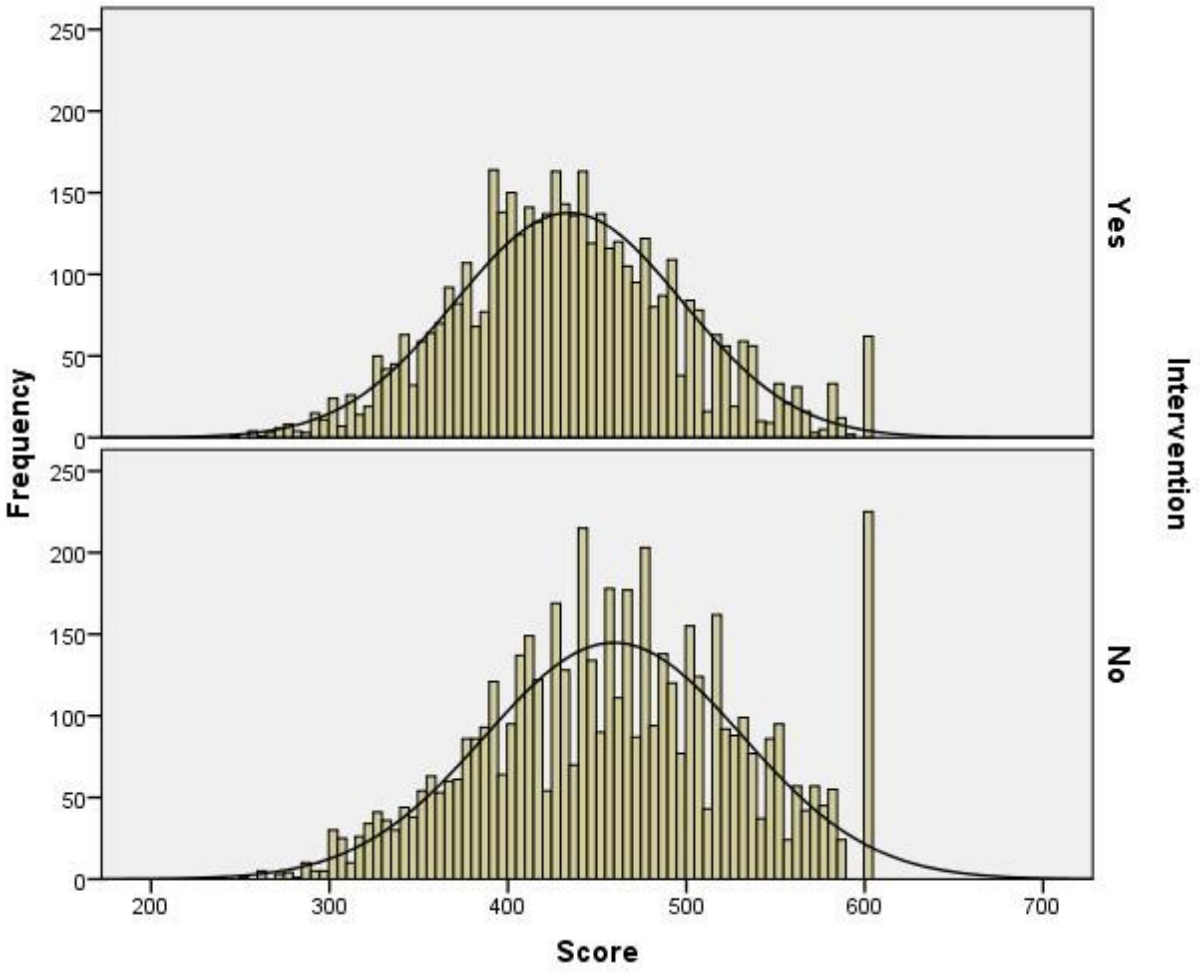

Figure 2. Virginia reading SOL Scores by treatment/intervention. Histogram for 2011-2013 Virginia Reading Standards of Learning Scores to compare treatment scores to non-treatment scores.

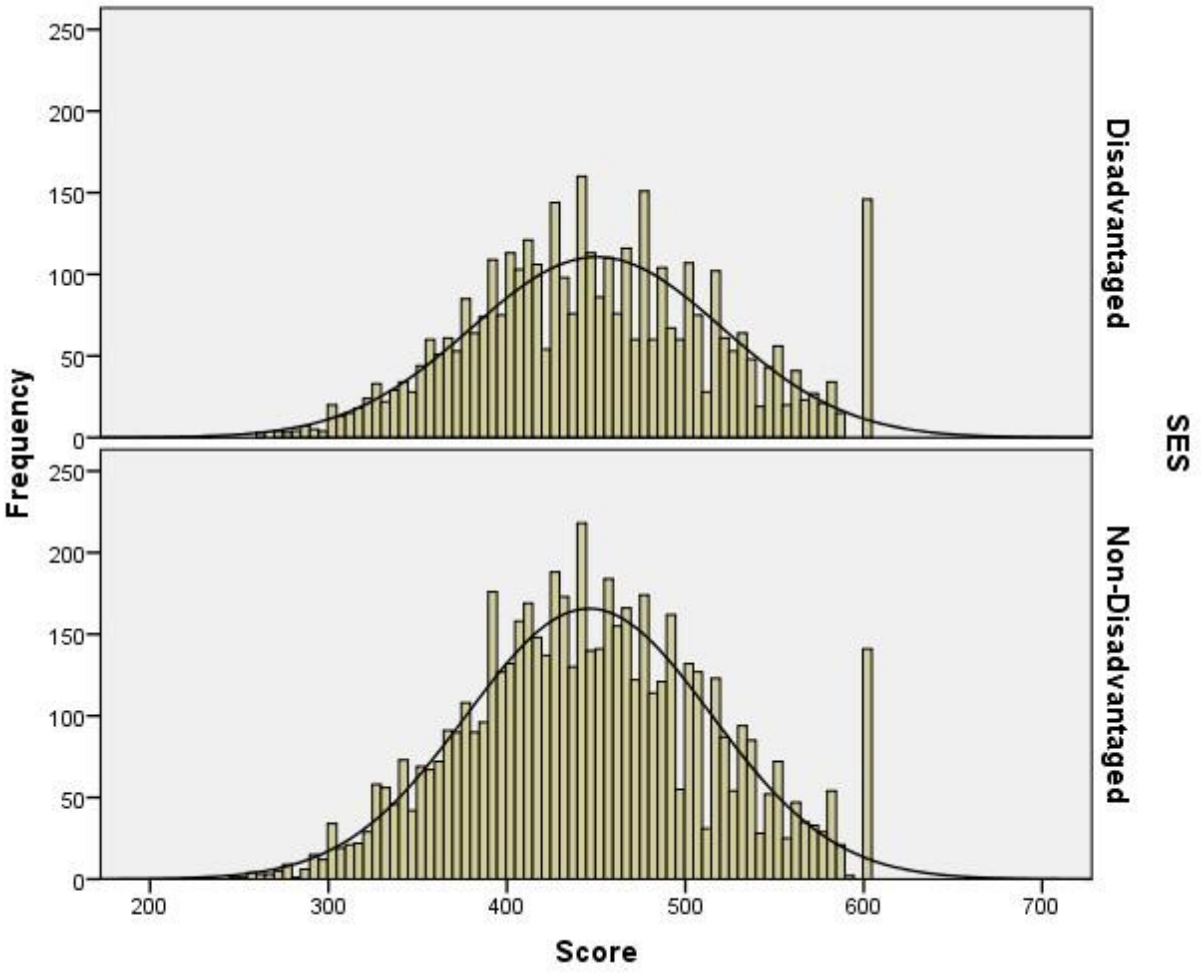

Figure 3. Virginia reading SOL scores by socio-economic status. Histogram for 2011-2013 Virginia Reading Standards of Learning Scores to compare socio-economic status.

