5-2006

An Examination of Student Performance in Reading/Language and Mathematics after Two Years of Thinking Maps® Implementation in Three Tennessee Schools.

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A dissertation
presented to
the faculty of the Department of Educational Leadership and Policy Analysis
East Tennessee State University

In partial fulfillment
of the requirements for the degree
Doctor of Education

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by
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May 2006

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Keywords: Brain-based Learning, Thinking Skills, Graphic Organizers, Thinking Maps®, Student Achievement, Visual Tools, Elementary Education

ABSTRACT

An Examination of Student Performance in Reading/Language and Mathematics after Two Years of Thinking Maps® Implementation in Three Tennessee Schools

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The purpose of this study was to determine what, if any, association exists between Thinking Maps® instruction and student achievement in fifth grade students in Reading/Language and Mathematics as reported by the State NCE scores of the criterion referenced portion of the Tennessee Comprehensive Assessment Program (TCAP) Achievement Test in 3 Title I elementary schools in northeast Tennessee. The association was examined after 2 years of Thinking Maps® implementation and instruction. Using a quantitative design, the quasi-experimental study included fifth grade students' State NCE scores from 2005 and the same students' State NCE scores from 2003. Scores obtained by fifth grade students who received Thinking Maps® instruction were examined for differences in Reading/Language and Mathematics and were also compared with scores obtained by fifth grade students who did not receive Thinking Maps® instruction for the same 2-year period. Paired *t*-tests and a 3-factor repeated measures design, repeated on 1 factor, were used to investigate differences in achievement as categorized by Thinking Maps® instruction or no Thinking Maps® instruction for 2 years.

The results of the study indicated that there was a significant difference for the Reading/Language means for students after 2 years of Thinking Maps implementation but not a

significant difference for Mathematics. There was not a significant difference between the two treatment schools in either Reading/Language or Mathematics. The 2 treatment schools had different percentages economically disadvantaged students.

The results of the study also indicated that there was a significant 2-way interaction for Year by School in Reading/Language between 1 treatment school and the control school, the 2 schools with similar percentages of economically disadvantaged students. The findings of the tests of simple effect for the differences between the 2003 and 2005 Reading/Language means for the treatment school showed the 2005 Reading/Language mean was over 7 points higher than the 2003 Reading/Language mean. The findings of the tests of simple effect for the differences between the 2003 and 2005 Reading/Language means for the control school were also significant with the 2005 Reading/Language mean being 6 points lower than the 2003 Reading/Language mean.

DEDICATION

This work is dedicated to:

My very first teachers, my parents, Gifford and Marjory Mabie, who instilled in me a love of learning and a belief that all things are possible.

To all my wonderful family and friends who traveled this journey with me. Thank you for your constant encouragement, support, and enthusiasm.

To my husband, Pat, the model of patience, encouragement, and love during this doctoral program, I thank you.

ACKNOWLEDGEMENTS

I would like to sincerely thank Dr. Hal Knight for his support, guidance, and wisdom throughout this process. His demand for excellence challenged me to go beyond what I thought was possible. Thank you for that demand.

My sincere appreciation goes to my committee members: Dr. Louise MacKay, Dr. Elizabeth Ralston, and Dr. Jasmine Renner. Each of you has served as a mentor to me in providing invaluable input, support, and kindness during this experience.

It is hard to give enough thanks to all of the people who provided continuous counsel and support. Without each one's encouragement this process would have been so much more difficult. Thanks to those of you who responded so quickly and helpfully each time I called and needed information. Thank you to Susan Twaddle and Anita Black who provided wonderful assistance and expertise in your professional areas. You were invaluable.

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CHAPTER 1

INTRODUCTION

> *All, regardless of race or class or economic status, are entitled to a fair chance and to the tools for developing their individual powers of mind and spirit to the utmost. This promise means that all children by virtue of their own efforts, competently guided, can hope to attain the mature and informed judgment needed to secure gainful employment, and to manage their own lives, thereby serving not only their own interests but also the progress of society itself* (National Commission on Excellence in Education, 1983, Introduction section, para. 1).

Danielson (2002) noted that with these compelling words, The National Commission on Excellence in Education's report on the status of American education became the catalyst for educational reform in America's schools. With this report the alarm was sounded about the poor quality of America's schools some twenty years ago. The intervening years have been filled with hand-wringing ("where have we gone wrong?'), confirmation (international studies of achievement of industrial nations indicating that students in the United States were at best in about the middle of the pack), defensiveness ("schools really are not that bad"), and surveying of opinions (that indicated that parents were more satisfied with their children's education than either the employers or the college professors who received the students (Danielson).

With education at the forefront of American interest and discussion, every recent United States president has made education a top priority. Federal, as well as state and local, policies have been recommended and implemented. In 1989, President George H. Bush invited the Nation's 50 governors to an Education Summit (U.S. Department of Education, 1996). Here, the governors agreed to the need for a national strategy to remedy the deficiencies of U.S. education. The Bush Administration proposed AMERICA 2000 with its specific recommendations for educational reform (U.S. Department of Education, 1996). Also during the 1988-1992 Bush Administration, the National Literacy Act of 1991 established new literacy programs to enhance the basic skills and literacy of adults (U.S. Department of Education, 1996). The Education Council Act of 1991 established the National Education Commission on Time and Learning and the National Council on Education Standards and Testing (U.S. Department of Education, 1996). The purpose of this second council was to examine the feasibility of developing national standards and conducting national testing of school children. In 1992, the Reauthorization of the Higher Education Act of 1965 was enacted to increase student access to postsecondary education and to encourage educational excellence (U.S. Department of Education, 1996).

Under President Bill Clinton, the National Assessment of Educational Progress (NAEP) was signed in 1994 that authorized the use of NAEP, a standardized test that would be administered to selected schools nationwide and would allow for state-by-state comparisons of the results (U.S. Department of Education, 1996). The main education legislation under President Clinton was GOALS 2000: Educate America that was signed into law in 1994 and amended 1996 (U.S. Department of Education, 1998). This initiative, through a system of grants to local communities and states, established a federal partnership in order to reform the Nation's system of education.

The federal *No Child Left Behind Act of 2001 (NCLB),* was signed into law on January 8, 2002, as the reauthorization of the *Elementary and Secondary Education Act* (ESEA) (No *Child Left Behind Act of 2001*, 2005). With this law, President George W. Bush communicated his commitment to education. The four major pillars of the law include: (1) holding schools and school systems more accountable for student learning, (2) the use of research-based practices to determine programs and policies, (3) expanded choice for parents, and (4) more local control and flexibility (*No Child Left Behind Act of 2001*, 2005). The call on educational practitioners to use "scientifically-based research" to guide their decisions about which interventions to implement, is an approach that the proponents of the law claim will produce major advances for the effectiveness of American education (*No Child Left Behind Act of 2001*). Paige (2002), the U.S. Secretary of Education at that time, wrote in a welcome letter on the government's website that, "The new law will give states more flexibility on how they spend their education dollars. In return, it requires them to set standards for student achievement, and hold students, teachers, and other educators accountable for results" (n.p.).

Cawelti (2004) in the *Handbook of Research on Improving Student Achievement* pointed to the key elements of high-achieving districts' improvement efforts: "focus on standards and assessment, increased use of research-based teaching strategies, and restructuring the system to link people to results" (p. 16). All three of these elements are vital parts of *No Child Left Behind Act of 2001*.

National and state report cards have been established that display the effectiveness of school districts as well as individual schools as determined by achievement assessments. The National Assessment of Educational Progress (NAEP) is also known as "the Nation's Report Card" (National Assessment of Educational Progress, 2005). NAEP, since 1969, has been a nationally representative, continuous assessment showing what American students know and can do in various subject areas (National Assessment of Educational Progress). The report is given for the nation and for specific geographic regions of the country. Students included in the assessments are from public and nonpublic schools with results provided for student achievement at grades 4, 8, and 12. Beginning in 1990, NAEP assessments were also administered in order to give results to participating states. In 2003, the assessments in reading and mathematics included state components at grades 4 and 8. Fifty-three states and jurisdictions took part in those 2 assessments (National Assessment of Educational Progress). Each state also has an accountability plan for reporting to the Federal government and a state report card is provided on individual state web sites (National Assessment of Educational Progress).

The intent of the accountability component of the *No Child Left Behind Act of 2001* is to demonstrate the importance of focusing on every child with the directive of closing achievement gaps in all subgroups of ethnicity, socioeconomic status, individuals with disabilities, and limited English proficiency. (*No Child Left Behind Act of 2001*, 2005). The ultimate goal is for all students to be proficient in all subjects by the year 2014. Standardized tests are mandated at certain grade levels, data are to be disaggregated according to specific subgroups, and schools are mandated to address achievement gaps as indicated by the data (*No Child Left Behind Act of 2001*). To that end, Tennessee has merged its accountability system with the provisions of *No Child Left Behind Act of 2001* (Tennessee Department of Education, 2003). One of the results was the addition of a criterion-referenced test whose results indicate math and reading proficiency levels of third and fifth and eighth grade students (Tennessee Department of Education, 2003).

Serious consequences result for schools that do not meet the minimum standards of adequate yearly progress (AYP) (Tennessee Department of Education, 2003). A schedule of intervention has been established by the Tennessee Department of Education for schools not meeting standards. During the first year, schools are designated as “target schools.” If a school fails to meet minimum standards for 2 years in a row, it is then defined as a “high priority school” (Tennessee Department of Education, 2003). First year “target schools” are given a warning and receive support (assistance) from the Tennessee Department of Education. A school that does not make progress during the second year moves into the “School Improvement 1” phase. During this phase parents of students in Title I schools are given school choice. During the third year of failing to meet minimum standards, a school enters the “School Improvement 2” phase that focuses on school improvement and support from both the local and state levels. Free tutoring services are made available to the students in Title I schools. By the fourth year of a school failing to show improvement, the school moves into the "Corrective Action" phase where the school is placed on probation and more drastic measures such as removal of staff may be taken by the state. "Restructuring 1" and "Restructuring 2" are designated phases for years 5 and 6. Mandates that may occur during that time include a takeover of the school by other agencies and/ or a replacement of the staff and administration (Tennessee Department of Education, 2003).

During the 2004-2005 school year, 86 schools in the state of Tennessee were designated as "target" schools and 165 were designated as "high priority" schools (Tennessee Department of Education, 2005). Stricter minimum standards for demonstrating adequate yearly progress (AYP) are set in place with each upcoming year (*No Child Left Behind Act of 2001*, 2005). Therefore, with higher expectations for students' performance, it is imperative for schools to design educational practices and to put into place policies and programs that will allow students to not only achieve full academic potential but will also address the achievement gaps and discrepancies that exist today.

The research from studying the brain with its implications for teaching and learning provides information for educational practitioners that will be helpful in designing and selecting such educational practices and policies. These discoveries in neuroscience include the role of patterns, emotions, environment, rhythms, positive thinking, assessment, music, gender differences and enrichment (Jensen, 1996). This new paradigm in education asks educators to design organizations around the way the brain learns best. According to Sylwester (1995), brain-based research literature maintains that by understanding how the brain works, educators will be able to restructure learning though a different manner of teaching. This change in thinking about learning will challenge administrators and educators as they attempt to gain benefit from this abundance of research. According to Jensen (1998) the brain has been recognized as a multipath parallel processor. Many sensory and sensory patterns are simultaneously processed with the goal of the brain being constant: turning data into meaning. Danielson (2002) indicated that most learning occurs during working memory and that knowledge is stored or kept in long-tem memory. She described ‘learning,’ as most educators understand it, taking place through the brain’s pattern-seeking mechanism in the stage of working memory. Gardner (1983), focusing on the mind and cognitive thought, presented a multi-faceted way to think about intelligence, explaining that intelligence is not a single characteristic or even a group of characteristics but is the ability to solve a problem or create or fashion a product that is valued in a culture using one or more of the several intelligences that a person possesses. Goleman (1995), in writing about the neglect of the emotional brain, discussed how analytical thinking is always influenced by emotions. Individuals with mature, healthy connections can control responses to the brain’s messages to go into a rage or act in a very inappropriate manner.

Smith (1986) stressed that learning is the primary function of the brain and that the brain is capable of tremendous learning accomplishments without effort. Caine and Caine (1991), agreeing with Smith, stated that the brain has an almost inexhaustible capacity to learn and go on to stress that the general guiding principle of brain research is the confirmation that multiple, complex, and concrete experiences are essential for meaningful learning and teaching.

According to Jensen (1996), the best thing that can be done from the point of view of the brain and learning is to teach learners how to think. He contended that intelligent thinking could be taught and should be a significant part of a school’s curriculum with the teaching of thinking based on real world problems, with real people under real conditions. Jensen is supported in previous work by Perkins (1986) who argued that intelligence would be improved by teaching of good thinking skills. Costa (1985) also stressed the importance of teaching thinking in his book, *Developing Minds*. Thus brain-based learning takes on the implications of education being organized around the basic principles of how the brain learns best.

New programs that promote their connection to brain-based research are emerging to take advantage of this paradigm shift in teaching and learning. According to Leary (1999), schools are constantly implementing new programs and interventions with the hopes of improving student learning and achievement. Often the purpose of the implementation is to discover what factors influence how student learn. Leary contended that the objectives of various programs could be to affect the cognitive domain of learning or to affect the affective domain of learning.

One of the components of No *Child Left Behind* requires the use of research-based practices to determine programs and policies (*No Child Left Behind Act of 2001*, 2005). The Thinking Maps® program, the subject of this proposed study, claims to have as its basis findings in brain research (Hyerle, 1995). The Results and Research section of *Thinking Maps® Training of Trainers Guide Resource Manual* (Hyerle & Yeager, 2000) graphically displays test scores before and after implementation of Thinking Maps® of several schools in various states to demonstrate the program's ability to improve student achievement.

However, these are two areas that this researcher believes need to be examined further when looking at the data of the Thinking Maps® program. First, the researcher is interested in data disaggregated by gender and socioeconomic status defined as economically disadvantaged (qualifying for free/reduced lunch.) The researcher is also interested in a study of the Thinking Maps® program that will provide a quasi-experimental design with intervention groups and a control group over a 2-year period.

Statement of the Problem

Consequences for failure to increase student achievement levels and make adequate yearly progress for all students are serious for schools and their staffs as spelled out by *No Child Left Behind Act of 2001*. Numerous programs and interventions exist today that purport to raise student learning and achievement levels. The problem, in the context of standardized testing consequences, is ensuring the selection of programs and or interventions that would allow students to accomplish increased learning and achievement. This study will take an in-depth look at one such program, Thinking Maps®. Thinking Maps®, a comprehensive visual language, makes use of eight specific graphic designs each representing a fundamental thinking process (Hyerle, 1996b). Each map has a common name for the map, a name for a specific thinking process, and an expandable graphic, with each being used to construct and show knowledge (Hyerle, 1996b).

The purpose of this study is to determine what, if any, association exits between the implementation and use of the Thinking Maps® program and students' academic achievement in Reading/Language and Mathematics as measured over time by the State NCE scores from the criterion-referenced Tennessee Comprehensive Assessment Program (TCAP) Achievement Test. The association will be examined after 2 years of Thinking Maps® implementation and instruction. The study will factor in gender and achievement levels prior to Thinking Maps® instruction and implementation in three Title I schools in a northeast Tennessee school system.

Research Questions

The central research question the investigator seeks to answer is: *Do Thinking Maps® function to improve student achievement?* Is there improvement in student academic achievement in Reading/Language and Mathematics as measured by the TCAP State NCE scores for students who have participated in the Thinking Maps® program? The research questions that will guide this study are:

1. Was there a difference between the 2003 and 2005 TCAP Reading/Language and Mathematics State NCE scores of fifth grade students who received Thinking Maps® instruction?

2. Were there differences in students' performance on TCAP Reading/Language State NCE scores based on school (School A and School B), gender (male and female), year (2003 and 2005), and interactions between variables?

3. Were there differences in students' performance on TCAP Mathematics State NCE scores based on school (School A and School B), gender (male and female), year (2003 and 2005), and interactions between variables?

4. Were there differences in students' performance on TCAP Reading/Language State NCE scores based on school (School B [a treatment intervention site] and School C [a control site]), gender (male and female), year (2003 and 2005), and interactions between variables?

5. Were there differences in students' performance on TCAP Mathematics State NCE scores based on school (School B [a treatment intervention site] and School C [a control site]), gender (male and female), year (2003 and 2005), and interactions between variables?

Significance of the Study

Administrators and other educational practitioners wrestle with the challenges of meeting the mandates of the *No Child Left Behind Act of 2001* as the discoveries in neuroscience demand a paradigm shift in education and learning to design organizations and programs around the way the brain learns best. Coupled with these challenges is a constant stream of new programs and interventions that claim their basis in brain-based research and also claim to provide the means to increase student achievement. In recent years, several schools in the southeastern United States have adopted the Thinking Maps® program for whole school implementation from Kindergarten through high school. Thinking Maps®, a comprehensive visual language, makes use of eight specific graphic designs each representing a fundamental thinking process (Hyerle, 1996b). Each map has a common name for the map, a name for a specific thinking process, and an expandable graphic, with each being used to construct and show knowledge (Hyerle, 1996b). The stated purpose of the program is to use Thinking Maps as a common visual language in a learning community for transferring thinking processes, integrating learning, and for continuously assessing progress (Hyerle, 1995).

> The term "Thinking Maps" and the term "Thinking Maps" with the graphic forms of the eight Maps have registered trademarks. No use of the term "Thinking Maps" with or without the graphic forms of the eight Maps may be used in any way without the permission of Thinking Maps, Inc. Specific training in Thinking Maps is required before classroom implementation (personal communication, General Manager, Thinking Maps, Inc., July, 6, 2005).

For teachers the Maps provide a way to teach content knowledge and facilitate the thinking of students, to assess students' prior knowledge, and to assess what and how students have learned. For students, Thinking Maps® provides a means of constructing knowledge by forming patterns of information, for transferring their thinking processes to content learning, and for promoting their own metacognition (Hyerle, 1995). The Thinking Maps® program claims to improve students' performance on state assessments and provides some data for those claims (Hyerle, 2000; Hyerle & Yeager, 2000).

More recently, a school system in East Tennessee chose to adopt this program in two of its Title I elementary schools but not in the third Title I elementary school in the system. The third school chose not to adopt this program because of its involvement in piloting a new Reading and Math program in grades K-6. An analysis of student achievement data for students who received instruction in the Thinking Maps® program for 2 years will assist this school system in making future decisions about this particular program. This study might provide data that could give insight into the effectiveness of the program. The researcher is particularly interested in the connection the author suggests between the Thinking Maps® program and brain-based research in support of how the program raises students' achievement scores on standardized tests. The Thinking Maps® program is based on the work of David Hyerle who created the program (Hyerle, 1993).

Leary (1999) suggested in his recommendations that more investigation expanding the time frame of the study period would enable educators to make a fair evaluation of the Thinking Maps® program. Thus a 2-year study of the effect of this program might be helpful for its evaluation.

Implementation of any new program or intervention can be an expensive proposition for individual schools or for an entire school district. Therefore, serious and careful consideration should take place before a school commits to full implementation of any new program or strategy. This study is significant in providing current data regarding the effectiveness of the Thinking Maps® program. From this investigation and the results of this study, administrators in other schools can determine if the expense and effort required for implementing the Thinking Maps® program is worth the student achievement results that might be obtained.

This study focuses on the effects of a visual tools program on standardized achievement scores in Reading/Language Arts and Mathematics. Both administrators and teachers constantly strive to find the most effective instructional strategies/programs that will help students succeed in school. There has been much discussion about this program among the teachers and administrators of the school system who are using the program and also by those who do not have access to the program. There are teachers in other schools in the system, Title and Non-

Title, who are interested in having this program. The information obtained from this study will be informative for both teachers and administrators, and it is hoped that this study will assist them in making decisions about this program for other schools. Teachers who are involved in the Thinking Maps® program are particularly interested in the effectiveness of these visual tools as they relate to student achievement. In addition, this study may be useful for other school systems with similar populations who are contemplating adopting the Thinking Maps® program.

Definition of Terms

For the purposes of this study, the following terms are defined:

<u>State Normal Curve Equivalent (NCE) Score</u>: Normal Curve Equivalent is the mapping of percentile data into corresponding points in a normal distribution. The purpose is to enable date to be analyzed consistent with the Value-Added Report and the Achievement Report on the Report Card. State NCE scores are scores for the state of Tennessee (Tennessee Department of Education, 2005).

<u>Criterion Referenced Tests (CRT):</u> Criterion referenced tests measure an individual student's performance against a predetermined set of standards that are established based on the curriculum (CTB McGraw-Hill, 2005c).)

<u>Academic Achievement:</u> Success as measured by the Tennessee Comprehensive Assessment Program (TCAP) Achievement Test (CTB/McGraw-Hill LLC, 2004).

<u>Thinking Maps®:</u> eight visual learning tools, each based on a fundamental thinking process and used together as a common visual language (Hyerle, 1996b).

<u>Economically disadvantaged</u>: student who qualifies for free/reduced lunch (*No Child Left Behind Act of 2001*, 2005).

No Child Left Behind Act of 2001: reauthorized the Elementary and Secondary Education Act (ESEA). NCLB is built on four principles: accountability for results, more choices for parents, greater local control and flexibility, and an emphasis on doing what works based on scientific research (*No Child Left Behind Act of 2001, 2005*).

Graphic Organizer: a visual display of conceptual information designed to convey enhanced meaning or understanding of learned material (Leary, 1999).

Delimitations and Limitations

Delimitations of this study include:

1. The population in this study is delimited to the three Title I schools in a northeast Tennessee school system.

2. The population is delimited to 2003 grade three students and 2005 grade five students in each of the 3 schools with TCAP Criterion Referenced Test (CRT) State NCE scores for Reading/Language and Mathematics for both years of the study.

3. The population is delimited to students in grade three (2003) and grade five (2005) who attained an attendance rate of at least 75% of the school year for the 2003-2004 and 2004-2005 school years in their respective schools.

Limitations of this study include:

1. Corrective Reading, an intervention reading program targeting students below the 35 percentile in reading, is present in each of the three schools.

2. Schools A, B, and C use the same Mathematics textbook series. Schools A, B, and C use the same Reading textbook series for grades K – 3. Schools A and B (the treatment schools) use the same Reading textbook series for grades 4-6; however, School C (the

control school) uses a different Reading textbook series in grades 4- 6 than Schools A and B.

3. School C, the comparison site, implements a skill-based instructional approach in the areas of reading and mathematics.

4. New teachers entering the school system after the initial year of Thinking Maps® implementation might have experienced a varied quality and amount of staff development in Thinking Maps® training (In order to protect the confidentially of the school system involved in this study, it is understood that specific individuals and the training that they received will not be indicated).

5. Teaching styles and abilities might vary among the third and fifth grade teachers.

6. Staff personnel for the second year of Thinking Maps® implementation (2004-2005) varied in each school for the fifth grade. School A retained one-fifth teacher only from the 2003-2004 year reducing the grade to one section for the 2004-2005 year. School B retained one fifth grade teacher from the 2003-2004 year and changed the second fifth grade teacher for the 2004-2005 school year. School C retained one fifth teacher from the 2003-2004 school year, changed one fifth grade teacher from the 2003-2004 to the 2004-2005 year, and added one additional fifth grade teacher for the 2004-2005 year.

7. The results of this study can be generalized only for the population being studied.

Overview of the Study

This study is divided into five chapters. Chapter 1 includes an introduction to the study with an explanation of the Thinking Maps® program as well as the statement of the problem, the purpose of the study, the research questions, the significance of the study, the definitions of terms, and the delimitations and limitations of the study. Chapter 2 presents a review of related literature pertinent to the curriculum standards movement, brain-based research, thinking skills and constructivist learning theory as well as graphic organizers that will allow the reader to understand the context of the Thinking Maps® program. Chapter 3 focuses on the research methodology and procedures used in this study to obtain data. Explanation of how the researcher proceeded to examine the effects of the Thinking Maps® program is given. Chapter 4 contains the presentation, analysis, and interpretation of the findings. Chapter 5 presents the summary, conclusions, and recommendations resulting from the study.

CHAPTER 2

REVIEW OF LITERATURE

The signing of the *No Child Left Behind Act of 2001* by President George W. Bush on January 8, 2001, created an ever-increasing level of federal involvement in education. The underpinning of this law included stronger accountability for results, more flexibility and freedom for states and communities, proven educational methods and strategies, and more choices for parents and students (*No Child Left Behind Act of 2001,* 2005).

As educators at all levels attempt to meet the demands of *No Child Left Behind*, they are examining research and educational practices that are not only based upon sound scientific research strategies but will also, hopefully, allow all children to maximize their efforts for achievement and success. For educators, there is the additional challenge of being current about sound educational practices and research including the research about brain-based learning. Extensive investigations of the brain, new brain theories, and brain-based learning have taken place. It is a challenge to educators, administrators and teachers alike, to sort through, examine, and implement the best practices from this research.

Paralleling the research on the brain and learning has been the examination and implementation of one particular instructional strategy, the graphic organizer, that according to Leary (1999), links the gap between brain-based learning and the classroom. According to McTighe (1992), graphic organizers have proven to be effective tools for enhancing thinking and promoting meaningful learning for both students and parents. A program that seems to merge the research of brain-based learning with the instructional strategy of the graphic organizers is Thinking Maps®, a set of graphic organizers (visual tools), each based upon a specific thinking process (Hyerle, 1995).

The review of literature will identify research relevant to this study. In the first part of the review, the standards movement including *No Child Left Behind Act of 2001* will be examined as well as brain research and theories. The second part of the literature review will discuss thinking skills, graphic organizers, and the Thinking Maps® program as well as the Tennessee Comprehensive Assessment Program Achievement Test, the assessment instrument that will be used in this study to determine student achievement.

Curriculum Standards Movement

History of the Standards Movement

The United States Constitution assigned responsibility for education to the individual states (Harnischfeger, 1995). But this did not keep the federal government from establishing a Department of Education that has become involved in educational affairs by requiring specific school and instructional organization in exchange for funding. In the 1960s, a far-reaching federal impact on elementary and secondary education was initiated during President Johnson's Great Society. Legislation was enacted by Congress that, to this day, still provides substantial federal support for improving the quality of education for children with special educational needs including economically disadvantaged children, language minority students, physically or mentally disabled children, and children who live in migratory families (Harnischfeger).

Federal involvement in education continued, when in 1983, a report given by The National Commission on Excellence in Education to the Secretary of Education entitled *A Nation at Risk: the Imperative for Educational Reform* provided the catalyst for the national curriculum standards movement. Three of the recommendations included strengthening graduation requirements and curriculum content, adopting more rigorous and measurable standards with higher expectations, and improving the preparation of teachers (National Commission on Excellence in Education, 1983).

Then in 1989, President George H. Bush invited the Nation's 50 governors to an Education Summit (U.S. Department of Education, 1996). Here, the governors agreed as to the need for a national strategy to remedy the deficiencies of the United States educational system. The Bush Administration proposed AMERICA 2000 with recommendations for educational reform (U.S. Department of Education, 1996). A year later in 1990, The Secretary of Labor issued the SCANS Report (Secretary's Commission on Achieving Necessary Skills) that recommended the skills young people needed to succeed in the work place (Phelan, n.d.). Two years later, the National Council on Education Standards and Testing was established to begin the bi-partisan creation of national standards and testing for K-12 education (U.S. Department of Education, 1996). However, according to Phelan, this effort to create national consensus standards was unsuccessful.

Phelan (n.d.) further detailed the chronology of the standards movement. In 1994 President Clinton signed the GOALS 2000: Educate America Act that created "A special council to certify national and state content and performance standards, opportunity-to-learn standards, and state assessment standards" (Phelan, p. 4). In both 1996 and 1999, National Education Summits were held bringing together the governors of more than 40 states along with business leaders and educators. At the 1999 Summit the leaders identified 3 areas where schools face challenge: improving educator quality, helping all students reach high standards, and strengthening accountability. At the 1999 Summit, it was agreed that each state would specify how it would deal with these challenges (Phelan).

Presently, standards have been developed in three main areas:

> *Academic standards* describing what students should know and be able to do in the core academic subjects at each grade level; c*ontent standards* describing basic agreement about the body of education knowledge that all students should know and p*erformance standards* describing what level of performance is good enough for students to be described as advanced, proficient, below basic, or by some other performance level (Phelan, n.d., p. 1).

Zemelman, Daniels, and Hyde (1998) contrasted the two major schools reform movements: the accountability reformers and the curriculum reformers. The conservative accountability reformers generally consisted of state legislators and governors, education agencies, business panels, and some urban school districts and focused almost totally on systems of high-stakes testing and accountability that are tied to elaborate awards and punishments for students, teachers, schools, and districts. The members of this group claimed that student achievement could be raised by measuring more often and by providing a framework of more extensive rules and regulations. On the other hand, were the curriculum reformers composed primarily of subject-area experts, classroom teachers, discipline organizations, professional associations, and research centers whose vision of school improvement depended not upon new rules and regulatory controls but upon improving instruction. Reform for this group meant that all students were afforded real access to the kinds of instruction that made reaching higher standards a possibility. They argued that simply doing the same things harder, longer, and stronger would not improve education (Zemelman et al.).

No Child Left Behind Act of 2001. The most recent influence from the federal government directing student learning and the roles and responsibilities of educators has been the comprehensive school components of the *No Child Left Behind Act of 2001* signed by President George Bush on January 8, 2002 (*No Child Left Behind Act of 2001,* 2005). According to this law, the major pillars of this bill include increased accountability for results, more freedom and flexibility for state and local units, proven educational methods, more choice for parents and students from disadvantaged background, ensuring every child can read with the Reading First initiative, strengthening teacher quality, and promoting English proficiency (*No Child Left Behind Act of 2001*). Schools have been directed to ensure that all students test at levels identified as "proficient" by the year 2014 and students are to make specific, mandated progress (adequately yearly progress) toward that goal each year. The consequences for failure to make such progress are a series of limitations imposed upon by the state at the direction of the federal government. According to *No Child Left Behind Act of 2001*, the intent of the law was to make use of the federal role in education in order to close the achievement gap between disadvantaged and minority students and their peers (*No Child Left Behind Act of 2001*). NCLB redefines the federal role in K-12 education. With the intent of bringing about fundamental reform in classrooms across the country, NCLB is the most sweeping reform of the Elementary and Secondary Education Act (ESEA) originally enacted in 1965 (*No Child Left Behind Act of 2001*).