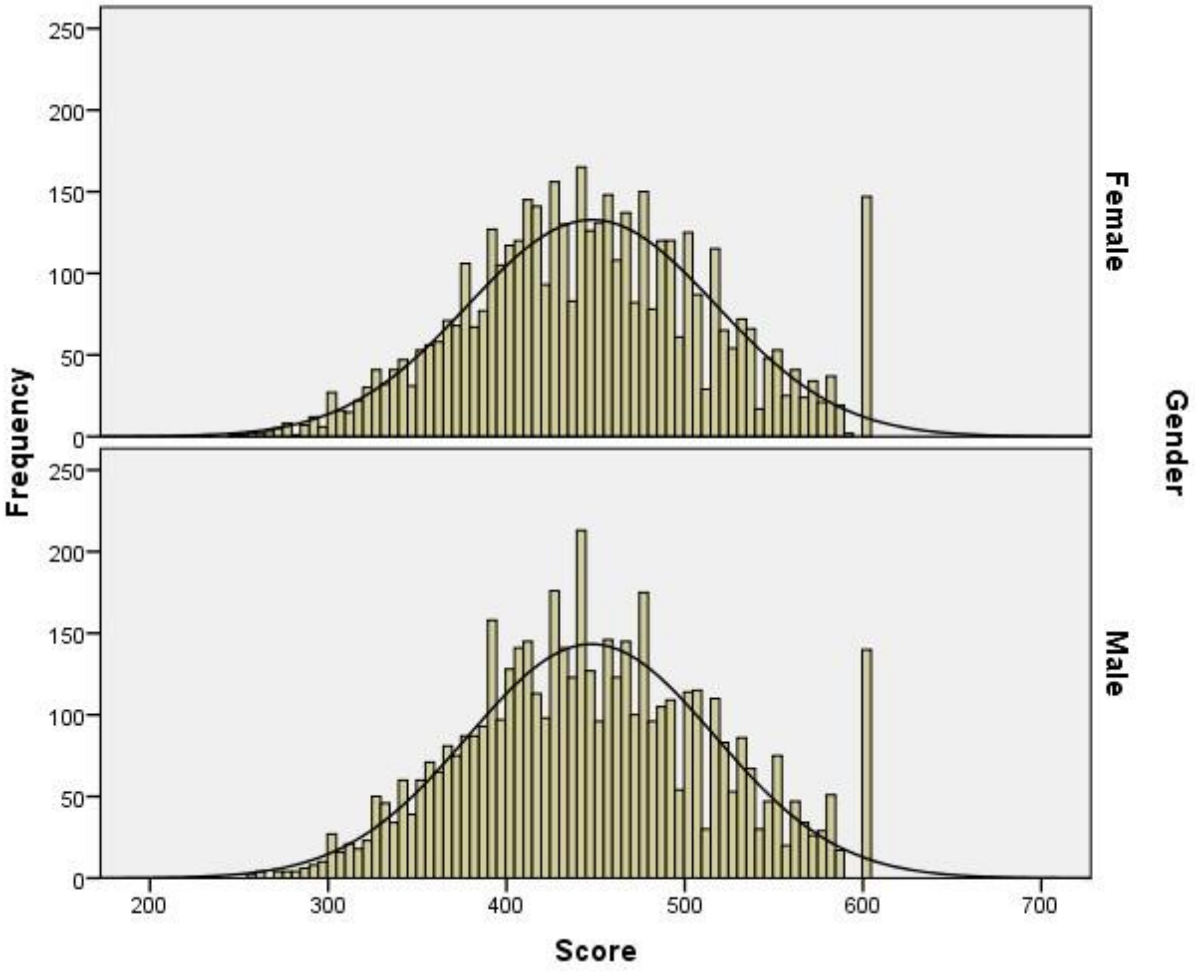

Figure 4. **Virginia reading SOL scores by gender**. Histogram for 2011-2013 Virginia Reading Standards of Learning Scores to compare gender scores.

Results

Analysis of Variance (ANOVA) tests were conducted on the data. Table 4 shows the data for mean scores achieved by each group.

Table 4

Total Mean Scores (2011-213) Achieved by Category: ANOVA (N= 9,609)

Variable	**N**	**μ**	**SD**	**F**	***P***
Gender					
Female	4631	447.98	69.56	.047	.828 ns
Male	4978	447.67	69.26		
Academic Year					
2011	3297	450.99	69.92	326.52	.000 **
2012	3258	466.90	72.08		
2013	3054	424.04	58.07		
School					
A	2149	433.20	67.50	7.23	.000 **
B	1529	423.22	54.30		
C	2855	439.91	67.27		
D	3076	477.60	69.33		
SES					
Disadvantaged	3904	450.38	70.38	9.006	.003 **
Non-Disadvantaged	5707	446.06	68.67		
Treatment Group					
Yes	4384	434.09	63.54	326.18	.000 **
No	5225	459.34	71.98		
Total Outcome					
Failed	2220	442.53	69.93	16.49	.000 **
Pass	7409	449.39	69.17		

Table 5

Final Mean Scores Post-Intervention (2013) by Category: ANOVA (N= 3,054)

Variable	N	μ	SD	F	*P*
Gender					
Female	1476	424.24	58.28	326.52	.000 **
Male	1578	422.91	57.86		
SES					
Disadvantaged	1264	426.37	56.89	326.52	.000 **
Non-Disadvantaged	1790	422.39	58.84		
Intervention Group					
Yes	1445	420.67	57.21	326.52	.000 **
No	1609	427.07	58.68		

Note. F-statistic and p reflect differences for all years.

Results of Null Hypothesis One

The first null hypothesis stated that there is no significant difference in the mean test scores on the 2011, 2012, and 2013 Standards of Learning reading test of middle school students using Thinking Maps® visual tools and middle school students that did not use Thinking Maps®. An analysis of variance test (ANOVA) was conducted to determine if Thinking Maps® as a school-wide strategy had a statistically significant effect on reading scores.

The average score for all schools in 2011 was about 451, which increased by nearly 16 points in 2012, and decreased by over 42 points in 2013. Changes in average scores were statistically significant (F=326.53, df=2, p=.000) for all schools in general. Scores varied over the three years studied but seemed to increase and decrease at approximately the same rate (see Figure 5). The decrease in scores in 2013 may be attributed to changes in the Standards of

Learning test, but the decrease was much higher than the state average of 14 points. Students attending School D, a non-treatment school achieved the highest average scores (M = 477.60, 69.33). By comparison, students at School B, a treatment school, achieved the lowest scores (M = 423.33, 54.30). Differences in average scores achieved between schools were statistically significant (F = 327.23, df = 3, p = .000). However, the statistical significance was for the non-treatment school and cannot be attributed to Thinking Maps®.

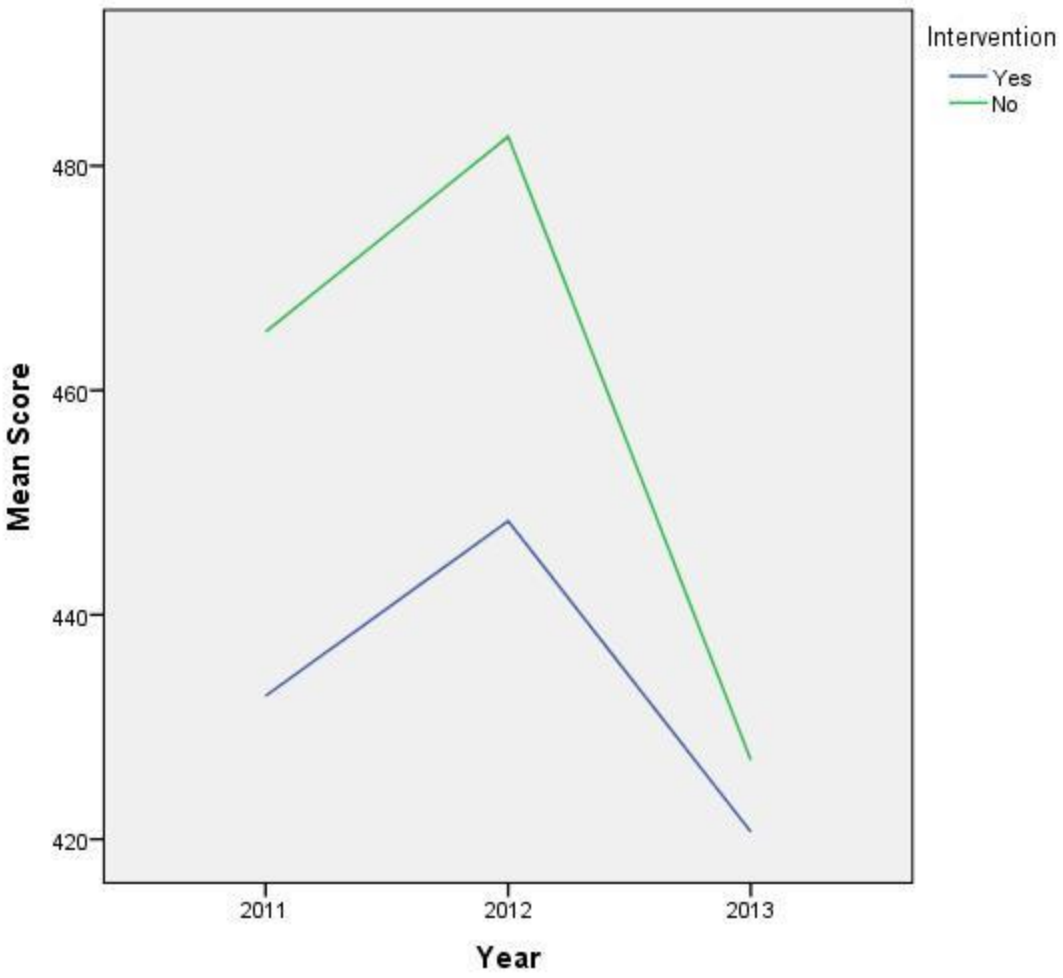

Figure 5. Trends in mean scores by year and intervention category (*N*= 9,609)**.** The graph suggests that trends in scores by year were variable by year but seem to suggest similar increase and decrease patterns. Average scores for the intervention group were consistently lower.

Schools receiving the intervention scored a lower average test score (M = 434.09, 70.38) than those in the non-intervention group (M = 459.34, 68.67). These differences were statistically significant (F = 326.18, df=1, p = .000). However, the statistical significance was for the non-treatment school and cannot be attributed to Thinking Maps®. Mean scores achieved in the intervention group were (M=420.67, 57.21) compared to those not in the intervention group (M=427.07, 58.68). Average scores post-intervention suggest that those not in the intervention group scored approximately 6.4 points higher. Differences in scores by intervention group status over the years reached maximum statistical significance (F=326.52, df=1, p=.000) for this data set.