There are, however, opponents of this law who cite major problems with NCLB. McKenzie (2003) cited several problems with the law: a lack of evidence for change strategies, the focus on a narrow curriculum, insufficient funding, punishment before capacity building, top down directives, the redirection of funding to home schooling and corporate schools, not enough focus on the social causes of poor school performance, violation of states rights, and the helter-skelter movement of students. Darling-Hammond (2004), Wood (2004), and Sizer (2004) challenged the NCLB approach to school improvement. Wood pointed to fundamental technical flaws of under funding, restrictive definitions of teacher qualifications and arbitrary expectations for subgroups that he argues will undermine the ability of NCLB to do any good. Sizer noted that NCLB did not address the real causes of school failure nor did the law advance an agenda for real improvement. Darling-Hammond argued that the manner that NCLB is measuring schools is not fixing them, and that NCLB did not address many of the resource failures of education, such as inadequate textbooks, or even a lack of heat. She also contended that NCLB has forced states to lower their standards in some cases and in others it has forced some schools to improve performance by being sure that lower performing students leave. NCLB, rather than raising the performance of low achieving students, Darling-Hammond argued, has increased the number of dropouts. But the standards movement alone has not been the only focus in educational thinking during the past 20 years (Darling-Hammond). Research about the brain and how it learns has drawn much attention from educational parishioners and the public alike.

Brain Research

Brain Models

For over 2000 years, there have been differing models of the brain. According to Jensen (1998), the brain has been described as a hydraulic system (the Greco-Roman model), a fluid system (the Renaissance model), an enchanted loom (the early Industrial Revolution model), a city's switchboard (early to mid 1900s model), and a computer (1950-1980s model). Today, a more holistic, whole-systems approach is taken toward the understanding of the brain (Bucko, 1997).

Two models popular in the 1970s and 1980s were the right brain/left brain model and the triune brain model. In 1981, Roger Sperry was awarded the Nobel Prize for his split-brain research (McCarthy, 1981). McCarthy noted that in the right-brain vs. left-brain theory of the structure and functions of the mind, the two different sides of the brain controlled 2 different 'modes' of thinking. Individuals preferred one mode over the other, but schools tended to favor left-brain modes of thinking, with scholastic subjects focusing on logical thinking, analysis, and accuracy. With the acceptance of the right brain/left brain theory, there was a push for more right-brain activities in school curriculums focusing on aesthetics, feelings, and creativity (Jensen, 1998). Although much of Sperry's original work remains valid today, updated research by Levy (1985) confirmed that both sides of the brain are involved in nearly every human activity. Gazzaniga (1992) later agreed with Levy stating that the events that occur in one hemisphere influence events that are developing at the same time in even remote parts of the other hemisphere.

MacLean first introduced his triune brain theory in the early 1970s (MacLean, 1990). Though popular during the 1970s and 1980s, it is now considered outdated (Jensen, 1998). MacLean identified the human brain as actually 3 brains in one. Each of the 3 parts, though responsible for separate functions, does interact with the other parts to a considerable degree. The first layer, the R-complex, responsible for maintenance including supplying food, waste disposal, comfort, and security dictates behaviors that are automatic, very resistant to change, and are ritualistic in nature. The second layer of the brain, the limbic system, is responsible for checking emotions and is also crucial in recalling new information and in organizing events. This limbic system is largely responsible for self-defense through the avenues known as fight or flight. The third and largest layer of the brain is the neocortex where creativeness, language, composing music, and engaging in complex analysis reside. Processing of sensory data, logical and formal operational thinking, and the ability to see ahead and plan for the future occur in this layer of the brain. Though the triune brain theory is generally not considered valid today recent discoveries in brain research indicate that much of the brain is involved in most every function (Levy, 1985).

New Brain Theories

New brain-based theories tend to address the developmental relationship between the brain's ancestors and the brain's current environment known as the 'nature versus nurture' issue. According to Sylwester (1995), the new theories argue that *nature* holds a more important role than the more dominant side of *nurture.* Edelman (1992) explained that the brain operates on the basis of *natural selection,* the process that explains instruction and learning. He argued that the computer, once considered the current model of our brain, is no longer an appropriate brain model because the computer is developed, programmed, and run by an outside force, and the brain is not. Edelman pointed to the nature of the brain as being more like a jungle, multilayered and full of loops and layers, with pathways of information naturally being selected for continued use if the organizer makes use of them and if the information serves a purpose. In his vision of the brain, systems interact continuously in quite a haphazard fashion. He went on to suggest that students have a natural inclination to learn, understand, and grow.

Cognitive psychologist Sternberg developed a Triarchic (three components) Brain Theory of Intelligence, first introduced in 1985. Sternberg (1985) stated that successfully intelligent individuals are so, in part, because of their ability to achieve a balance among the 'triarchy' of their abilities: analytical, creative, and practical. He examined successfully intelligent people who were not necessarily high in all three of these abilities but had found a way to effectively use whatever pattern of abilities they did have. Sternberg (1996) asserted that practical intelligence could predict an individual's future job success equally as well, if not better, than scores on the traditional IQ test.

Recent Brain Literature

> We underrate our brains and our intelligence. Formal education has become such a complicated, self-conscious and overregulated activity that learning is widely regarded as something difficult that the brain would rather not do. . . . But reluctance to learn cannot be attributed to the brain. Learning is the brain's primary function, its constant concern, and we become restless and frustrated if there is no learning to be done (Smith, 1986, p. 18).

Knowledge about the brain has developed at an unprecedented rate according to Janowsky, a learning and memory neuroscientist at Oregon Health Sciences University in Portland. She stated, "Anything you learned 2 years ago is already old information" (Kotulak, 1996, p. 124). According to Danielson (2002), the brain processes information in 3 stages: sensory memory, working memory, and long-term memory. The brain scans all input during the sensory memory stage disregarding the majority of it as irrelevant. During the working memory stage, most learning takes place, with knowledge stored in long-term memory. Learning takes place through the brain's pattern-seeking mechanism in the working memory stage. Individuals can remember information by engaging in rote rehearsal. When information is repeated over and over, it becomes automatic and can be accessed even as the brain is engaged in other cognitive activities. However, the brain must process complex data actively in order to make the information meaningful. Although some information is learned that is not immediately relevant, when the learning experience is emotionally engaging for individuals, learning is much more likely to be permanent.

According to Caine and Caine (1991),

> The brain has virtually an inexhaustible capacity to learn… Each healthy human brain comes equipped with a set of exceptional features: The ability to detect patterns and to make approximations; phenomenal capacity for various types of memory; the ability to self-correct and learn from experience by way of analysis of external data and self-reflection; and an inexhaustible capacity to create (Caine & Caine, p. 3).

Sylwester (1995) indicated that it is important for educators to understand how scientists study the brain. He argued that the challenge for educators is to be knowledgeable of brain research so they might begin to discover useful applications to brain theory and research. "*Knowing why* generally leads to *knowing how to"* (p. 5). Caine and Caine (1991) noted that learning about the brain should improve teaching. "Educators do not need to be experts on brain anatomy, but they must have some appreciation of how multifaceted the brain is" (p. 25).

In 1983, Gardner presented his researched and documented theory of multiple intelligences arguing that the American culture had defined intelligence too narrowly and proposed the existence of at least seven intelligences. Gardner, in focusing on the mind and especially cognitive thought (that depends heavily on symbols such as language, mathematics, the visual arts, body language, and other human symbols), presented a multi-faceted way to think about intelligence-- not as a single characteristic or even as a group of characteristics that could be summed up with the single measure of IQ. Armstrong (1994) supported Gardner and his theory of multiple intelligences.

> In his theory of multiple intelligences (MI theory), he sought to broaden the scope of human potential beyond the confines of the IQ score. He seriously questioned the validity of determining an individual's intelligence through the practice of taking a person out of his natural learning environment and asking him to do isolated tasks he'd never done before—and probably would never choose to do again (p. 1).

Using the working definition that intelligence is the ability to solve a problem or create or fashion a product that is valued in a culture, Gardner (1983) identified over 200 ways of "being smart" and grouped them into seven intelligences that individuals possess for perceiving and understanding the world: linguistic intelligence, logical-mathematical intelligence, spatial intelligence, musical intelligence, bodily-kinesthetic intelligence, interpersonal intelligence, and intrapersonal intelligence. Gardner (1993) stressed that the MI theory was not a "type theory" for determining the *one* intelligence that fits but was a theory of cognitive functioning with each individual having capabilities in all seven intelligences. He suggested that virtually everyone has the capacity to develop all seven intelligences to a reasonably high level of performance if given the appropriate encouragement, enrichment, and instruction and suggested that the intelligences usually work together in complex ways.

Goleman (1995) expanded on Gardner's "personal intelligences"—the intrapersonal (knowing oneself) and interpersonal (knowing how to get along with others) in his discussion of the emotional brain. Goleman pointed to the neglect of the emotional brain and the danger of such to students and advocated making social and emotional competence key components of the curriculum. He contended that emotional well being is the strongest predictor of achievement in school and on the job. Goleman used the term 'emotional intelligence' to encompass five dimensions or characteristics: *self-awareness*--knowing your emotions and the basis for self-confidence; *mood management*—handling feelings and impulses relevant to the current situation and appropriate reaction; *self-motivation*—moving toward a goal, despite self-doubt, inertia, and impulsiveness; *empathy*—recognizing feelings in others and tuning into verbal and nonverbal cues; and *managing relationships*----handling interpersonal interaction, conflict resolution, and negotiations.

According to Sylwester (1994) developments that have occurred in the cognitive sciences are revealing the mysteries of just how and where our body and brain process emotion. In 1995 Sylwester outlined six areas in that emotional and social learning must join together in order to benefit schools and children: "accepting and controlling emotions, using metacognitive activities, using activities that promote social interaction and provide emotional context, avoiding intense emotional stress in school, and recognizing the relationship between emotions and health" (p.

76). He concluded, "... we know emotion is very important to the educative process because it drives attention, which drives learning and memory" (Sylwester, 1994, p. 60).

Elias et al. (1997) stated,

> Brain studies show that memory is coded to specific events and linked to social and emotional situations, and that the latter are integral parts of larger units of memory that make up what we learn and retain, including what takes place in classrooms" (p. 3).

Kotulak (1996), in acknowledging the emotional aspect of the brain, focused on key brain research findings: emotion is the gatekeeper to learning; intelligence is a function of experience; and the brain stores most effectively what is meaningful from the learner's perspective.

Caine and Caine (1994) discussed implications from brain research: (1) the beginning is critical: Brain research supports the point that Freud insisted upon (the most critical time of development for a psychologically healthy adult is the first 5 years of life) that is also supported by other cognitive psychologists in telling us that there are critical periods of cognitive development in early years; (2) learning and maturation cannot be separated; (3) the environment affects the brain physiologically that means that education can no longer separate brain development from life experience; and (4) the time scale of change varies enormously—with tremendous differences in the rates of development in "normal" children.

Caine and Caine (1997) summarized 12 principles that synthesized brain research and learning. These principles are intended to provide a framework for teaching and learning while offering a theoretical foundation for brain-based learning. The brain, uniquely organized, is a complex but adaptive system, social, and is innately searching for meaning through patterning. Emotions are critical to this patterning, as each brain perceives and creates parts and whole. Learning, what is always conscious and unconscious, is made up of both focused attention and peripheral attention and is developmental. Memory is organized in at least two ways and learning is enhanced by challenge and is thwarted by threat.

Many of the principles of brain-based learning support the theoretical basis of the Thinking Maps® program that will be examined later in a discussion of that program (Hyerle & Yeager, 2000).

Learning Theory

Thinking Skills

> Perhaps most importantly in today's information age, thinking skills are viewed as crucial for educated persons to cope with a rapidly changing world . . . specific knowledge will not be as important to tomorrow's workers and citizens as the ability to learn and make sense of new information (Gough [Cotton, 1991], 1991, p.1).

In examining the global terms for thinking (metacognition, thinking, critical thinking, and creative thinking), Kizlik (2005) outlined eight thinking processes: "concept formation, principle formation, comprehending, problem solving, decision-making, research, composing, and oral discourse" (p. 3). He further defined the eight specific core thinking skills:

> Focusing skills (attending to selected pieces of information and ignoring others), information gathering skills (bringing to consciousness the relative data needed for cognitive processing), remembering skills (storing and retrieving information), organizing skills (arranging information so it can be used more effectively), analyzing skills (clarifying existing information by examining parts and relationships), generating skills (producing new information, meaning or ideas), integrating skills (connecting and combining information), and evaluating skills (assessing the reasonableness and quality of ideas) (p.4).

Cotton (1991), in a meta-analysis of 33 research studies on thinking skills, discussed the general findings of the analysis:

> Thinking skills instruction enhances academic achievement….; research supports instruction in numerous skills and techniques….; different instructional approaches enhance thinking skills….; computer-assisted instruction helps to develop thinking skills….; research backs the use of numerous specific thinking skills programs….; (and) training teachers to teach thinking skills leads to student achievement.... (pp. 4-7).

During the time of the behaviorists' ideology, a fundamental framework for teachers to teach thinking skills was Bloom's (1956) *Taxonomy of Educational Objectives*. Bloom, in his

Taxonomy, divided the way people learn into three domains: cognitive (knowledge and the development of intellectual skills), affective (growth in feelings or emotional areas), and psychomotor (manual or physical skills). The cognitive domain was further divided into six major categories or levels (Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation) that begin with the simplest behavior and range to the most complex. The affective domain was also divided into five major categories or levels (Receiving phenomena, Responding to phenomena, Valuing, Organization, and Internalizing values-characterization (Bloom, 1956). Although the basis for Bloom's Taxonomy was not grounded in brain research, current curriculum and project planners (Forte & Schurr, 2003) do integrate Bloom's Taxonomy with the multiple intelligences as described by Gardner (1983) and the affective domain levels of the Taxonomy are pertinent components of Emotional Intelligence as described by Goleman (1995).

The 1980s brought about a deluge of thinking skills programs that offered a way to improve achievement. Reports supported the teaching of thinking skills (Banks, 1991). Sternberg (1996) noted the general consensus among educators concerning the importance of including critical thinking skills in all aspects of the curriculum. Previously, Perkins (1986) had supported the basis of these reports and argued that intelligence could be improved by the teaching of good thinking skills. Defining intelligence as the combination of power (natural ability), tactics (thinking strategy), and content, he reasoned that these 3 combined to create an enlightened person. This analysis led to the idea that students must be taught these skills in a number of ways, and he described tactics/strategies or thinking frames that enhanced intelligence. Costa (1985) had previously presented practical ways to enhance thinking in content areas such as writing, reading, science, and math.

According to Bucko (1997), John Dewey was referenced in literature as one of the first educators to discuss brain-based learning. Dewey (1933) suggested that thinking could be done well or badly, and that good thinking, like good manners, could be taught. Bucko extended Dewey's premise by stating that if good thinking could be taught, it could have far-reaching effects that would go well beyond the classroom.

Constructivism

In 1962, Dewey focused attention on the premise that from birth, unconsciously, humans learn to do, by doing.

> Our first teachers . . . are our feet, hands, and eyes. To substitute books for them does not teach us to reason; it teaches us to use the reasons of others rather than our own; it teaches us to believe much and to know little (cited in Dewey & Dewey, p. 2).