In looking at Figure 6, the average scores were notably lower for the intervention group in 2011 and 2012 compared to the non-intervention group. However, by 2013 the scores between the intervention and non-intervention group appeared to be equal. This data suggest that the intervention may have equalized performance scores between the intervention and non-intervention groups even with test changes that measured increased rigor. In Figure 7, the data show that over the three year time frame it appears that School D, a non-treatment school, had the largest decline in scores. During this same time School B, a treatment school, showed the largest increase. The first null hypothesis was not rejected as Thinking Maps® did not have a statistically significant impact on reading achievement of middle school students overall.

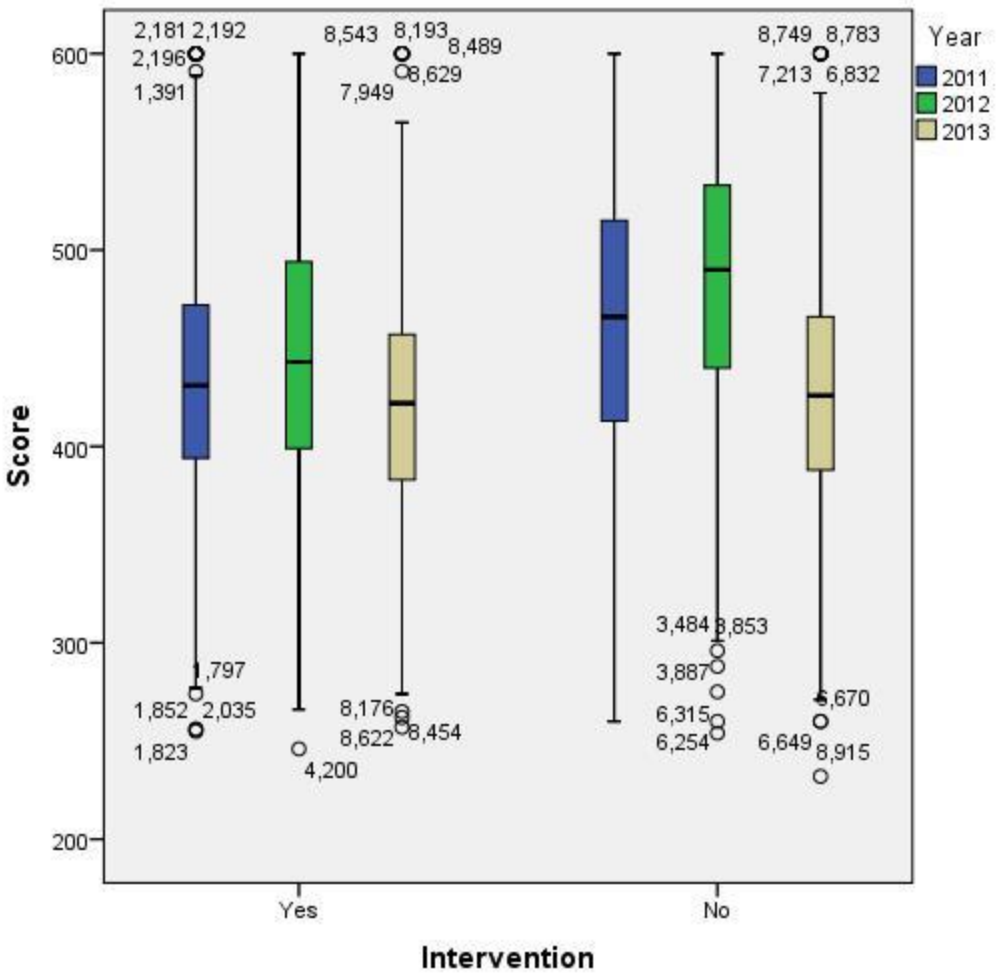

Figure 6. Box plot of mean scores and 95% CI by year and intervention status (N = 9,609). A Box Plot Graph suggests that the average scores were notably lower for the intervention group in 2011 and 2012 compared to the non-intervention group. However, by 2013 the scores between the intervention and non- intervention group appeared to be equal. The fact that the scores between the treatment and non-treatment schools were equal in 2013 suggests that the intervention may have equalized performance scores between the two groups.

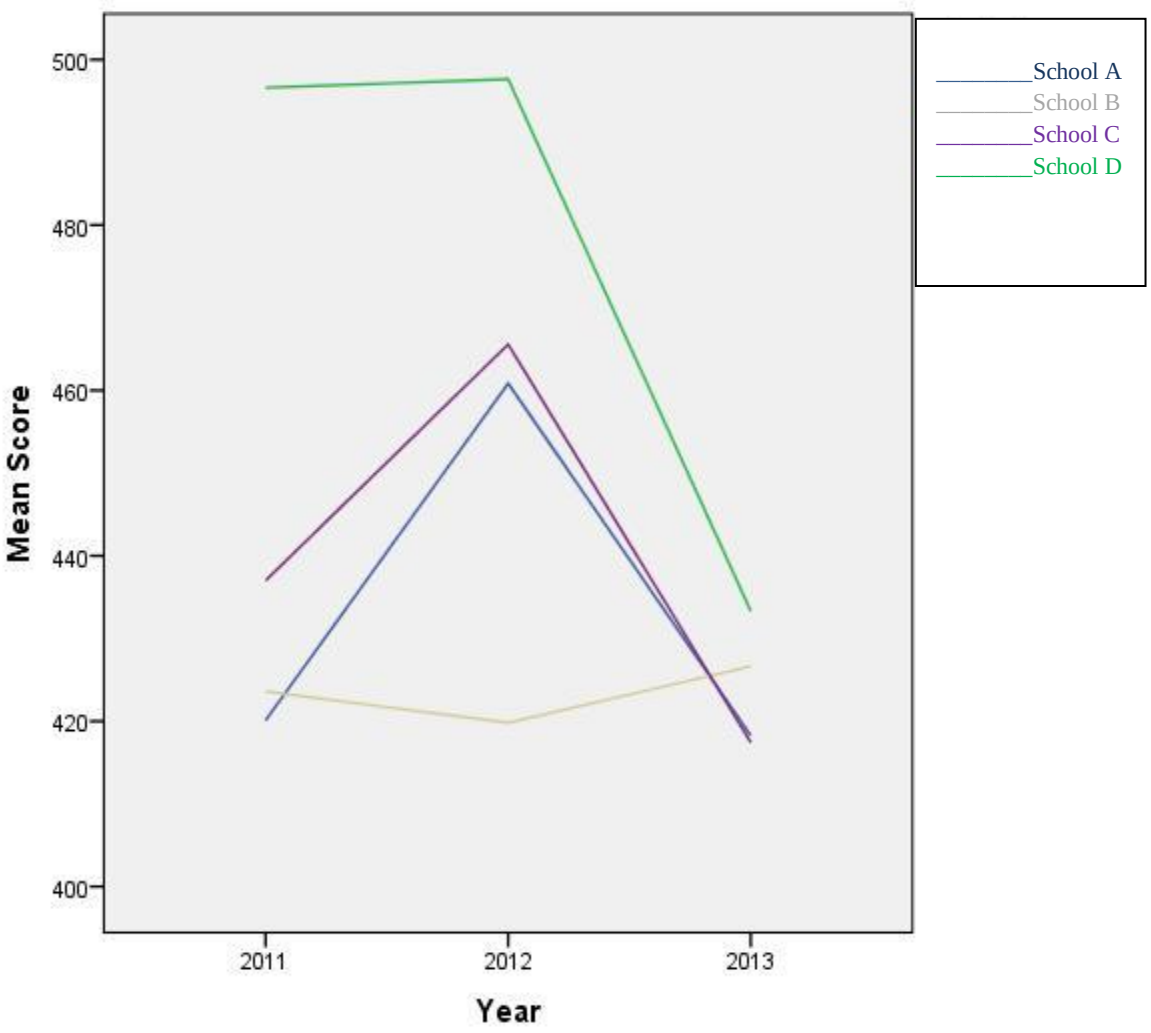

Figure 7. Trends in mean scores by year and school (*N* = 9,609). This graph suggests that trends in scores by year were variable by year for all schools. School D appeared to experience the greatest decline in scores between 2011 and 2013. School B appeared to make the largest gains.

Results of Null Hypothesis Two

The second null hypothesis stated that there is no significant difference in the mean test scores on the 2011, 2012, and 2013 Standards of Learning reading test of economically disadvantaged middle school students using Thinking Maps® visual tools and middle school students that did not use Thinking Maps®. Children who were categorized as disadvantaged achieved higher average scores (M=450.38, 70.38) than those children who were not categorized as disadvantaged (M=466.06, 68.67) (See Figure 8). These differences were statistically significant (F=9.00, P=.003). The average score achieved among those categorized as disadvantaged was 3.98 points higher than those children not categorized as disadvantaged. Mean differences between these two groups over the years reached maximum statistical significance (F=.326.52, df=1, *p*=000) for this dataset.

Therefore, the second null hypothesis was rejected. The data indicate that there is a significant difference in scores for children categorized as disadvantaged when compared to their non-disadvantaged peers.

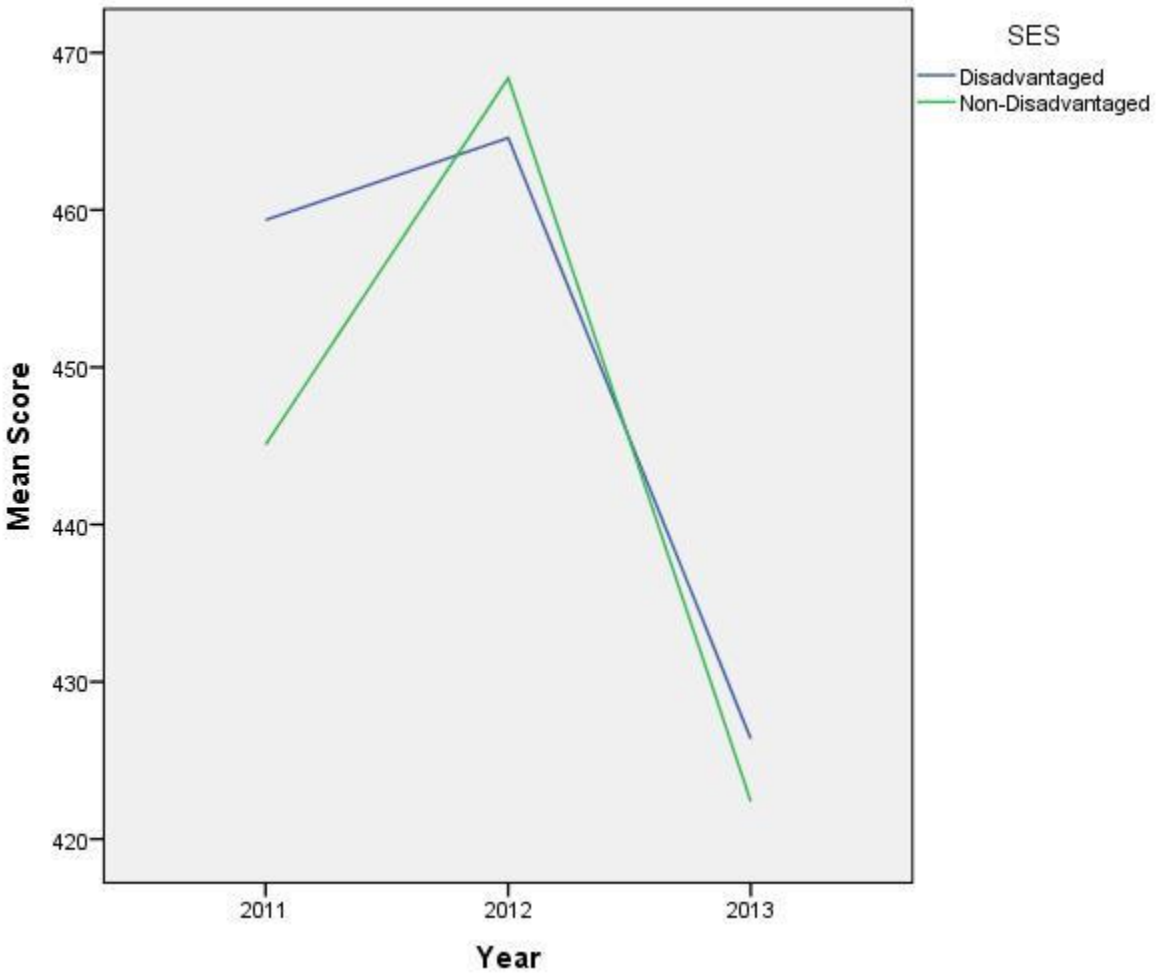

Figure 8. Trends in mean scores by year and SES category (N = 9,609). The graph suggests that trends in scores by year were variable. Comparatively, average scores for the disadvantaged group were notably higher than the disadvantaged group in 2011, lower in 2012, and only slightly higher in 2013.

Results of Hypothesis Three

Null hypothesis three stated that there is no significant difference in the mean test scores on the 2011, 2012, and 2013 Standards of Learning reading test between female and male middle school students using Thinking Maps® visual tools. Mean score trend were varied but almost identical for males and females (See Figure 9).

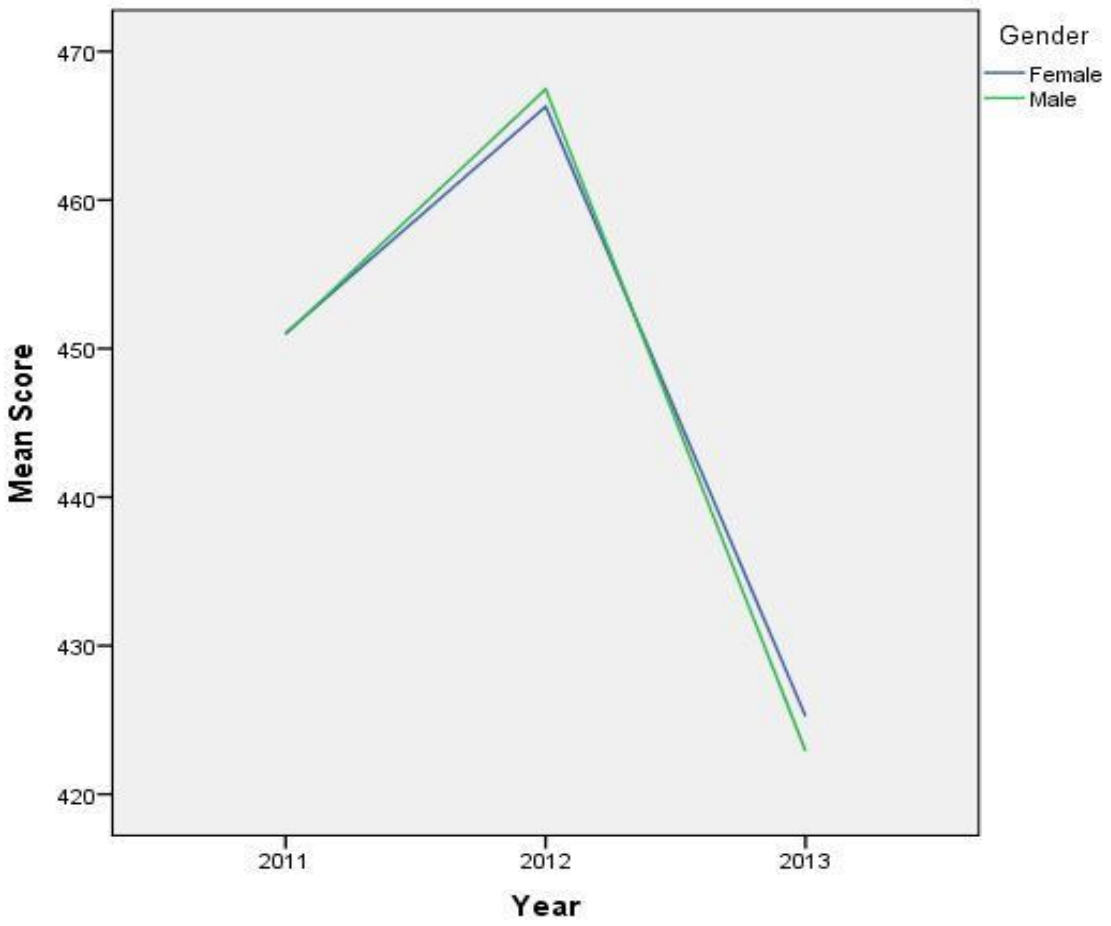

Figure 9. Trends in mean scores by year for males vs. females (*N* = 4,604). Graph suggests that trends in scores by year were nearly identical for male and female students.

There were no differences in average final scores between males and females, but there were differences in average scores by year between gender groups. Differences reached maximum level of significance for this data set (F= 326.52, df=1, p=.000). The final scores achieved were an average of 1.33 points higher for females than males.

Results Summary

Student performance on the Virginia Standards of Learning tests were compared between two middle schools using Thinking Maps® as a school-wide strategy and two middle schools not using Thinking Maps®. Overall school groups were compared, as well as males and females in the treatment group, and students from different socio-economic environments. The results of the study indicated that students receiving the treatment scored significantly lower than students not receiving the treatment. Two interesting pieces of data to consider are that scores over the three-year period did appear to equalize between treatment and non-treatment schools and one of the middle schools using Thinking Maps® had the largest gain over three years in schools, even though it did not surpass the non-treatment schools.

There was a statistical significance between students in the treatment school that were disadvantaged and those in the non-treatment school. Statistically disadvantaged students in the treatment schools scored on average 3.98 points higher than non-treatment schools. Finally, females in treatment schools scored significantly higher than males in the treatment schools. Female scores were on average 1.33 points higher than male scores.

CHAPTER FIVE: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

The results of the study on the effects of Thinking Maps® on Middle School reading achievement are discussed in Chapter Five. A discussion of the findings and implications were stated. The limitations were reviewed and recommendations for future research were suggested.

Discussion

Thinking Maps® is an expensive proposition for any school division interested in using it to raise achievement in their students. This research investigated the reading achievement of students using Thinking Maps® as compared to students that were not using the maps. Overall achievement was compared, as well as the achievement of disadvantaged students using the treatment to those that were not. In addition, gender differences were examined within the treatment group to investigate if there was a significant difference in achievement.

The first research question in this causal-comparative study was to determine if a significant difference existed with regard to the Virginia Standards of Learning reading mean scale scores between students who used Thinking Maps® visual tools versus the non-use of Thinking Maps® visual tools for middle school students.

The data indicated that there was a significant difference in scores between the treatment and non-treatment schools; however, the non-treatment schools had scores that were higher. Changes in average scores were statistically significant for all schools in general due to a change in the test format in the spring 2013 test session. On average, the spring of 2013 reading Virginia SOL scores for schools in Virginia had a 14-point decrease in scores. All of the schools in this study had scores that dropped more than the 14-point average in 2013. Scores varied over the three years studied, but seemed to increase and decrease at approximately the same rate.