Dewey stated that all learning was simply a reconstruction of experiences. Jean Piaget (cited in Wadsworth, 1978) observed that human development was a progression of stages of cognitive development. His model of child development was based on the idea that a developing child builds cognitive structures, mental maps, schemes, and networked concepts in order to understand and respond to the experiences within his/her environment. Theorist, Bruner (1960) claimed that experience and exploration were the keys for the learner and that learning was an active process where learners build new ideas and concepts that were based upon their present and past knowledge. Thus, the philosophy of learning called constructivism was built on the premise that learning is the integration of new information with prior understandings. Smilkstein (2003) pointed to constructivism being supported by cognitive research that recognizes that making connections within the brain is the critical component to embedding information in long-term memory. Smilkstein described the basic tenets of constructivism: learning comes about from exploration and discovery and participation in authentic activities; it is a community activity facilitated by shared inquiry; assessment is done during the entire learning process and not just at the end; and that the outcomes of constructivist activities are unique and varied.

Graphic Organizers

History of Graphic Organizers

According to Leary (1999), one instructional strategy that links the gap between brain-based research and the classroom is the graphic organizer. Graphic organizers are closely aligned with the schema theory, one theory that explains how the brain thinks (Leary). According to this theory, as the brain encounters new information, it either fits the new information into existing patterns of thinking or modifies its existing structures to make sense of the new information (Monroe & Pendergrass, 1997).

Graphic organizers had their roots in advance organizers, a concept developed and studied by Ausubel (1960). Ausubel defined an advance organizer as a “cognitive instructional strategy used to promote the learning and retention of new information” (p. 267). The advance organizer, an introductory passage that contained new material the students read prior to reading a longer passage, was framed to include content that was important to the structure of the passage. Ausubel’s intent was to aid students in learning new material by previewing information to be learned. According to Gagne (1985), this approach encouraged students to build upon prior knowledge and organize their thoughts before being introduced to concept details. Hendron (n.d.) described an advance organizer as an instructional unit that was introduced before direct instruction and was designed to cross the gap between what an individual already knew and what that individual needed to know.

Hendron (n.d.) explained the Dual-Coding Theory of Information Storage. Knowledge is stored in two forms: the linguistic form and the nonlinguistic, or “imagery” form. The linguistic form involves writing and speaking and is most often used in today’s schools. The nonlinguistic or “imagery” form involves mental pictures and the physical sensations of smell, taste, touch, sound, and kinesthetic associations. This form of information storage results when nonlinguistic representations stimulate and increase activity in the brain. Many activities produce imagery representations: creating graphic representations, making physical models, generating mental pictures, drawing pictures and pictographs, and engaging in kinesthetic activities. Graphic organizers combine the linguistic and non-linguistic modes of information storage (Hendron). Moreover, according to Marzano (1998) and Marzano, Pickering, and Pollock (2001), one instructional strategy that positively affected student achievement was nonlinguistic representation. Further breakdown of this instructional strategy divides it into specific behaviors:

·asking students to generate mental images representing content,

·asking students to draw pictures or pictographs representing content,

·asking students to construct graphic organizers representing content,

·asking students to act out content,

·asking students to make physical models of content, and

·asking students to make revisions in their mental images, pictures, pictographs, graphic organizers, and physical models (Marzano, 2003, p. 82).

Because the Advance Organizer presented written material representing more extensive written material, students had difficulty concluding inferences (Robinson, 1998). He explained that educators proposed a type of Structured Overview (SO) where there would be a graphic display of words represented in a hierarchical organization of important concepts. Thus the Structured Overview displayed, for students, key vocabulary and concepts found in the text in an illustrated form. In its initial introduction, the SO was presented as a pre-reading activity much as any overview traditionally precedes an activity. However, eventually the term "structured overview" was changed to "graphic organizer" as the instructional position switched from the prereading to postreading position (Robinson).

Graphic organizers offer a visual, holistic representation of concepts and facts and the relationship that exists between them in an organized framework (McTighe, 1992). According to McTighe, graphic organizers have proven to be effective tools for enhancing thinking and promoting meaningful learning for both teachers and students in numerous ways: organizing information and ideas, generating and elaborating on ideas, representing abstract concepts in more concrete ways, illustrating relationships between concepts, relating new information to previous knowledge, storing and retrieving information, and assessing thinking and learning.

Graphic Organizers Research

Numerous researchers have examined the use of graphic organizers for the benefit of student achievement in *literacy development,* defined as reading comprehension and vocabulary knowledge. Brookbank, Grover, Kulberg, and Strawser (1999) determined that graphic organizers benefited 80% of students at all grade levels in mastering critical vocabulary skills. The National Reading Panel (2000) indicated that graphic organizers and semantic organizers were one of seven categories of instruction considered to be the most effective in improving reading comprehension.

Darch, Carnine, and Kameenui (1986), Gardill and Jitendra (1999), Idol and Croll (1987), and Willerman and Mac Harg (1991) concluded that the use of graphic organizers raised comprehension when using measures that included comprehension questions, a concept acquisition test, teacher-made tests, written summaries, and story grammar tests. Previously, Moore and Readence's (1984) meta-analysis of 23 different graphic organizer studies had also found a consistent but small effect on comprehension. But more importantly in the area of vocabulary knowledge, Moore and Readence pointed to evidence showing the gains in vocabulary knowledge to be even greater than comprehension with the mean effect size being more than twice as large.

Other studies have examined the effect of graphic organizer use on thinking and learning skills. Brookbank et al. (1999) and DeWispelaere and Kossack (1996) looked at how critical thinking skills were heightened with the use of graphic organizers. Elementary, middle school, and high school students were involved and the findings suggested that these skills were improved with graphic organizer use. In looking at the effects of graphic organizers on retention and recall, Ritchie and Volkl (2000) and Griffin, Malone, and Kameenui (1995) suggested that graphic organizers assist students in improving retention and recall of information for both middle and elementary students. Griffin et al. also suggested that graphic organizer use assisted students in transfer, retention, and recall skills to new situations. Doyle (1999) and Meyer (1995) examined the use of graphic organizers as an outlining tool. Doyle used graphic organizers with senior high students who had learning disabilities in the area of social studies and found that graphic organizers were a successful alternative to the conventional note taking method when measuring results with an end-of chapter-test. Meyer studied third grade students and the integration of graphic organizers into the writing process to enable students to organize their ideas. He determined that the students' writing improved, as measured by writing samples, when using graphic organizers.

Armbruster, Anderson, and Meyer (1991) and Griffin and Tulbert (1995), using fourth and fifth grade students in the area of social studies, examined graphic organizers as they aided students in organizing information from expository texts and in comprehension of content area reading. Measured with posttests, the results indicated that graphic organizers helped students select, organize, and recall relevant information. The researchers also indicated that the students were able to transfer thinking and learning skills to new situations and new content.

Leary (1999) contended in his review of research studies on graphic organizers that “no studies reviewed in the literature are able to pronounce that graphic organizers are more suited to males or females as an instructional advantage” (p. 20). In previous work, Foxworthy (1995) had indicated that she found no significant differences for gender.

According to Moore and Readence (1984), in their extensive meta-analysis of graphic organizer studies, the point of implementation is a crucial factor in determining the degree of improvement in learning results. They determined that graphic organizers used as a pre-reading activity resulted in little success with mean effect sizes being small. However, they found that when graphic organizers were used as a follow-up to reading, there were somewhat larger improvements in the learning outcomes.

Griffin et al. (1995) presented work that is directly linked to the research about Thinking Maps®. They attempted to answer the question of the teacher’s role in the instructional process. They concluded that without explicit instruction in a procedure such as graphic organizer instruction, students might not achieve any more successfully than with traditional methods.

Rice (1994), in reviewing research relating to graphic organizers, suggested that there is no systematic approach in the analysis of graphic organizer research. The researcher argued that without a logical approach to graphic organizer research, the result is a lack of explanation about why graphic organizers do or do not work. Similarly, Griffin and Tulbert (1995) examined 45 studies between 1974 and 1995 and pointed out that the studies often provided contradictory results and recommendations. They, too, argued that there was no constant in graphic organizer research citing the example that studies of graphic organizers that are teacher made are not examined separately from studies of graphic organizers that are student constructed. They suggested that this lack of consistency in the study design could indicate misleading effect sizes obtained in meta-analysis. They recommended that graphic organizer research be administered in studies that have a similar set of visual features and teaching procedures with the use of a control group. Use of controls, therefore, would increase the possibility of complementary, rather than contradictory, results. They further recommended that the number of independent variables to be examined be limited.

McTighe (1992) concluded that graphic organizers could be viewed as practical tools that assist students in organizing information and ideas. Research on the use of graphic organizers has determined that these cognitive tools allow students to represent abstract information in more concrete forms, depict relationships between concepts and facts, tie new information to previous knowledge, organize thoughts and ideas for writing, and assess the understanding of new concepts all that are the specific thinking processes of the eight Thinking Maps® and the Thinking Maps® program.

Thinking Maps®

Overview and Description of Thinking Maps®

Thinking Maps®, a comprehensive visual language, makes use of eight specific graphic designs each representing a fundamental thinking process (Hyerle, 1996b). Each map has a common name for the map, a name for a specific thinking process, and an expandable graphic, with each being used to construct and show knowledge (Hyerle, 1996b). According to Hyerle and Yeager (2000), the eight foundational thinking skills upon where the maps are based were identified by early psychologists and present day cognitive scientists as basic cognitive structures for thinking, language development, and learning. The eight maps are:

The *Circle Map* allows representing and seeing things in context, defining in context. This tool enables students to generate and identify relevant contextual information about the topic written in the center of the circle.

The *Bubble Map* is designed for describing, generating characteristics, qualities, and attributes.

The *Double Bubble Map* is designed as an extension of the Bubble Map; it analyzes 2 things by comparison and contrasts.

The *Tree Map* enables students to classify according to categories and the specific details and items within the categories.

The *Brace Map* is used to understand and show the structure of physical things; students represent part to whole relationships.

The *Flow Map* allows students to represent visual sequencing; it is used to order events, cycles, actions, directions, processes, and solve multi-step problems.

The *Multi-Flow Map* is used to show causes and effects of events; students identify motives and predict or discuss consequences.

The *Bridge Map* provides a pathway for understanding the relating factors within analogies (identifying the relationship) and for investigating conceptual metaphors (Hyerle & Yeager, 2000).

Each map exists only for the definition of the respective thinking process it represents (Hyerle, 1996b). Without that specific definition for the various thinking processes, there would be no need for Thinking Maps®. In lieu of the maps, students and teachers would continue to encounter the endless variety of graphic organizers that exist (Hyerle, 1996b).

The five major characteristics of Thinking Maps®, as a visual language for learning, are consistent graphics, flexibility of form, developmental in use, integrative and interdisciplinary, and student and teacher use for reflectiveness, metacognition, and assessment (Hyerle, 2000). Each map, defined as a fundamental cognitive process and pattern, is represented by a specific graphic design and is also expandable in order to match the content concept that students are learning. Hyerle (1996b) explained that the maps are based on basic, human cognitive processes, and, therefore, may be used by pre-K through adults for learning. The maps allow students to transfer thinking skills within content areas and across content areas. According to Hyerle (1996b), when students construct multiple maps, it allows them to self-assess their retention of information and their understanding.

According to Hyerle and Yeager (2000), frames of reference (large squares drawn around each map) assist learners in focusing on how they know knowledge or information. Thinking is guided by "frames," one's extended cultural and personal experiences, values, and belief systems. Frames of references influence thinking, feelings, and judgments. The frame of reference is used to identify prior knowledge in order to connect to personal experiences, to identify sources from where information comes, to assess and take measure of the quality of the source, to analyze an issue or topic from different perspectives, and to identify the purpose for gathering the content (Hyerle & Yeager).

The stated purpose of the program is "to use Thinking Maps as a common visual language in your learning community for transferring thinking processes, integrating learning, and for continuously assessing progress" (Hyerle, 1995, p. 1-3 *sic*). It is a commercially published program that may be used in any area of content and at any grade level, Kindergarten through the college level. See Appendix 1: The eight Thinking Maps® as developed by Hyerle (1995).

History of Thinking Maps®

David Hyerle, the creator of Thinking Maps, became interested in visually linking ideas first as a student and then as a teacher (Hyerle, 1996b). As a senior at the University of California at Berkeley, he became interested in the teaching of writing and took a course with the Bay Area Writing Project learning how to use webbing techniques (Hyerle, 1996a). During that time he began to create his own personal visual language using the webbing techniques in other courses. Later, teaching at an inner-city middle school in Oakland, California in the 1980s, he became frustrated in trying to help students make connections to content and introduced his students to webbing (Hyerle, 1996a). The students became comfortable with visual brainstorming techniques and experienced success with the quantity of ideas that they could web (Hyerle, 1996b). However, students, who often brainstormed numerous, exciting and imaginative ideas, had difficulty organizing them for a completed writing piece (Hyerle, 1996a). When Hyerle began piloting a "thinking skills" program that contained diagrams based on numerous thinking processes, he started to investigate different techniques that were based on students using more structured mapping for concept development. This brought about the question: "What would happen if teachers and students had basic maps for applying different, fundamental thinking processes" (Hyerle, 1996b, p. 2)? By the late 1980s Hyerle had begun to develop the common visual language of the eight flexible maps that became the basis of the Thinking Maps® program (Hyerle, 1996b).

In 1988, Innovative Sciences, Inc. published Thinking Maps® and training methods began for teachers (Hyerle, 1995). In 1992, Thinking Maps® resource materials were created for all elementary grade levels and in 1995, Thinking Maps®: Tools for Learning was published as the collective resource and training manual for using Thinking Maps® (Hyerle, 1995). In 1998, *Write... from the Beginning*, a writing program by Jane Buckner based on Thinking Maps®, was published initially as a K-3 writing program and later expanded for grades K-5 (Hyerle & Yeager, 2000). By the year 2000, there were 2,000 whole schools across the United States where teachers had received in-depth and follow-up training in Thinking Maps® (Hyerle & Yeager).

Theoretical Basis of Thinking Maps®

According to Hyerle and Yeager (2000), many of the 12 principles of brain-based learning research summarized by Caine and Caine (1997) support the use of Thinking Maps® and provide a theoretical basis for Thinking Maps® use. The maps give students a concrete way to see abstract ideas. Students first use each map in personal ways with their own information, thus hooking them emotionally. These initial personal experiences and successes with the maps allow students not to feel threatened when used later for deeper thinking. The maps provide meaning because they are repeated consistent patterns with each pictured thought process reinforced with the vocabulary of that thought process and the student's previous usage of the map (Hyerle & Yeager). The repeated use of these specific maps as a way to integrate and retain knowledge in permanent memory was supported by research from Marzano (2003) who stated "multiple exposures to knowledge are required to integrate and retain knowledge in permanent memory" (p. 112). According to Hyerle and Yeager, once the maps have been taught to students, the brain unconsciously pays attention to the eight thought processes. When the brain pays attention to information that has emotion or meaning, it attempts to store that information in short-term memory (Kotulak, 1996). However, in order for information to be stored in long-term memory, an individual must process the material (Danielson, 2002). Thinking Maps® allow students to analyze the material and thus strengthen the neural networks that have stored the information. More dendrites are grown as the neural connections branch out as bits of information are related to each other and to other types of information. Information is then stored in long-term memory—memory that is accessed when the thinking process begins anew (Hyerle & Yeager).