Students attending School D, a non-treatment school, achieved the highest average scores. By comparison, students at School B, a treatment school, achieved the lowest scores. Differences in scores cannot be attributed to Thinking Maps® instruction as treatment scores had significantly lower scores than non-treatment scores.

One interesting note in the data was that by 2013, the scores between the intervention and non- intervention group appeared to be equal. This suggests that the intervention may have equalized performance scores between the intervention and non-intervention groups even with test changes that measured increased rigor. Over the three-year time frame, it appears that School D, a non-treatment school, had the largest decline in scores. During this same time School B, a treatment school, showed the largest increase. A possible explanation for this increase may be that School B had a stronger fidelity to the implementation of Thinking Maps® as a school-wide strategy than School C, which was also a treatment school. Thinking Maps research (Hyerle, 2011) indicates that for Thinking Maps® to be effective, all teachers in all content areas must use the maps consistently. An additional difference between School B and C, treatment schools, was that School B was participating in the Making Middle Grades work grant at the time of the study. This grant provides teachers with literacy strategies that are designed to improve overall reading performance. Without further research, it cannot be determined which intervention may have made the greatest impact on the improvement of School B in reading.

Overall as a school-wide strategy, Thinking Maps® did not have a significant impact on reading achievement as measured by the Virginia Standards of Learning reading test. This finding itself is significant. There is a multitude of research on the value of graphic organizers as a visual language for learning (Ausubel, 1960; DiCecco & Gleason, 2002; Hyerle, 2008; Hyerle, 2011; Stull & Mayer, 2007). Thinking Maps® are designed to create a common, school-wide

language for all learners. The simple construction and consistency of the maps provide visual structures for students to organize their learning input and output. The fact that this program did not demonstrate measurable improvement could be based on a lack of fidelity in the school-wide implementation, which was not examined in this study and/or the incorrect use of the Thinking Maps® program, which was also not examined.

Since Thinking Maps® is such an expensive program, consumers would be wise to look at further research conducted in the future for middle school students before investing such large amounts into the program. Since research supports the use of graphic organizers as one of the strategies that can increase academic achievement in school (Marzanno et al., 2001), other types of graphic organizer programs may produce more significant results.

The second research question was to determine if there was a significant difference in mean scores on the Virginia Standards of Learning reading test for economically disadvantaged middle school students in schools using Thinking Maps® versus non-treatment schools. Children who were categorized as disadvantaged achieved higher average scores than those children who were not categorized as disadvantaged. These differences were statistically significant, and the average score achieved among those categorized as disadvantaged was 3.98 points higher than those children not categorized as disadvantaged. Mean differences between these two groups over the years reached maximum statistical significance for this dataset. There is indication from the data that students categorized as disadvantaged benefited from the Thinking Maps® intervention.

Research confirms that explicit and systematic instructional materials can help disadvantaged students acquire literacy skills and promote student success (Bahr & Dansereau, 2005). Even though strategies that are appropriate for disadvantaged students are effective for

all students, the data from this study indicate that the structure and consistency of this visual organizer is more beneficial to the disadvantaged student. One aspect of Thinking Maps® is that it levels the playing field for all students (Hyerle, 2008). This aspect could explain the performance of socio-economically disadvantaged students.

Data from this study indicate that the Thinking Maps® program would be very beneficial for schools with a high number of students that are disadvantaged or have high free and reduced lunch rates. As Payne states in her book *A Framework for Understanding Poverty* (2005), "disadvantaged kids need to have the concrete translated to the abstract through mental models" (p. 51). Thinking Maps ® as a visual model for disadvantaged students is supported through this research. The concrete representation of content information and the consistent organization of information using the eight models of thinking increases student performance in reading.

A personal observation as an administrator in a school that uses Thinking Maps® as a school-wide strategy is that advanced students, who are often not socio-economically disadvantaged, like to structure and organize information in their own way. They are typically strong readers and did not need the explicit instruction related to comprehension as their disadvantaged counterparts. By middle school, they have developed their strategies and hesitate to try new strategies that are not familiar to them. This may be one reason why non-disadvantaged students did not increase their reading scores at the same level of their disadvantaged peers throughout the three-year period of this study.

The final research question of this causal-comparative study was to determine if there was a significant difference in mean scores on the Virginia Standards of Learning reading test for female students compared to male students in schools using Thinking Maps®. Mean score trends were varied but almost identical for males and females. There were no differences in

average final scores between males and females; however, differences in average scores by year between gender groups reached maximum level of significance. The scores achieved were an average of 1.33 points higher for females than males.

Research indicates that females typically do better on linguistic tasks than do males (Gurian & Bellew, 2003; McGeown et al., 2012; Coles & Hall, 2002). Further research in the areas that males typically excel in, such as science or math would be an interesting research study for the future. Since research shows that females do better at reading tasks, the research falls in line with previous research on achievement by gender.

Mullis et al. (2007) research confirms that girls, on average, read more frequently, have more positive attitudes towards reading, higher reading motivation, and greater confidence in their reading skills. The fact that the data trend for males and females using Thinking Maps® were similar with females performing better than males mimics the research of others. The question then becomes whether girls in the treatment would have done better than the males whether they had the treatment of not. The fact that the male and female trends throughout the three year study of data were consistently varied does indicate that Thinking Maps® may have assisted the males in the study with making average scores that were comparable with the females in performance.

Conclusions

Research indicates that reading comprehension was a major predictor of student achievement. Research indicates that teachers that explicitly teach reading strategies will improve reading performance over time, and if these strategies are used consistently, they create habits of mind that students will use over and over to help them achieve success. Based on the research conducted in this study, Thinking Maps® may be an appropriate tool for some classroom teachers and their students. There is an impact on the achievement of disadvantaged

students. However, based on this study there is not an overall significant effect on the majority of students as a whole.

Thinking Maps® has all of the components of a strong research-based program. Its flexibility, consistency, use in all contents, and simplicity meets two of the nine strategies identified in *Classroom Instruction That Works: Researched-Based Strategies for Increasing Student Achievement,* by Marzanno et al. (2001). These strategies are identifying student similarities and differences and using non-linguistic representations. In addition, the maps can be used to build higher level thinking skills that are necessary for the 21st century learner. However, this study did not support the use of Thinking Maps® as a school-wide strategy compared to the level of expense incurred by the school. The researcher feels strongly that the reason for this may rely heavily on the lack of implementation and fidelity to the program by schools B and C. There are currently four dissertations (Leary, 1999; Hickie, 2006; Russell, 2010; Edwards, 2011) at the elementary level that have all shown academic increases for students. One of these studies measured the level of fidelity by teachers and found that it was vital to the success of implementation.

In retrospect, the researcher may have had more significant results if a mixed methods approach had been taken. The researcher then could have measured the fidelity of implementation of the program to eliminate the question of teachers actually using the program as it is designed. Conway and Abawi (2013) note that school-wide strategies are only effective if the entire school feels that they have had a voice in choosing the strategy. When principals or instructional departments push achievement strategies and they do not have teacher buy in, the strategy will most likely fail. "Research suggests that schools need to build capacity for change by developing a foundation of quality principles and practices, created and agreed upon by

teaching staff, and that become the reference point for decision-making within the whole school community" (2013, p. 176).

One interesting and telling piece of data from this study is the equalization of scores in 2013 between schools when there was the change to the testing instrument. All schools had a drop in scores, but the treatment and non-treatment scores appeared to become more equal. This data contributes to the researcher's belief that more research should be done on Thinking Maps® and its consistent use over time. Perhaps it is not a high yield strategy for school improvement, but a strategy that demonstrates more success over time.

Implications

While this research cannot be the sole decision making information a school or school division uses before contemplating the purchase of Thinking Maps®, it does indicate that further study into the program should be considered. While research at the elementary level determined that significant improvement occurred with the use of Thinking Maps®, this study at the secondary level indicated that Thinking Maps® use did not provide a significant improvement of scores for schools that were looking for a program to enhance school improvement efforts.

Since Thinking Maps® is a costly program, this study can help divisions determine if the purchase of this product is worth the dollars it would take from already stretched school budgets. It may be worth the cost if a school is predominately socio-economically disadvantaged, as this research showed a significant gain in this subgroups' scores over three years. School leaders must be committed to ensuring fidelity of the program and classroom use in a consistent way. Thinking Maps® is a program that must have the buy in of the educators using the product in order for it to be effective. Administrators should meet with leadership teams and professional

learning communities to ensure they are on board with this school-wide program from initial implementation.

This research indicates a need for more research into school-wide strategies that can assist with reading comprehension and overall achievement. The findings of the National Reading Panel (NICHD, 2000) are highly researched, and this research indicates that explicit instruction in comprehension strategies is vital for student growth. Visual maps have proven to be a researched-based strategy that enhances comprehension and is necessary for student organization of information. The research of Hyerle (2011) supports the improvement of reading for students that are at risk in multiple subgroups. This researcher would urge a more in depth study of Thinking Maps® and the effective use of it as a strategy for middle school readers.