According to Sylwester (1995), when a network of neurons is established for a specific purpose with repeated firings, the brain begins to recognize a pattern automatically. As teachers and students establish a pattern for what each type of thinking “looks like” with repeated use of that pattern in a wide variety of content areas, the brain begins to pick up that pattern automatically (Hyerle & Yeager, 2000). According to Caine and Caine (1994), the major need of learners is for meaningfulness. Thus, as the brain acts as a pattern detector, the understanding of a subject comes from perceiving relationships. The brain makes sense of the world by constructing these patterns. Wolfe and Brandt (1998) reported that the brain is essentially curious and is always striving to make connections between the new and the old. The creators of Thinking Maps® state that the maps provide the experiences that allow students to perceive the patterns that connect (Hyerle, 1996b). According to Hyerle, each of the maps, in different ways, supports patterning and the networking of information, assists in organizing information into knowledge from different sources, and supports searching for meaning within prior knowledge. Each map also allows the linking of isolated bits of information into holistic systems.

Thinking Maps® differ in purpose and design from other visual tools/graphic organizers (Hyerle, 1995). The creators of Thinking Maps® distinguish between the 3 main types of visual tools that are used for learning: 1) brainstorm “webs” for personal knowledge, 2) task-specific graphic organizers for isolated tasks, and 3) Thinking Maps® with each map based upon a specific thinking process (Hyerle, 1995). The critical difference between Thinking Maps® and other graphic organizers is that each Thinking Map® is based on a fundamental thinking process. Hyerle and Yeager (2000) suggested that the reason Thinking Maps® have shown considerable improvement in student performance is the fact that the graphics are consistent but flexible. Used individually or together, the maps allow students to construct and communicate mental models of both linear and nonlinear concepts. Thinking Maps® work in conjunction with the brain's natural ability of networking configurations and thus allow students to construct their own networks of knowledge (Hyerle, 1996b).

Research about Thinking Maps®

The web page for Designs for Thinking, http://www.mapthemind.com/, (Hyerle's homepage), references six research projects using Thinking Maps®: four are master's degree projects (Blount, 1998; Curtis, 2001; Hindman, 2000; Matt-Kawryga, 2001) and 2 are dissertations (Ball, 1998; Hyerle, 1993). Curtis used interviews, teacher and student documents, and surveys to show how Thinking Maps® training and follow-up training directly supported teacher thinking and reflection. Matt-Kawryga showed how Thinking Maps® had been used effectively in every discipline in fourth grade urban classrooms in Syracuse, NY. Hindman looked at 1,000 students and determined that more than half used a visual tool during test taking. A second conclusion drawn by the researcher, however, was that there needed to be more than 1 year of Thinking Maps® use for students to internalize the tools. Blount examined the reading comprehension of underachieving fourth grade students in an inner city school and determined that Thinking Maps® use indicated improvement in reading comprehension.

Two doctoral dissertations were documented on the web page. Hyerle (1993) explained the conceptual and theoretical foundations for using Thinking Maps® as tools for personal, interpersonal, and social understanding in his study. Ball (1998) found a highly significant correlation between the use of Thinking Maps® and reading comprehension scores of college students using the Stanford Diagnostic Reading Test as the evaluating instrument

At least one doctoral dissertation examining Thinking Maps® is not included on the web page. Leary (1999) examined the standardized test results of a treatment group and a control group (both comprised of fourth grade students) after 7 months of instruction in the Thinking Maps® program. He found no significant difference between the treatment group and the control group with regard to reading, mathematics, and language achievement. However, Leary used only 78 students in his sample and indicated that the small cell size may have contributed to the lack of significant findings in the investigation. According to Banerji and Malone (1993) any new program should not be evaluated during the first year of implementation. Leary supported the conclusion that the Thinking Maps® program needed time to affect such a strong variable as student achievement and he argued that 7 months was not sufficient time to affect that variable.

The Designs for Thinking web page (www.mapthemind.com), also presented a substantial amount of information on collected data to support evidence of student performance changes when Thinking Maps® were used. There is a selected collection of excerpts showing both quantitative and qualitative evidence of student performance changes when Thinking Maps® were used systematically over a period of time. Hyerle (2000) also referenced Thinking Maps® Test Scores Summary: Appendix A of *A Field Guide to Using Visual Tools,* a collection of data that show gains in mathematics, reading, and writing from 1995-1999 in schools of several states including Texas, North Carolina, Florida, and Mississippi.

Finally, the Results and Research section of *Thinking Maps® Training of Trainers Guide Resource Manual* (Hyerle &Yeager, 2000) graphically displayed test scores before and after implementation of Thinking Maps® of several schools in various states.

Tennessee Comprehensive Assessment Program Achievement Test

According to the CTB/McGraw-Hill LLC (2004), the Tennessee Comprehensive Assessment Program Achievement Test (TCAP) is administered to Tennessee students in Grades 3-8 each spring. This achievement test is customized yearly to measure the academic basic skills in reading, language arts, mathematics, science, and social studies. Content knowledge as well as the application of that knowledge is assessed in each of the subject areas. The test makes use of the multiple choice format for questions and set time limits are established for each section of the test. There is no passing or failing grade on the test. In Grades 3-8 criterion-referenced score reports are given. In this type of report, a student's performance is measured according to specific standards or criteria, and not to the performance of other test takers. The state of Tennessee establishes specific curriculum standards for each content area and provides objectives for student accomplishment. Performance Indicators are written from these objectives to describe how the objectives are to be measured. Each test item is linked directly to a Performance Indicator on the TCAP Achievement Test. For the identification of performance, students fall into one of the three performance levels within each content area: advanced, proficient, and below proficient (CTB/McGraw-Hill LLC).

For the purpose of this study, the TCAP Achievement Test will serve as the dependent variable for the implementation of the Thinking Maps® program. Content validity and reliability of the TCAP test are discussed in Chapter 3. Also discussed in Chapter 3 are the State Normal Curve Equivalent (NCE) scores that are derived from the TCAP Achievement Test.

Summary of Review of Literature

The implementation and requirements of increased curriculum standards and the knowledge of brain-based learning research have been at the forefront of educational challenges during the last twenty years. As medical science research unlocks the secrets of how the brain functions and schools are challenged to provide ways for all students to achieve at increased levels, educators must constantly explore new and creative ways to bring the findings from research into the classroom.

An instructional strategy that is associated with the findings of how the brain leans is the graphic organizer (Marzano, 2003). For the past 40 years, a research base has existed about the different types of graphic organizers. While several studies have shown clearly that graphic organizers can improve student achievement in a number of areas, there have been few research studies that have explored the specific visual tools of the Thinking Maps® program whose authors' claim will increase student achievement. There continues to be constant challenges to administrators to explore new ways to increase student achievement in light of the standards movement. Additional research is necessary to discover the association, if any, between the use of these particular visual tools and student achievement.

This chapter has provided a review of pertinent information regarding the curriculum standards movement with the current requirements of *No Child Left Behind Act of 2001*, brain research examining past brain models and new brain theories with a review of recent literature and information about two learning theories, thinking skills and constructivism. This chapter has also provided an overview and a review of graphic organizer research as well as the description, history, and theoretical basis of the Thinking Maps® program and an examination of the TCAP Achievement Test.

CHAPTER 3

METHODS AND PROCEDURES

Introduction

This chapter describes the methodology and procedures used in this study to determine the effects of 2 years of Thinking Maps® instruction upon the achievement of fifth grade students in the subjects of Reading/Language and Mathematics. This chapter is organized into the following sections: research design, population, instrumentation, data collection, data analysis, listing of hypotheses, and summary.

Research Design

In the spring of 2002, the elementary principals of an upper East Tennessee school system were introduced to an instructional strategy that addresses student thinking skills with the intention of improving student achievement. The explanation and description of the program were given during the regular administrative staff meeting for approximately 1 hour. The particular program, Thinking Maps®, was presented to the six elementary principals during a regular administrative meeting by a certified trainer for this particular visual tools program. Subsequently two of the Title I elementary schools, designated School A and School B for the purpose of this study, chose to adopt this program as a means to improve student thinking and learning with the hopes of increased student achievement. The other Title I elementary school, designated School C, chose not to adopt this particular program due to its involvement in piloting a reading and math program for the school system. At that particular time, School C was involved in piloting a reading and math program for the school system. The administrator of the school stated that the piloting program was meeting the School Improvement goals of School C and was providing the faculty and staff with new research and instructional strategies (personal communication, 2003-2005 School C Administrator, February 24, 2006).

Initial training for the Thinking Maps® program occurred in the summer of 2003 for all faculty members of School A and School B. Two separate dates were offered by the certified trainer to accommodate all faculty members. The training in the Thinking Maps® program was a full-day format. An introduction to the program was given with instruction concerning teaching, transferring, integrating, and assessing with Thinking Maps® (Hyerle, 1995). Timetables were specific in how to integrate the maps for a complete school year. Follow up training occurred for the teachers in early fall of the school year (October). In the follow up training teachers brought examples of how they had incorporated the maps into the various areas of curriculum and were then provided a question and answer period to discuss specific concerns about how to use the maps appropriately. The control site, School C, did not receive instruction in the Thinking Maps® program.

This study was designed to investigate the effects of the Thinking Maps® program on student achievement as measured by the Tennessee Comprehensive Assessment Program (TCAP) Achievement Test after 2 years of Thinking Maps® instruction and implementation. Specifically the study examined the effects on student achievement in two Title I schools as compared to student achievement in a third Title I school that did not adopt this program. Therefore, the question that was addressed became, “Does evidence support this program in raising students’ achievement levels in Reading/Language and Mathematics as measured by the State NCE scores from the criterion-referenced test (CRT) of the Tennessee Comprehensive Assessment Program Achievement Test (TCAP)?” Specifically, the researcher was asking:

1. Was there a difference between the 2003 and 2005 TCAP Reading/Language and Mathematics State NCE scores of fifth grade students who received Thinking Maps® instruction?

2. Were there differences in students' performance on TCAP Reading/Language State NCE scores based on school (School A and School B), gender (male and female), year (2003 and 2005), and interactions between variables?

3. Were there differences in students' performance on TCAP Mathematics State NCE scores based on school (School A and School B), gender (male and female), year (2003 and 2005), and interactions between variables?

4. Were there differences in students' performance on TCAP Reading/Language State NCE scores based on school (School B [a treatment intervention site] and School C [a control site]), gender (male and female), year (2003 and 2005), and interactions between variables?

5. Were there differences in students' performance on TCAP Mathematics State NCE scores based on school (School B [a treatment intervention site] and School C [a control site]), gender (male and female), year (2003 and 2005), and interactions between variables?

In order to establish trends, a quasi-experimental design was established. In order to interpret findings, the emphasis was on the use of comparative data. According to Gall, Borg, and Gall (1996), a quasi-experimental design will likely produce useful knowledge if used in an appropriate manner. It is often a useful method when random assignment is not a feasible approach.

This quasi-experimental study was conducted using demographic data collected from the three elementary schools and the central office of the particular school system. Data were collected from the 2005 Tennessee State Report Card that provides State NCE scores. For this study it is necessary to have a baseline of achievement prior to Thinking Maps® instruction occurring in Schools A and B, the intervention sites, and also for School C, the control site. State NCE scores were available for students who were in third grade in 2003 and in fifth grade in 2005. These scores provided a longitudinal comparison of scores for growth purposes.

The independent variable for this study was the Thinking Maps® program. The dependent variables were the 2005 fifth grade students' State NCE scores in Reading/Language and Mathematics as measured by the TCAP Achievement Test. Gender, year, school, and State NCE scores were used to examine interaction. Analysis using these variables was made between the intervention treatment groups and the control group in order to establish differences.

Population

This study was conducted in one school system in northeast Tennessee. The subjects for this study were fifth grade students who attended one of the three Title I elementary schools (K-6) in that system for the 2002-2003 school year as third graders, the same school in the 2003-2004 school year as fourth graders, and the same school in the 2004-2005 school year as fifth graders. Elementary Schools A and B served as the intervention/treatment sites where each student in the school received Thinking Maps® instruction in the program. Elementary School C served as the non-intervention site, the comparison group, where Thinking Maps® instruction and implementation did not take place. This study was based on a population of approximately 70 students in third grade in 2003 and 70 students in fifth grade in 2005.

Based upon the percent of the student population that is eligible for free or reduced lunches, some Title I schools quality for school-wide status. The three elementary schools used in this study qualified for Title I funding as school-wide programs. Also, all three schools earned Safe School status on the Tennessee Report Card (Tennessee Department of Education, 2003, 2005).

Comparison data for all three schools were provided. The student population of each school with the percent of economically disadvantaged students is displayed in Table 1. Student race percentages for each school are shown in Table 2. The 2003 Proficiency level (below, proficient and advanced) percentages for third grade students involved in this study prior to any intervention are displayed in Tables 3 and 4. The percentage of degree levels of each school faculty and the mean number of years of faculty teaching experience is given in Table 5.

Table 1

School-wide Student Population with Percentage of Economically Disadvantaged

School	2003 Student Number	2003 % Economically Disadvantaged	2005 Student Number	2005 % Economically Disadvantaged
A	259	80.0	197	83.5
B	285	63.0	255	70.8
C	319	62.4	331	70.5

Table 2

School-wide Student Population: Race

School	2003 White	2003 Black	2003 Other	2005 White	2005 Black	2005 Other
A	97 %	<1 %	3 %	95 %	< 1%	5 %
B	81 %	15 %	4 %	79 %	16 %	5 %
C	91 %	6 %	3 %	89 %	7 %	4 %

Table 3

Proficiency Percentages of Students Prior to Thinking Maps® Instruction: Reading

Reading 2003 Third Grade	School A %	School B %	School C %
Below Prof.	37	18	**22**
Proficient	45	49	**49**
Above Prof.	18	33	**31**

Table 4

Proficiency Percentages of Students Prior to Thinking Maps® Instruction: Mathematics

Mathematics 2003 Third Grade	School A %	School B %	School C %
Below Prof.	25	21	**22**
Proficient	45	53	**43**
Above Prof.	30	26	**35**

Table 5

Educational Degree Levels with Mean Years of Teaching Experience of School Faculties

School	Bachelor's	Master's	Master's + 45	Specialist	Doctorate	Mean Years Experience
A	34 %	48 %	9 %	9 %	NA	19
B	72 %	20 %	4 %	NA	1 %	12
C	47 %	38 %	9 %	6 %	NA	15

School A, an intervention site, showed a steady decrease in student population, but the percentage of school-wide economically disadvantaged students remained rather consistent. The student population of School B, an intervention site, fluctuated from a high of 285 to the current enrollment of 255 but the percentage of school-wide economically disadvantaged students remained rather consistent. School C, the comparison site for this study, had student population that also showed a consistently similar enrollment. The percentage of School C's school-wide economically disadvantaged students was also consistent.

Race and ethnic population percentages at all three of the schools remained constant even as the total student population fluctuated. The student population was predominately white for each of the schools with a slightly higher white population for school A. School B had a lower white population and higher black population than either of the other two schools. Gender distribution was also relatively even in both third and fifth grade for each of the years of the study for each school with a noted exception: in 2003, the third grade of School C had 19 males and 33 females with a similar distribution 2 years later in fifth grade in 2005: 22 males and 36 females. Class size for third and fifth grade students for all 3 schools fell in a comparable range with an mean class size of 17 for the 2003 third grades and 20 for the 2005 fifth grades. (personal communication, Office of Student Services, July 30, 2005).

The mean teaching experience for each of the school faculties varied somewhat but with all schools having experienced teachers: 19 years mean teaching experience for School A, 12 years mean teaching experience for School B, and 15 years mean teaching experience for School C. Degrees earned by the staff of each school showed a much higher percentage of staff with bachelor's degrees and a much lower percentage of staff with master's degrees at school B than at either of the other 2 schools (personal communication, Office of Elementary Director, July 27, 2005).