The final implication is that different approaches may work better for different groups of students and that a "one size fits all" approach may not be beneficial to schools looking to improve. It is evident in past research done at the elementary level (Edwards, 2011; Hickie, 2006; Leary, 1999; Russell, 2010) that Thinking Maps® can be a tool to boost student achievement. At this time, this is the only research at the middle school level, and it does not indicate overall achievement for students. Therefore, Thinking Maps® may not be appropriate for the tasks middle school students are asked to complete.

While this study did not show statistically significant improvement in reading scores between treatment and non-treatment schools, it did point to significant scores for disadvantaged students. This study will begin the discussion of future research into the use of Thinking Maps® as a school-wide approach to improvement at the secondary level. While there is evidence that this program is effective in some elementary settings, further exploration into its use at the secondary level must be examined.

This study does not eliminate the consideration of the use of Thinking Maps®, but it does encourage schools to consider options for students that may include some of the principles of Thinking Maps®, such as consistency, flexibility, and shared use throughout the school to foster a learning community with a common learning language. Hyerle has several books written on Thinking Maps® that could offer excellent suggestions for school improvement that do not require a school to spend almost $3000 per teacher for the training. This researcher would offer that the basic concepts of Thinking Maps® could be developed in any research based strategy to foster student success at a lower cost.

Limitations

Even though the subjects of the research design were selected based on the attendance of the schools being studies, there is no way to attribute success completely to the treatment and no other external factor (Gall et al., 2007). The following threats to internal and external validity were monitored and noted during the research. External validity can compromise our confidence that results can be applicable to other groups. External validity for this study was controlled by the fact that the research took place under normal conditions in the field. Due to the fact that the data were gathered ex post facto, there was no experimental model that had to be created to gather the data. The treatment schools were not changing any instruction for the study itself and proceeded as normal and data were gathered without the school even realizing they were being studied. In addition, all populations were a part of the data, including male and female, all ethnicities, and all socio-economic groups. No students were excluded from testing based on these factors. Therefore, the data can be generalized over subgroups.

Internal validity can create doubt that a relationship truly exists between the independent and dependent variables. The selection of students was a non-random, convenience sampling because the students had to be chosen from two treatment schools and two non-treatment schools

to participate in the study. In an effort to equalize the study, the researcher specifically looked for non-treatment schools with similar demographics and free and reduced lunch statuses. The only students excluded from the study were students that transferred into the treatment school and did not receive a full year of Thinking Maps® instruction. Even though the sample was not random, the researcher kept the groups being compared as equal as possible for the study.

One threat to validity that unexpectedly occurred was the changing of the Reading Virginia Standards of Learning test in the spring of 2013 to include items at a higher level of rigor. Validity was not compromised because all of the students were exposed to the same change in the test. Therefore, the researcher could continue to make connections in the relationship between Thinking Maps® instruction and achievement.

The sample size of the data used for the study was nine thousand six hundred and nine participants. By using such a high number of test subjects and scores, the researcher could eliminate the threat of small sample size as a threat. The following are limitations of the study that were beyond the control of the researcher:

- The study was limited by the individuality of the delivery of Thinking Maps® instruction by various classroom teachers.
- The study was limited by teacher competency and experience and the impact this competency has on student growth.
- The study was limited by the other interventions or remediation that each student may have received and the impact it may have had to student performance.

Recommendations for Future Research

The following recommendations for further study are proposed:

1. Conduct a mixed methods study in middle school that looks at the effects of Thinking Maps® on reading achievement while it also examines the level of fidelity to the program through surveys and interviews with teachers and principals.
2. Complete a quantitative study within a middle school using Thinking Maps® as a school-wide strategy that compares performance in reading and math between males and females and between socio-economically disadvantaged and non-disadvantaged students.
3. Conduct a longitudinal study of disadvantaged students over a three year period of Thinking Maps® implementation in a middle school environment to determine if students from poverty respond better to the structure and simplicity of the program. This research could examine reading and math performance for these students using a gain model of achievement.
4. Consider implementing a study in middle school that looks specifically at random students in history and science performance that are taught using the Thinking Maps® program compared to students within the same school that are not using the program. This equalization of population in the same school, receiving the same overall interventions would target the direct impact that Thinking Maps would have on students.
5. Complete a qualitative case study on middle school special education students identified as learning disabled in reading using the Thinking Maps® program. Follow their journey from learning the program to using it for inputting and outputting information. This study would be more about how the students using the program feel about the elements of the program that appear to be positive for student achievement.

Summary

Data from this research study indicate that Thinking Maps® does not provide an overall increase in student performance on the Virginia Standards of Learning reading Test. However, data does suggest that Thinking Maps® are a helpful tool for students that are disadvantaged. The flexibility, consistency, and routine of the maps provides the appropriate scaffold for these students that is needed as they build their vocabulary knowledge and the necessary comprehension skills needed for success at the secondary level.

It is certain that all students must be taught comprehension explicitly and throughout secondary school. The researcher feels strongly that the key for success with Thinking Maps® is the fidelity of implementation and the consistency of use as a school-wide strategy. More research at the secondary level that measures student achievement and program fidelity would provide stronger data to decide if school divisions should invest such a costly amount in this program.

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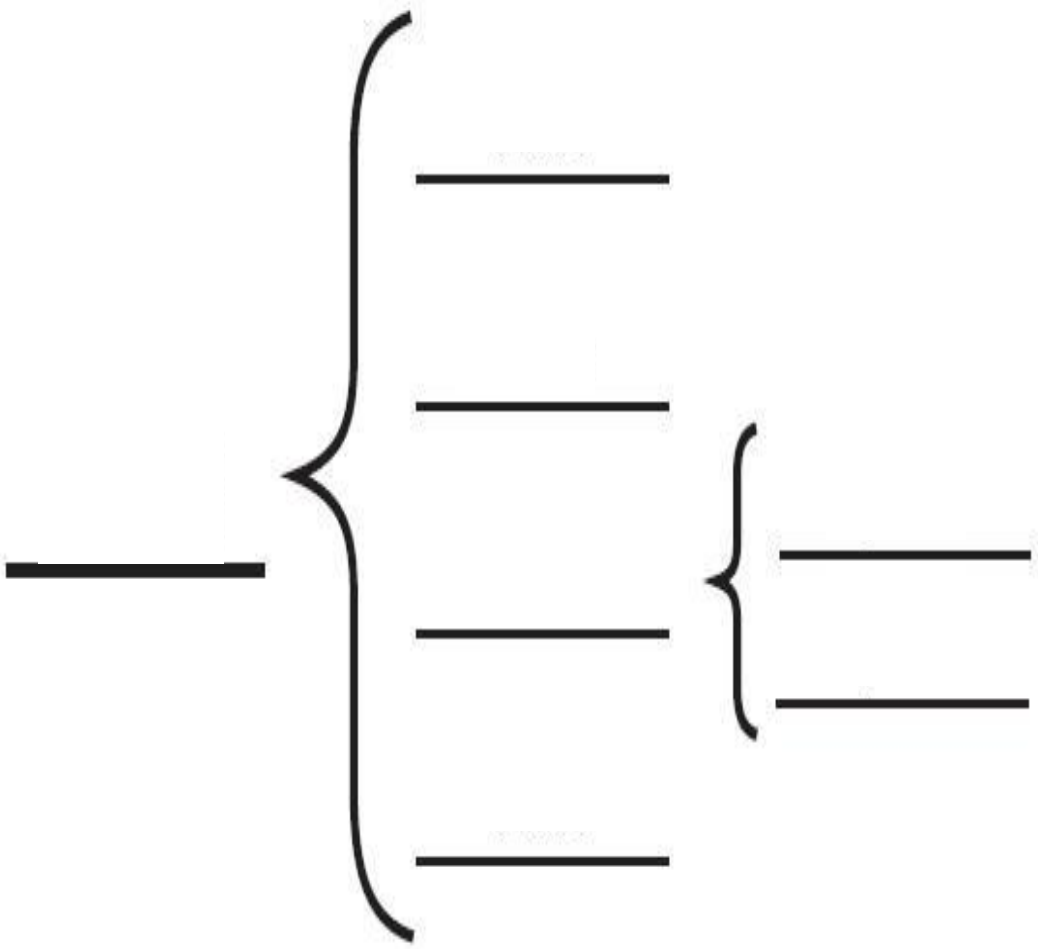
APPENDIX A