The student populations of the Schools A, B, and C involved in this study did not have large enough numbers for all the different subgroups of ethnicity and race, as defined by the *No Child Left Behind Act of 2001* (White, Black, Hispanic, American Indian/Alaska Native, and Asian/Pacific Islander), to do an analysis of all of these subgroups. To protect student privacy, results are not provided for categories with fewer than 8 students (Tennessee Department of Education, 2003, 2005). Reporting data require a minimum group of 45 to provide data on a race/ethnic subgroup (Tennessee Department of Education, 2003, 2005).

For the purpose of this study, students who were designated as special education students were not a part of this study. In the group being studied, there was a large difference in the percentage of students who were classified as ‘special education" between the 3 schools with Schools A and B (the treatment schools) having a larger number and percentage of special education students than School C, the control school.

An attendance qualification existed for the purpose of this study. During the 2003-2004 school year (year one of treatment), a student must have attended school at the same school for at least 75% of the total days of that school year for the TCAP CRT State NCE scores of that student to qualify for analysis. During the 2004-2005 school year (year 2 of treatment), a student must have attended the same school as he/she attended in 2003-2004 and again for at least 75% of the total days of that school year for the TCAP CRT State NCE scores to qualify for analysis (personal communication, Office of Student Services, July 30, 2005).

Coleman et al. (1966) was one of the first to indicate that SES was the best predictor of school success, an assumption that educational practitioners and researchers had held for years. White (1982) noted that the belief in the strong relationship between academic achievement variables and SES was so accepted in the research literature that it was often not questioned. The following quotes supported that belief:

> The family characteristic that is the most powerful predictor of school performance is socioeconomic status (SES): the higher the SES of the student's family, the higher his academic achievement. This relationship has been documented in countless studies and seems to hold no matter what measure of status is used (occupation of principal breadwinner, family income, parents' education, or some combination of these) (Boocock, 1972, p. 32).

> "The positive association between school completion, family socioeconomic status, and measured ability is well known" (Welch, 1974, p. 32).

White (1982) argued, however, that the actual research findings varied widely with correlations between SES and student achievement as high as 0.80 and as low as 0.10. His argued that the correlation between student achievement and SES could deviate considerably depending on how SES was defined. Research Questions 2 and 3 examined differences between students' State NCE scores in Reading/Language and Mathematics at the two intervention treatment sites. The researcher examined differences in treatment as treatment related to the economically disadvantaged percentage of a school. School A had an economically disadvantaged population of 80.0% in 20003 and 83.5% in 2005. School B had an economically disadvantaged population of 63.0% in 2003 and 70.8% in 2005. Therefore, the researcher was interested in examining the effects of treatment as it related to the economically disadvantaged percentage of a school.

Research Questions 4 and 5 examined differences between students' State NCE scores in Reading/Language and Mathematics at one intervention treatment site and the control site, schools that had very similar percentages of student population of economically disadvantaged students. School B had an economically disadvantaged student population of 63.0% in 2003 and 70.8% in 2005 and the control school, School C, had a similar percentage of economically disadvantaged student population of 62.4% in 2003 and 70.5% in 2005. The researcher examined the difference between treatment and no treatment in schools with similar economically disadvantaged populations in order to investigate the strength of the argument that student academic achievement is related on SES.

Instrumentation

Data were collected from scores provided by the Tennessee State Department of Education. Tennessee schools mandate that students in Grades 3-8 take the TCAP CRT test each spring during a 2-to-3 week designated period. The purpose of the test is to measure a student's academic knowledge and skills in mathematics, reading/language, science, and social studies (CTB/McGraw-Hill LLC, 2004). Criterion Referenced Tests (CRT) measure a student's performance against a previously determined set of standards. These standards are established based on a specific curriculum.

Previously the state of Tennessee had administered a Norm Referenced Test (NRT) that gave a comparison of student performance in the five content areas against a national norm group of students who took a similar test (Tennessee Department of Education, 2005). In the spring of 2004, Tennessee administered both the Norm Referenced Test (NRT) and the Criterion Referenced Test (CRT) with each student taking both tests. This enabled an equating of the 2 tests that has allowed previous NRT test data to be mapped onto the CRT scale. After mapping onto the CRT scale, the data were converted into state normal curve equivalents (NCE) using the 1998 data as a base (Tennessee Department of Education, 2005). State NCE scores were available for the participants in this study for both the 2003 and 2005 school years.

Presently, Tennessee is able to measure student progress using the Tennessee Value Added Assessment System (TVAAS). These data measures student progress within a grade and subject and shows the influence of in-school factors on student achievement. As a tool, it is designed to improve educational opportunities for students (Tennessee Department of Education, 2005). Using these data was appropriate in examining the effects of the Thinking Maps® program (an in-school factor) on student achievement.

The establishment of the content validity of the TCAP CRT plays a critical role in establishing its validity.

> Content validity can be achieved by consistent adherence to the test blueprints. This can be done using test blueprints that closely if not exactly reflect what Tennessee students will know and be able to do in the subject area being assessed and through items that truly measure student performance on the TCAP CRT content standards. The degree to which the test blueprints represent the content domains really determines this validity. Hence, the alignment of the items in the test blueprints to Tennessee content and performance standards is critical to the validity of the assessment (CTB Mc-Graw Hill, 2005a p. 5).

According to Bratton, Horn, and Wright (1996), the content validity of the TCAP achievement tests is good given that the Criterion-Referenced Test (CRT) items are written by Tennessee teachers with the specific intent to match the Tennessee curricula in mathematics and language arts. Reliability of the TCAP is also good; TCAP reliability can be demonstrated statistically with figures that are available to show for the TCAP (Bratton et al.).

CTB McGraw-Hill, the publishers of the TCAP test, assert that the integrity of the test construction is based on the company's adherence to the Standards for Educational and Psychological Testing defined by the American Educational Research Association, the American Psychological Association, the Code of Professional Responsibilities of the National Council on Measurement in Education (CTB McGraw-Hill, 2005b).

Data Collection

Exempt status was secured from the East Tennessee State University Institutional Review Board prior to the initiation of the study. Permission was also secured from the Director of Schools in the school system where this study took place. Copyright permission was secured from Thinking Maps®, Inc. in order to use the term Thinking Maps® and the eight visual tools associated with that term.

State NCE scores derived from the criterion-referenced test (CRT) of the TCAP Achievement Test were secured from the 2005 State Report Card provided at Tennessee Department of Education web site. Data were also secured with the assistance of the testing coordinator of the school system using the Clarity software program to generate reports. These reports provided gender, ethnicity, and special education status of each student in grade 3 for Schools A, B, and C in 2003 and in grade five for the 3 schools in 2005. Demographic data were obtained from the Federal Project Office and Student Services Office of the school system.

Data Analysis

The Statistical Program for the Social Sciences (SPSS) was used to analyze the data. The following strategies were used to answer the stated research questions:

Research Question #1

Was there a difference between the 2003 and 2005 TCAP Reading/Language and Mathematics State NCE scores of fifth grade students who received Thinking Maps® instruction? Paired *t* tests were used to answer this research question: one for TCAP Reading/Language and one for TCAP Mathematics.

For each of the remaining research questions, a three-factor repeated measures design, repeated on one factor, was used to answer the research question. Each repeated measures model tested seven null hypotheses. If there were significant interactions, tests of simple effects were conducted to evaluate the nature of the interactions.

Research Question # 2

Were there differences in students' performance on TCAP Reading/Language State NCE scores based on school (School A and School B), gender (male and female), year (2003 and 2005), and interactions between variables?

Research Questions # 3

Were there differences in students' performance on TCAP Mathematics State NCE scores based on school (School A and School B), gender (male and female), year (2003 and 2005), and interactions between variables?

Research Question # 4

Were there differences in students' performance on TCAP Reading/Language State NCE scores based on school (School B [a treatment intervention site] and School C [a control site]), gender (male and female), year (2003 and 2005), and interactions between variables?

Research Question # 5

Were there differences in students' performance on TCAP Mathematics State NCE scores based on school (School B [a treatment intervention site] and School C [a control site]), gender (male and female), year (2003 and 2005), and interactions between variables?

Hypotheses

This study tested the following null hypotheses:

Research Question #1

Was there a difference between the 2003 and 2005 TCAP Reading/Language and Mathematics State NCE scores of fifth grade students who received Thinking Maps® instruction?

$Ho1_1$: There was no difference between the 2003 and 2005 TCAP Reading/Language State NCE scores of fifth grade students who received Thinking Maps® instruction.

$Ho1_2$: There was no difference between the 2003 and 2005 TCAP Mathematics State NCE scores of fifth grade students who received Thinking Maps® instruction.

Research Question #2

Were there differences in students' performance on TCAP Reading/Language State NCE scores based on school (School A and School B), gender (male and female), year (2003 and 2005), and interactions between variables? The null hypotheses are:

$Ho2_1$: There were no differences in students' performance on TCAP Reading/Language State NCE scores between School A and School B (the two treatment intervention schools).

$Ho2_2$: There were no differences in students' performances on TCAP Reading/Language State NCE scores of male and female students.

$Ho2_3$: There were no differences in students' performance on TCAP Reading/Language State NCE scores between 2003 and 2005.

$Ho2_4$: There was no two-way interaction for School by Gender.

$Ho2_5$: There was no two-way interaction for School by Year.

$Ho2_6$: There was no two-way interaction for Gender by Year.

$Ho2_7$: There was no three-way interaction for School by Gender by Year.

Research Question #3

Were there differences in students' performance on TCAP Mathematics State NCE scores based on school (School A and School B), gender (male and female), year (2003 and 2005), and interactions between variables? The following null hypotheses will be tested:

$Ho3_1$: There were no differences in students' performance on TCAP Reading/Language State NCE scores between School A and School B (the two treatment intervention schools).

$Ho3_2$: There were no differences in students' performances on TCAP Mathematics State NCE scores of male and female students.

$Ho3_3$: There were no differences in students' performance on TCAP Mathematics State NCE scores between 2003 and 2005.

$Ho3_4$: There was no two-way interaction for School by Gender.

$Ho3_5$: There was no two-way interaction for School by Year.

$Ho3_6$: There was no two-way interaction for Gender by Year.

$Ho3_7$: There was no three-way interaction for School by Gender by Year interaction.

Research Question #4

Were there differences in students' performance on TCAP Reading/Language State NCE scores based on school (School B [a treatment intervention site] and School C [a control site]), gender (male and female), year (2003 and 2005), and interactions between variables? The null hypotheses for this research question are:

$Ho4_1$: There were no differences in students' performance on TCAP Reading/Language State NCE scores between School B and School C.

$Ho4_2$: There were no differences in students' performances on TCAP Reading/Language State NCE scores of male and female students.

$Ho4_3$: There were no differences in students' performance on TCAP Reading/Language State NCE scores between 2003 and 2005.

$Ho4_4$: There was no two-way interaction for School by Gender.

$Ho4_5$: There was no two-way interaction for School by Year.

$Ho4_6$: There was no two-way interaction for Gender by Year.

$Ho4_7$: There was no three-way interaction for School by Gender by Year interaction.

Research Question #5

Were there differences in students' performance on TCAP Mathematics State NCE scores based on school (School B [a treatment intervention site] and School C [a control site]), gender (male and female), year (2003 and 2005), and interactions between variables?

To answer this research question, the null hypotheses are:

$Ho5_1$: There were no differences in students' performance on TCAP Mathematics State NCE scores between School B and School C.

$Ho5_2$: There were no differences in students' performances on TCAP Mathematics State NCE scores of male and female students.

$Ho5_3$: There were no differences in students' performance on TCAP Mathematics State NCE scores between 2003 and 2005.

$Ho5_4$: There was no two-way interaction for School by Gender.

$Ho5_5$: There was no two-way interaction for School by Year.

$Ho5_6$: There was no two-way interaction for Gender by Year.

$Ho5_7$: There was no three-way interaction for School by Gender by Year interaction.

Summary

Chapter 3 consists of the presentation of the research design, the population, instrumentation, data collection, data analysis, and a list of null hypotheses used for this study. Quantitative data will be used in this quasi-experimental design. Data were collected from the State NCE scores derived from the Tennessee Comprehensive Assessment Program Achievement Test (TCAP) for third and fifth grade students. The TCAP instrument is described and explained as well as the State NCE scores.

Null hypotheses based on research questions are listed. The results from the analysis are presented in Chapter 4.

CHAPTER 4

DATA ANALYSIS

Introduction

The research questions presented in Chapter 1 and Chapter 3 and the hypotheses introduced in Chapter 3 are addressed in this chapter. The purpose of this study was to determine what, if any, associations existed between the implementation of the Thinking Maps® program and students' achievement in Reading/Language and Mathematics on the TCAP CRT test after 2 years of Thinking Maps® implementation and use. State Normal Curve Equivalent (NCE) scores were used to measure growth. Test scores of students not receiving Thinking Maps® instruction were compared to test scores of students receiving Thinking Maps® instruction. Test scores were collected from three Title I elementary schools from one school system in East Tennessee. This study was guided by five research questions and the corresponding null hypotheses.

Analysis of Research Questions

Data for this study were compiled from the results of the 2003 (third grade) and 2005 (fifth grade) TCAP CRT tests from which was derived State NCE scores. Various statistical methods were used to analyze the data. The organization of this chapter follows the order of the research questions listed in Chapters 1 and 3.

Research Question #1

Was there a difference between the 2003 and 2005 TCAP Reading/Language and Mathematics State NCE scores of fifth grade students who received Thinking Maps® instruction?

The analysis of this research question was restricted to students who received Thinking Maps® instruction (Schools A and B). The null hypotheses were:

$Ho1_1$: There was no difference between the 2003 and 2005 TCAP Reading/Language State NCE scores of fifth grade students who received Thinking Maps® instruction.

$Ho1_2$: There was no difference between the 2003 and 2005 TCAP Mathematics State NCE scores of fifth grade students who received Thinking Maps® instruction.

Reading. A paired *t* test was conducted to evaluate whether there was a difference between the 2003 and 2005 Reading/Language State NCE scores of fifth grade students who received Thinking Maps® instruction. Prior to the analysis, one-sample Kolmogorov-Smirnov tests were used to evaluate the assumptions of normality for the 2003 and 2005 scores. The null hypothesis tested by the Kolmogorov-Smirnov test is that the variable is normally distributed. The results of the Kolmogorov-Smirnov tests showed the null hypotheses for the 2003 Reading/Language State NCE scores (p =.97) and the 2005 scores (p = .85) were retained. In order words, neither variable showed a violation of the assumption of normality.

The paired *t* test for the 2003 and 2005 Reading/Language State NCE scores showed there was significant difference between the 2003 and 2005 reading means, $t(34) = 4.80$, $p < .01$. The mean for the 2005 reading scores (M = 60.66, SD = 18.08) was over eight points higher than the mean for the 2003 reading scores (M = 52.51, SD = 14.81). The box plots for the distributions of the 2003 and 2005 Reading/Language State NCE scores are shown in Figure 1.