Brace Map

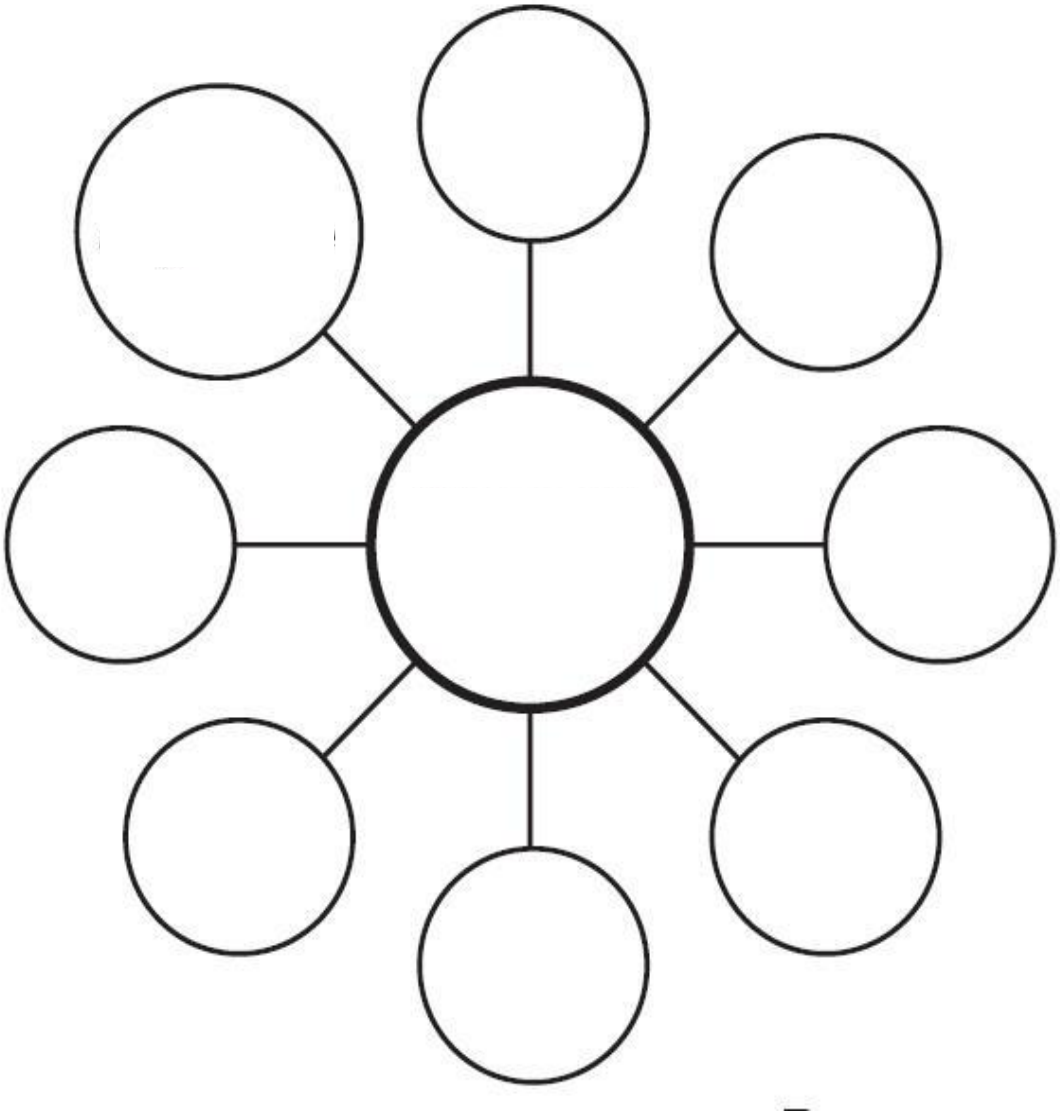


APPENDIX B

Bridge Map

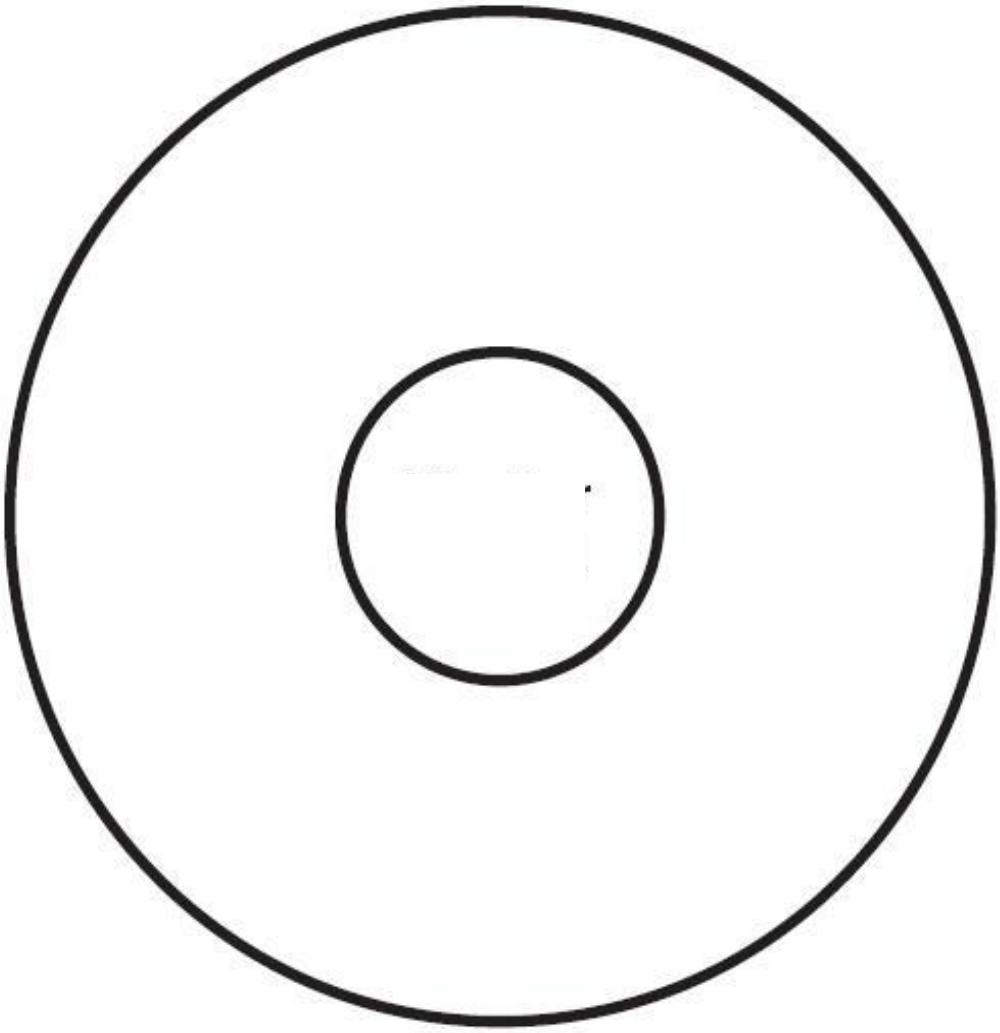
APPENDIX C

Bubble Map



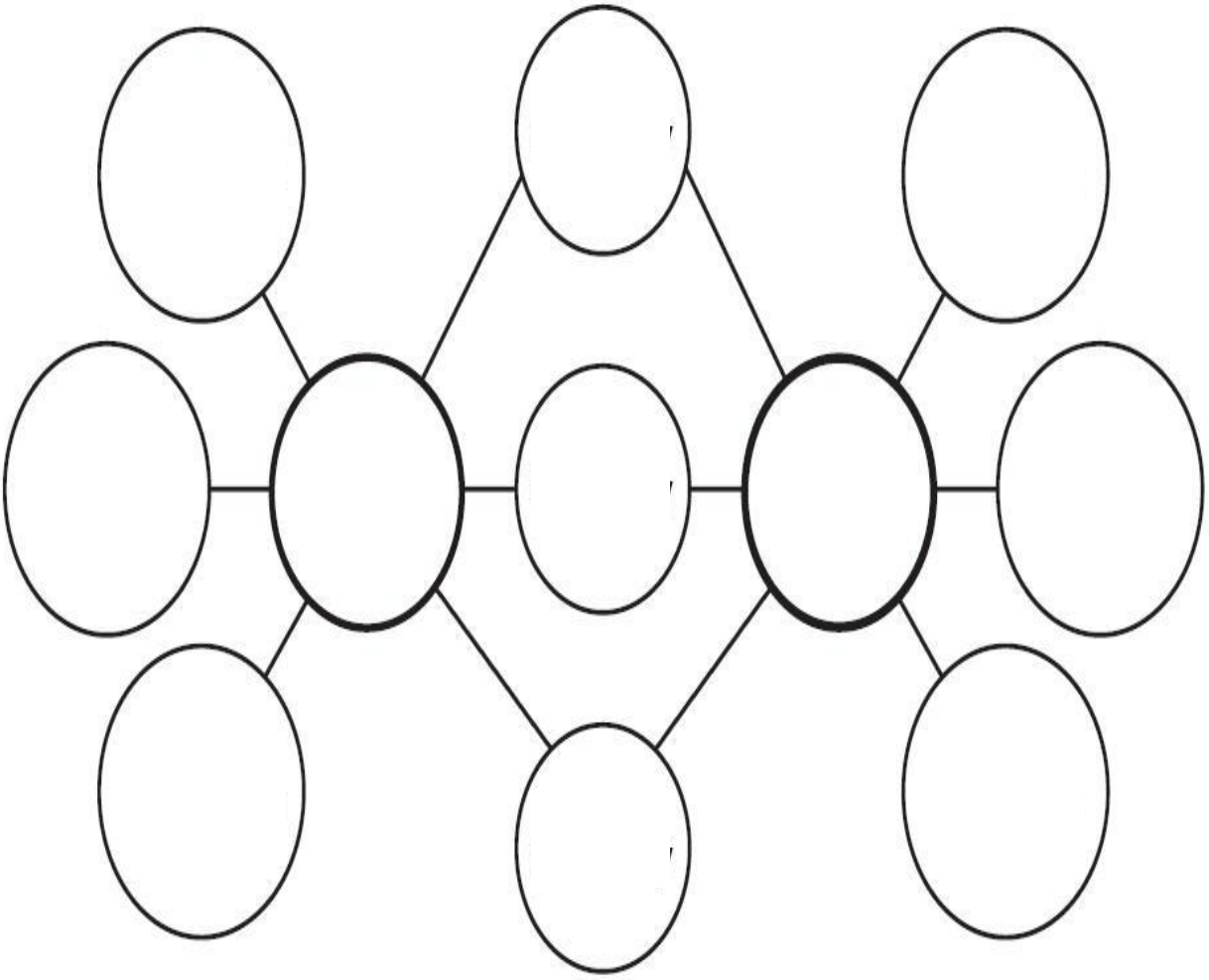
APPENDIX D

Circle Map



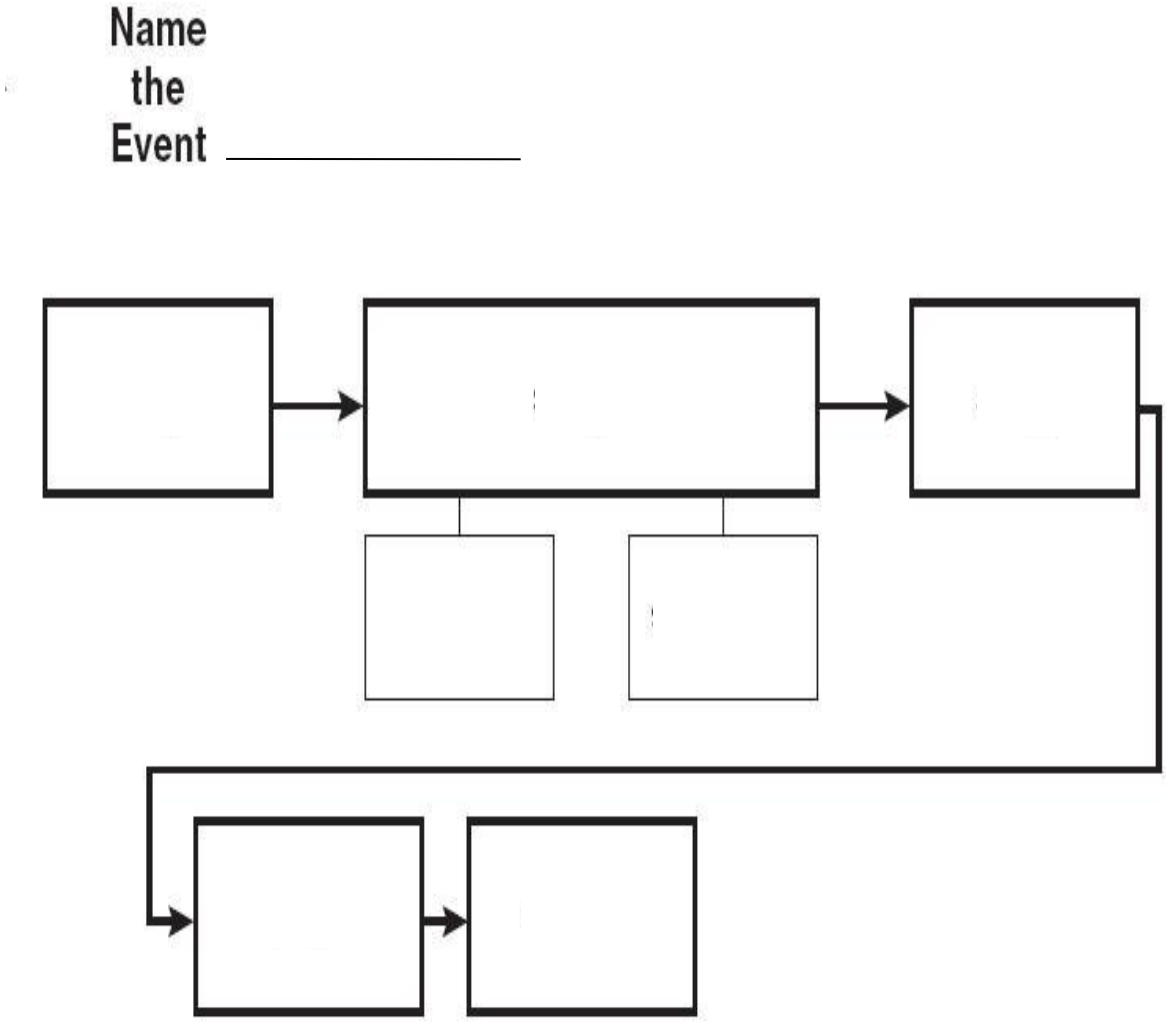
APPENDIX E

Double Bubble Map



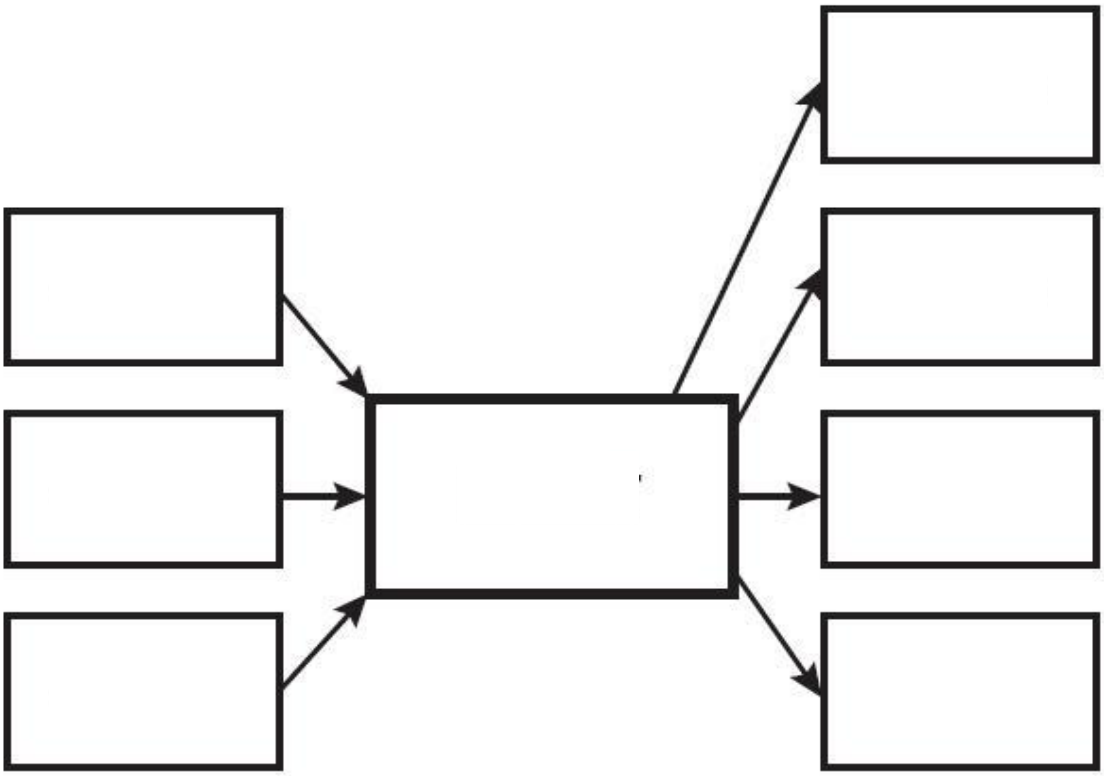
APPENDIX F

Flow Map



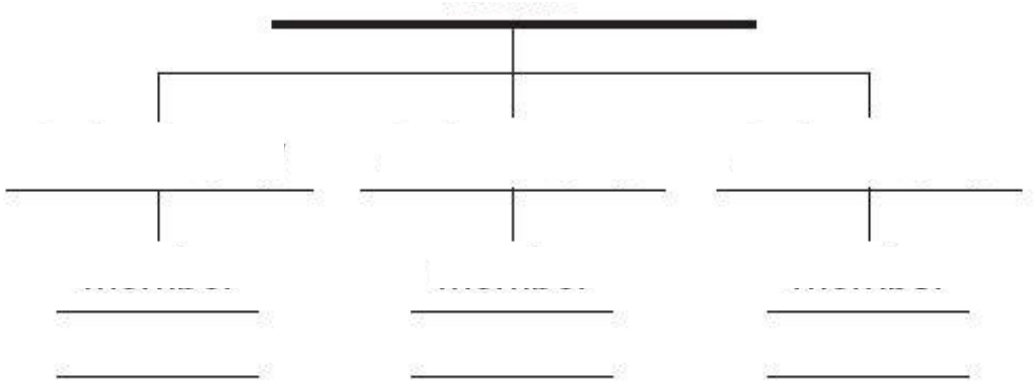
APPENDIX G

Multi-Flow Map



APPENDIX H

Tree Map



APPENDIX I

LIBERTY UNIVERSITY
Institutional Review Board

November 14, 2014

Karen Ogden Woodford
IRB Exemption 2010.111414: The Effect of Thinking Maps® on the Reading Achievement of Middle School Students: An Ex Post Facto Causal Comparative Study

Dear Karen,
The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application, and that no further IRB oversight is required.

Your study falls under exemption category 46.101 (b)(4), which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:
(4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

Please note that this exemption only applies to your current research application, and that any changes to your protocol must be reported to the Liberty IRB for verification of continued exemption status. You may report these changes by submitting a change in protocol form or a new application to the IRB and referencing the above IRB Exemption number.
If you have any questions about this exemption, or need assistance in determining whether possible changes to your protocol would change your exemption status, please email us at irb@liberty.edu.

Sincerely,

Fernando Garzon, Psy.D.

Professor, IRB Chair

Counseling

(434) 592-4054