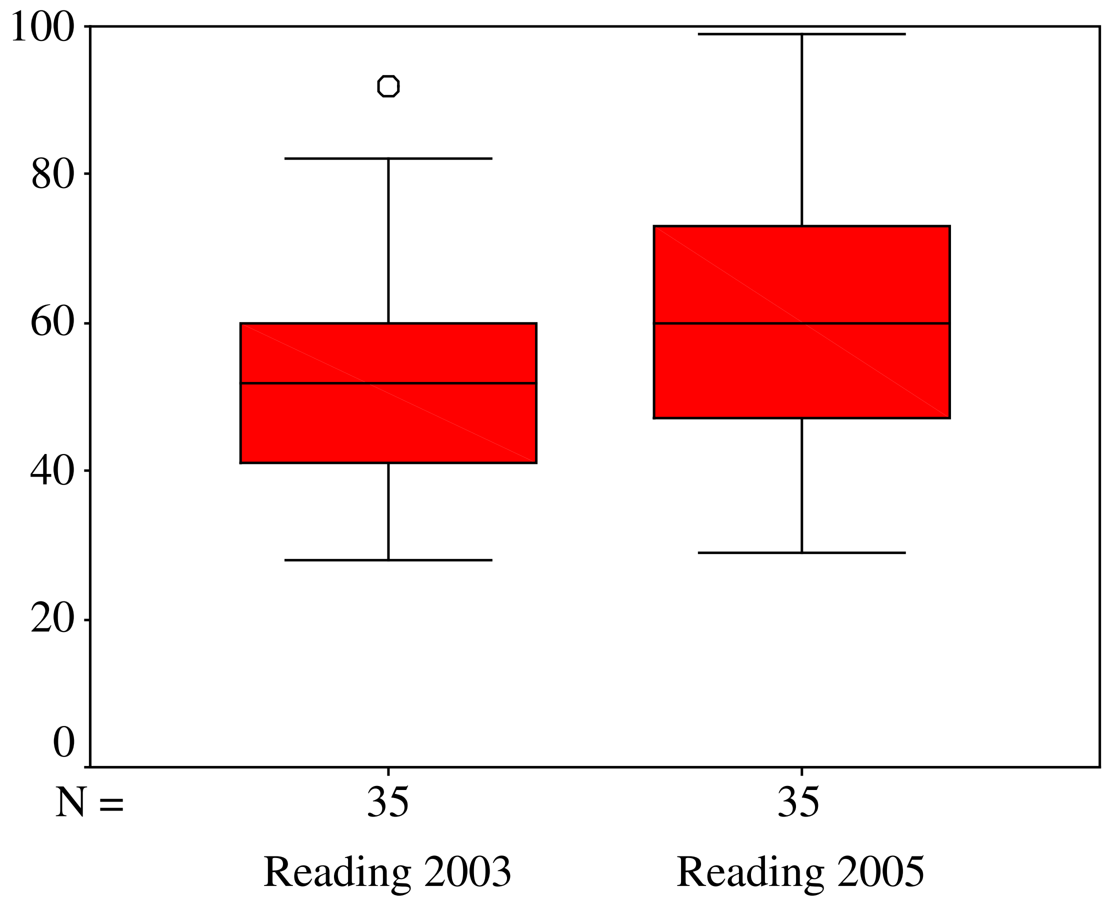

Figure 1. Boxplots for the Distribution of 2003 and 2005 Reading/Language State NCE Scores

Mathematics. A paired *t* test was conducted to evaluate whether there was a difference between the 2003 and 2005 Mathematics State NCE scores of fifth grade students who received Thinking Maps® instruction. Prior to the analysis, one-sample Kolmogorov-Smirnov tests were used to evaluate the assumptions of normality for the 2003 and 2005 scores. The null hypothesis tested by the Kolmogorov-Smirnov test is that the variable is normally distributed. The results of the Kolmogorov-Smirnov tests showed the null hypotheses for the 2003 Mathematics State NCE scores (p =.24) and the 2005 scores (p = .79) were retained. Neither variable showed a violation of the assumption of normality.

The paired *t* test for the 2003 and 2005 Mathematics State NCE scores showed there was no significant difference between the 2003 and 2005 mathematics means, $t(35) = 1.42$, $p = .17$. The mean for the 2005 mathematics scores ($M = 63.36$, $SD = 18.51$) was only 3 points higher than the mean for the 2003 mathematics scores ($M = 60.31$, $SD = 21.01$); thus, the null hypothesis is retained. The boxplots for the distributions of the 2003 and 2005 Mathematics State NCE scores are shown in Figure 2.

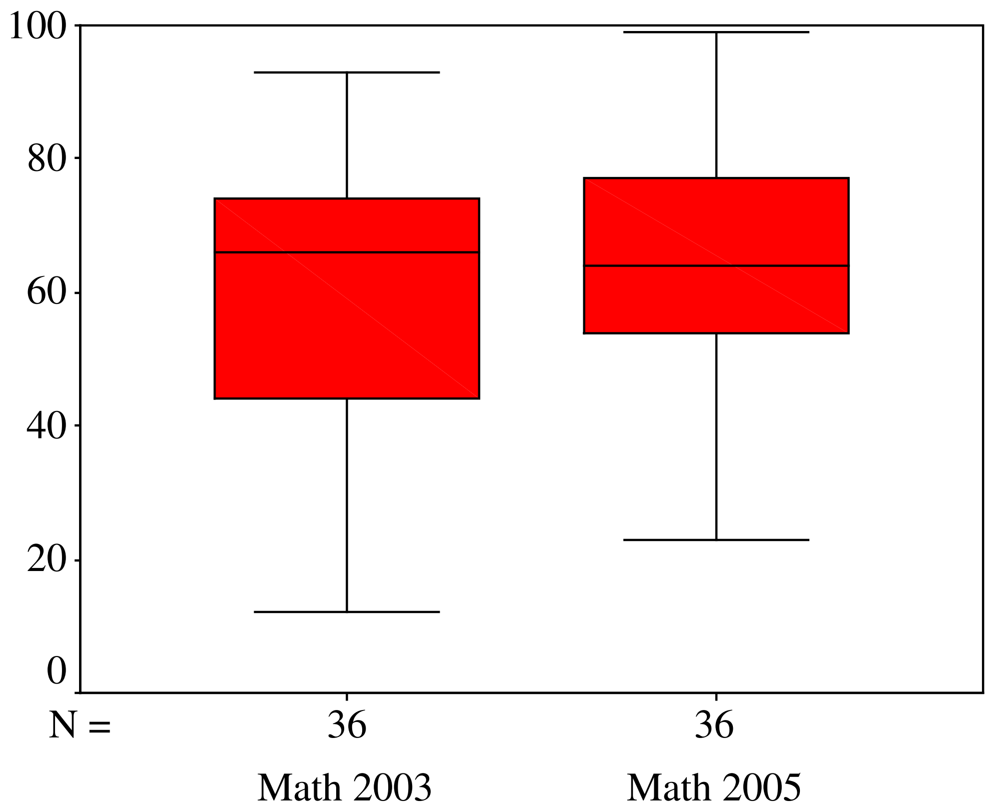

Figure 2. Boxplots for the distribution of 2003 and 2005 Mathematics State NCE Scores

Research Question #2

Were there differences in students' performance on TCAP Reading/Language State NCE scores based on school (School A and School B), gender (male and female), year (2003 and 2005), and interactions between variables? The null hypotheses are:

$Ho2_1$: There were no differences in students' performance on TCAP Reading/Language State NCE scores between School A and School B (the two treatment intervention schools).

$Ho2_2$: There were no differences in students' performances on TCAP Reading/Language State NCE scores of male and female students.

$Ho2_3$: There were no differences in students' performance on TCAP Reading/Language State NCE scores between 2003 and 2005.

$Ho2_4$: There was no two-way interaction for School by Gender.

$Ho2_5$: There was no two-way interaction for School by Year.

$Ho2_6$: There was no two-way interaction for Gender by Year.

$Ho2_7$: There was no three-way interaction for School by Gender by Year.

A three-factor repeated measures design, repeated on one factor, (three-way ANOVA) was conducted to analyze this research question. The analysis was restricted to students who received Thinking Maps® instruction (Schools A and B). The Kolmogorov-Smirnov test to check for a violation of the assumption of normality for both variables showed there was no violation of the assumption of either for Reading/Language 2003 and Reading/Language 2005. The results showed the null hypotheses for the Reading/Language 2003 State NCE scores (p=.97) and the 2005 scores (p=.85) were retained. The results of the Levene's Tests for Equality of Variances showed there was no violation of the assumption for the 2003

Reading/Language scores (*F* (3, 31) = .53, *p* = .67)) or the 2005 Reading/Language scores ((*F* (3,31) = .63, *p* = .60)).

None of the interaction terms was significant as displayed in Table 6. Therefore, it was appropriate to independently evaluate each of the three factors (main effects). The findings showed that the main effect of school was not significant, *F* (1, 31) = .21, *p* = .65. According to Cohen (1988), the operational definitions of "small," "medium," and "large" are small effect size = .01, medium effect size = .06, and large effect size = .14. The effect size for school, as measured by partial η^2, was small (.01). The main effect of gender was not significant, *F* (1, 31) = 2.97, *p* = .10. The effect size of gender was medium (.09). The main effect of year was significant, *F* (1, 31) = 21.41, *p* <.01. The effect size for year was large (.41). The effect size for school, as measured by partial η^2, was (.01). The mean for the 2005 Reading/Language scores (*M* = 60.66, *SD* = 18.08) was over eight points higher than the 2003 Reading/Language scores (*M* = 52.51, *SD* = 14.81). In conclusion, the null hypotheses for school and gender were retained while the null hypothesis for year was rejected. The means and standard deviations for the Reading/ Language scores by school, gender, and year are shown in Table 7.

Table 6

Three Factor Repeated Measures ANOVA Table for Reading/Language State NCE Scores for Schools A and B

Source	*df*	*F*	Partial η^2	*p*
		Between subjects		
School	1	.21	.01	.65
Gender	1	2.97	.09	.10
School by Gender	1	.42	.01	.52
S within-group error	31			
		Within Subjects		
Year	1	21.41	.41	<.01*.
Year by School	1	.38	.01	.54
Year by Gender	1	1.65	.05	.21
Year by School by Gender	1	.08	.01	.78
B x S within-group error	31			

*significant at the .01 level

Table 7

Descriptive Statistics for Reading/Language State NCE Scores for Schools A and B by Gender and Year

	School	Gender	*N*	*M*	*SD*
Reading 2003	A	Female	5	54.00	15.02
		Male	6	46.17	7.88
		School A Reading 2003 total	11	49.73	11.75
	B	Female	12	61.83	16.16
		Male	12	45.75	11.77
		School B Reading 2003 total	24	53.79	16.08
		Reading 2003 total	35	52.51	14.81
Reading 2005	A	Female	5	61.80	18.34
		Male	6	57.67	11.96
		School A Reading 2005 total	11	59.55	14.51
	B	Female	12	66.33	19.51
		Male	12	56.00	19.44
		School B Reading 2005 total	24	61.17	19.77
		Reading 2005 total	35	60.66	18.08

Research Question #3

Were there differences in students' performance on TCAP Mathematics State NCE scores based on school (School A and School B), gender (male and female), year (2003 and 2005), and interactions between variables? The following null hypotheses will be tested:

$Ho3_1$: There were no differences in students' performance on TCAP Mathematics State NCE scores between School A and School B (the two treatment intervention schools).

$Ho3_2$: There were no differences in students' performances on TCAP Mathematics State NCE scores of male and female students.

$Ho3_3$: There were no differences in students' performance on TCAP Mathematics State NCE scores between 2003 and 2005.

$Ho3_4$: There was no two-way interaction for School by Gender.

$Ho3_5$: There was no two-way interaction for School by Year.

$Ho3_6$: There was no two-way interaction for Gender by Year.

$Ho3_7$: There was no three-way interaction for School by Gender by Year interaction.

A three-factor repeated measures design, repeated on one factor, (three-way ANOVA) was conducted to analyze this research question. The analysis was restricted to students who received Thinking Maps® instruction (Schools A and B). The Kolmogorov-Smirnov test to check for a violation of the assumption of normality for both variables showed there was no violation of the assumption of either for Mathematics 2003 and Mathematics 2005. The results showed the null hypotheses for the Mathematics 2003 State NCE scores (p=.24) and the 2005 scores (p=.79) were retained. The results of the Levene's Tests for Equality of Variances showed there was no violation of the assumption for the 2003 Mathematics scores (F (3, 32) = .29, p = .83)) or the 2005 Mathematics scores ((F (3, 32) = .10, p = .96)).

As shown in Table 8, none of the interaction terms was significant. Therefore, it was appropriate to independently evaluate each of the three factors (main effects). The findings showed that the main effect of school was not significant, F (1, 32) = .77, p = .39. The effect size for school, as measured by partial η^2, was small (.02). The main effect of gender was not significant, F (1, 32) = .40, p = .53. The effect size of gender was small (.01). The main effect of year was not significant, F (1, 32) = 2.65, p =.11. The effect size for year was medium (.08). The mean for the 2005 Mathematics scores (M = 63.36, SD = 18.51) was only 3 points higher than the 2003 Mathematics scores (M = 60.31, SD = 21.01). In conclusion, the null hypotheses for school, gender, and year were retained. The means and standard deviations for the Mathematics scores by school, gender and year are shown in Table 9.

Table 8

Three Factor Repeated Measures ANOVA Table for Mathematics State NCE Scores for School A and B

Source	*df*	*F*	Partial η^2	*p*.
	Between subjects			
School	1	.77	.02	.39
Gender	1	.40	.01	.53
School by Gender	1	.67	.02	.42
S within-group error	32			
	Within subjects			
Year	1	2.65	.08	.11
Year by School	1	.23	.01	.64
Year by Gender	1	.02	<.01	.90
Year by School by Gender	1	4.13	.11	.06
B x S within group error	32			

Table 9

Descriptive Statistics for Mathematics State NCE Scores for Schools A and B by School and Gender

	School	Gender	*N*	*M*	*SD*
Math 2003	A	Female	5	60.60	16.16
		Male	7	66.14	23.15
		School A Math 2003 total	12	63.83	19.89
	B	Female	12	65.83	21.84
		Male	12	51.25	19.89
		School B Math 2003 total	24	58.54	21.75
		2003 Math total	36	60.31	21.01
Math 2005	A	Female	5	69.60	16.53
		Male	7	66.57	18.20
		School A Math 2005 total	12	67.83	16.81
	B	Female	12	63.58	19.01
		Male	12	58.67	20.02
		School B Math 2005 total	24	61.12	19.26
		2005 Math total	36	63.36	18.51

Research Question #4

Were there differences in students' performance on TCAP Reading/Language State NCE scores based on school (School B [a treatment intervention site] and School C [a control site]), gender (male and female), year (2003 and 2005), and interactions between variables? The null hypotheses for this research question are:

$Ho4_1$: There were no differences in students' performance on TCAP Reading/Language State NCE scores between School B and School C.

$Ho4_2$: There were no differences in students' performances on TCAP Reading/Language State NCE scores of male and female students.

$Ho4_3$: There were no differences in students' performance on TCAP Reading/Language State NCE scores between 2003 and 2005.

$Ho4_4$: There was no two-way interaction for School by Gender.

$Ho4_5$: There was no two-way interaction for School by Year.

$Ho4_6$: There was no two-way interaction for Gender by Year.

$Ho4_7$: There was no three-way interaction for School by Gender by Year interaction.

A three-factor repeated measures design, repeated on one factor, (three-way ANOVA) was conducted to analyze this research question. The analysis was restricted to students at School B who received Thinking Maps® instruction and students at School C who did not receive Thinking Maps® instruction. The Kolmogorov-Smirnov test to check for a violation of the assumption of normality for both variables showed there was no violation of the assumption of either for Reading/Language 2003 and Reading/Language 2005. The results showed the null hypotheses for the Reading/Language 2003 State NCE scores (p=.96) and the 2005 scores (p=.97) were retained. The results of the Levene's Tests for Equality of Variances showed there was no violation of the assumption for the 2003 Reading/Language scores (F (3, 50) = .76, p = .52)) or the 2005 Reading/Language scores ((F (3, 50) = .20, p = .90)).

As shown in Table 10 the two-way interaction for Year by School was significant. Significant interaction means the effect of a given factor on the dependent variable varies by levels of another factor in the model. In other words, a factor involved in the interaction should not be evaluated in isolation of the other factor. Instead, tests of simple effects should be performed. However, because none of the interaction terms involving Gender was significant, the main effect of Gender was evaluated. Gender was not significant, F (1, 50) = 3.47, p = .07. The effect size was medium (.07). The null hypothesis for Gender was retained.

Table 10

Three Factor Repeated Measures ANOVA Table for Reading/Language States NCE Scores for Schools B and C

Source	*df*	*MS*	*F*	Partial η^2	*p*
		Between subjects			
School	1	5.90	.01	<.00	.92
Gender	1	2053.90	3.47	.07	.07
School by Gender	1	443.88	.75	.02	.39
B within-group error	50	590.65			
		Within subjects			
Year	1	25.26	.32	.01	.57
Year by School	1	1026.71	13.12	.21	<.01*
Year by Gender	1	142.50	1.82	.04	.18
Year by School by Gender	1	6.32	.08	<.01	.78
B x S within-group error	50	78.24			

*significant at the .01 level

The two-way interaction term for Year by School was significant, F (1, 50) = 13.12, p <.01. Therefore, two sets of tests of simple effects were performed. The first set compared the difference between School B and C for each year, while the second set compared the years for each school.

The appropriate error term for testing a between subjects factor (School) at each level of the repeated factor (Year) is the pooled mean of the $MS_{error\ (between)}$ and the $MS_{error\ (within)}$. (Winer, 1971, p. 563). {$MS_{error\ (between)}$ + (r-1) $MS_{(within)}$] / *r* where *r* is the number of levels of the repeated factor. In this case, $r = 2$ (2 years). Therefore, the appropriate error term for the tests of simple effects of School for each year is

$$[MS_{error(between)} + (r\text{-}1)\ MS_{(within)}] / r$$

$$= 590.646 + [\ (2\text{-}1)\ 78.235]$$

= 334.441 with 50 degrees of freedom.

In the first set of tests, the test of the simple main effect of School for the 2003 Reading/Language scores was not significant, $F\ (1, 50) = 2.54$, $p = .12$. In addition, there was no difference between the 2005 Reading/Language means of School B and C, $F\ (1, 50) = 1.16$, $p = .29$. However, although neither of these tests of simple effects showed differences between School B and C for either 2003 or 2005, the nature of the interaction was revealed in the second set of tests of simple effects: the mean comparisons of 2003 and 2005 Reading/Language means for each school.

The appropriate error term for testing a repeated measures factor (Year) for each level of a between subjects fixed factor (School) is the $MS_{error\ (within)}$. (Winer, 1971, p. 563). As shown in table 10 the $MS_{error\ (within)}$, was 78.235 with 50 degrees of freedom.

The result of the test of simple effect for the difference between the 2003 and 2005 reading scores for School B was significant, $F(1, 50) = 8.35$, $p < .01$. For School B the mean for the 2005 Reading/Language scores ($M = 61.17$, $SD = 19.77$) was over seven points higher than the mean for 2003 (M = 53.79, SD = 16.08). The result of the test of simple effect for the difference between the 2003 and 2005 Reading/Language Arts scores for School C was significant, F (1,50) = 6.90, p = .01. However, for School C, the 2005 Reading/Language mean (M = 55.77, SD = 19.14) was six points lower than the mean for 2003 (M = 61.77, SD = 18.97). The line graph depicting the year by school interaction is shown in figure 3. The means and standard deviations for the 2003 and 2005 Reading/Language NCE scores by gender for Schools B and C are shown in Table 11.

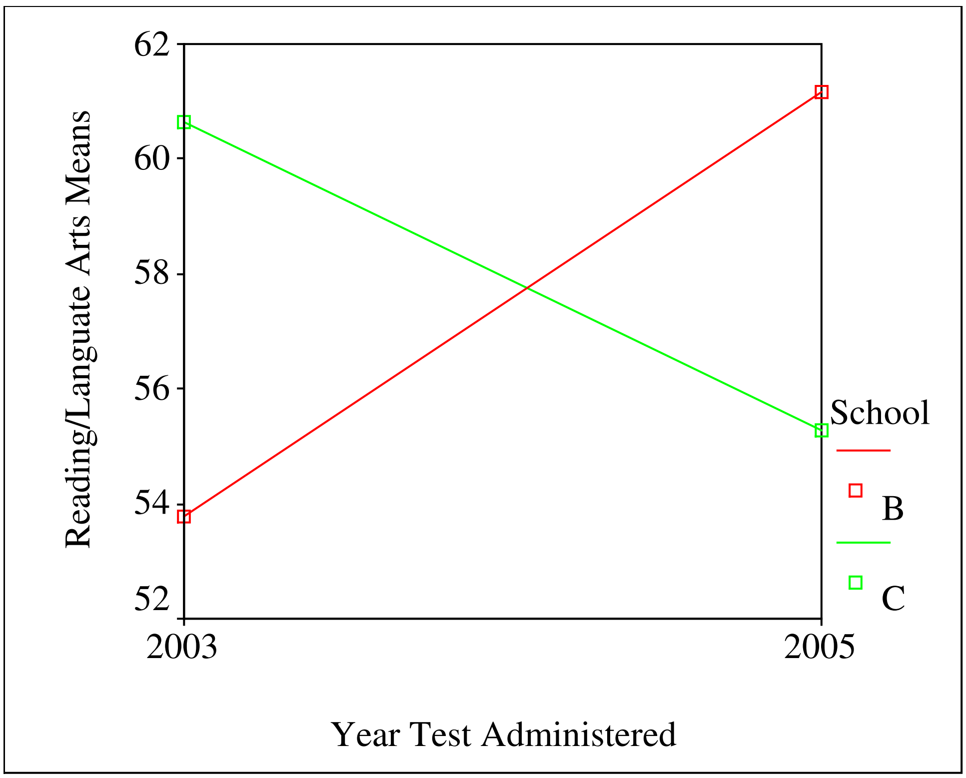

Figure 3. Line Graph for Reading/Language State NCE Means for 2003 and 2005 by Schools B and C

Table 11

Descriptive Statistics for Reading/Language State NCE Scores for Schools B and C by Gender and Year

	School	Gender	*N*	*M*	*SD*
Reading 2003	B	Female	12	61.83	16.16
		Male	12	45.75	11.77
		School B Reading 2003 total	24	53.79	16.08
	C	Female	20	64.00	18.97
		Male	10	57.30	19.14
		School C Reading 2003 total	30	61.77	18.97
		Reading 2003 total	54	58.22	18.03
Reading 2005	B	Female	12	66.33	19.51
		Male	12	56.00	19.44
		School B 2005 Reading total	24	61.17	19.77
	C	Female	20	56.75	20.02
		Male	10	53.80	18.13
		School C 2005 Reading total	30	55.77	19.14
		Reading 2005 total	54	58.17	19.43

Research Question #5

Were there differences in students' performance on TCAP Mathematics State NCE scores based on school (School B [a treatment intervention site] and School C [a control site]), gender (male and female), year (2003 and 2005), and interactions between variables?

To answer this research question, the null hypotheses are:

$Ho5_1$: There were no differences in students' performance on TCAP Mathematics State NCE scores between School B and School C.

$Ho5_2$: There were no differences in students' performances on TCAP Mathematics State NCE scores of male and female students.

$Ho5_3$: There were no differences in students' performance on TCAP Mathematics State NCE scores between 2003 and 2005.

$Ho5_4$: There was no two-way interaction for School by Gender.

$Ho5_5$: There was no two-way interaction for School by Year.

$Ho5_6$: There was no two-way interaction for Gender by Year.

$Ho5_7$: There was no three-way interaction for School by Gender by Year interaction.

A three-factor repeated measures design, repeated on one factor, (three-way ANOVA) was conducted to analyze this research question. The analysis was restricted to students at School B who received Thinking Maps® instruction and students at School C who did not receive Thinking Maps® instruction. The Kolmogorov-Smirnov test to check for a violation of the assumption of normality for both variables showed there was no violation of the assumption of either for Mathematics 2003 and Mathematics 2005. The results showed the null hypotheses for the Mathematics 2003 State NCE scores (p=.91) and the 2005 scores (p=.98) were retained. The results of the Levene's Tests for Equality of Variance showed there was no violation of the assumption for the 2003 Mathematics scores (F (3, 51) = .12, p = .95)) or the 2005 Mathematics scores ((F (3, 51) = .22, p = .88)).

As shown in Table 12, none of the interaction terms was significant. Therefore, it was appropriate to independently evaluate each of the three factors (main effects). The findings showed that the main effect of school was not significant, F (1, 51) = .43, p = .51. The effect size for school, as measured by partial η^2, was small (<.01). The main effect of gender was not significant, F (1, 51) = .97, p = .33. The effect size of gender was small (.02). The main effect of year was not significant, F (1, 51) = 1.45, p =.23. The effect size for year was small (.03). The mean for the 2005 Mathematics scores (M = 59.05, SD = 18.33) was slightly over 2 points higher than the 2003 Mathematics scores (M = 56.91, SD = 19.57). In conclusion, the null hypotheses for school, gender and year were retained. The means and standard deviations for the Mathematics scores by school, gender and year are shown in Table 13.

Table 12

Three Factor Repeated Measures ANOVA Table for Mathematics State NCE Scores for Schools B and C

Source	*df*	*F*	Partial η^2	*p*
		Between subjects		
School	1	.43	<.01	.51
Gender	1	.97	.02	.33
School by Gender	1	.89	.02	.35
S within-group error	51			
		Within subjects		
Year	1	1.45	.03	.23
Year by School	1	.08	<.01	.78
Year by Gender	1	1.49	.03	.23
Year by School by Gender	1	2.45	.05	.12
B x S within-group error	51			

Table 13

Descriptive Statistics for Mathematics State NCE Scores for Schools B and C by Gender and Year

	School	Gender	*N*	*M*	*SD*
Math 2003	B	Female	12	65.83	21.84
		Male	12	51.25	19.89
		School B Math 2003 total	24	58.54	21.75
	C	Female	21	55.52	17.86
		Male	10	55.90	19.20
		School C Math 2003 total	31	55.65	17.98
		2003 Math total	55	56.91	19.57
Math 2005	B	Female	12	63.58	19.01
		Male	12	58.67	20.02
		School B Math 2005 total	24	61.12	19.26
	C	Female	21	57.71	16.54
		Male	10	56.90	20.96
		School C Math 2005 total	31	57.45	17.73
		2005 Math total	55	59.05	18.33

Summary

The results of data collected are presented in Chapter 4 with accompanying analyses. A paired *t* test was conducted to determine if significant differences existed between the 2003 and 2005 State NCE scores in Reading/Language and Mathematics for students after 2 years of Thinking Maps® implementation and instruction. The tests showed there was a significant difference for the Reading/Language means but not a significant difference for the Mathematics means. The Reading/Language mean for 2005 was higher than the 2003 mean.

In examining differences between the two treatment schools (Schools A and B), gender, and the 2003 and 2005 Reading Language State NCE scores, a three-factor repeated measures design, repeated on one factor (three-way ANOVA) was conducted. None of the interaction terms were significant, nor did the findings show significance for the main effect of school or gender. The main effect for year was significant with the effect size being large (.41). The Reading/Language mean for 2005 was higher than the mean for 2003. For the Mathematics State NCE scores, a three-factor repeated measures design, repeated on one factor was also conducted. The findings showed there was no significant interaction between school, gender and year. The main effects of school, gender, and year were not significant either.

Again using a three-factor repeated measures design, difference were examined between a treatment school (School B) and the control school (School C), gender, and the 2003 and 2005 Reading/Language State NCE scores and the Mathematics State NCE scores. These schools had similar percentages of student populations who are economically disadvantaged. In Reading/Language, the two-way interaction for Year by School was significant. The findings of the tests of simple effect for the differences between the 2003 and 2005 Reading/Language scores for School B were significant with the mean for the 2005 Reading/Language scores over seven points higher than the mean for 2003. The findings of the tests of simple effect for the differences between the 2003 and 2005 Reading/Language scores for School C were also significant. However, for School C, the 2005 Reading/Language mean was six points lower than the mean for 2003. None of the interaction terms involving Gender was significant, and the main effect of Gender was not significant. Differences were examined between the treatment school (School B) and the control school (School C), gender, and the 2003 and 2005 Mathematics State NCE scores. None of the interaction terms was significant. The main effects for school, gender, and year were not significant either.

Chapter 5 presents an analysis of the results of the study, a summary of the study, and findings associated with each research question. Chapter 5 also includes a summary of the conclusions drawn from the study as well as recommendations for future study.

CHAPTER 5

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to determine what, if any, associations existed between the implementation of the Thinking Maps® program in fifth grade students' Reading/Language and Mathematics achievement on the TCAP Achievement Test. The focus of the analysis was on the Reading/Language and Mathematics scores of fifth students who had had Thinking Maps® instruction for 2 years as compared to fifth grade students who had not had Thinking Maps® instruction. All the participants in the study were in one northeast Tennessee school system in three Title I elementary schools. State NCE scores provide a longitudinal comparison of scores for growth purposes. Test scores of students who received Thinking Maps® instruction were analyzed to determine growth in Reading/Language and Mathematics. In addition, the scores of the fifth grade students in the two treatment schools were examined because of the large percentage difference of economically disadvantaged student populations in the three schools. Using analytical procedures, comparisons were made between participation and nonparticipation in the Thinking Maps® program, gender, school, and year.

Summary of Findings

The analysis focused on five research questions. Independent variables involved in this study were the participation and nonparticipation in the Thinking Maps® Program, gender, school, and year. The dependent variables were the State NCE scores reported for third grade students in 2003 and the same students as fifth grade students in 2005. The population consisted of 67 students from three Title I elementary schools. Each student attended the same elementary school for the 2002-2003, 2003-2004, and the 2004-2005 school year. An attendance rate of the 75% was required for the 2003-2004 and 2004-2005 school years (treatment years) for participation in the study. The test scores of students of special education status were omitted from the study.

Research Question #1

Was there a difference between the 2003 and 2005 TCAP Reading/Language and Mathematics State NCE scores of fifth grade students who received Thinking Maps® instruction?

A paired *t* test was conducted to evaluate whether there was a difference between the 2003 and 2005 Reading/Language State NCE scores of fifth grade students who received Thinking Maps® instruction (Schools A and B). The findings showed that there were significant differences between the 2003 and 2005 reading means. The mean for 2005 (*M*=60.66) was over eight points higher than the mean for the 2003 reading scores (*M*=52.51). However, for the 2003 and 2005 Mathematics State NCE scores, the paired *t* test findings showed there was no significant difference between the 2003 and 2005 Mathematics means. The 2005 Mathematics mean (*M*=63.36) was only three points higher than the 2003 Mathematics mean (*M*=60.31).

Research Question # 2

Were there differences in students' performance on TCAP Reading/Language State NCE scores based on school (School A and School B), gender (male and female), year (2003 and 2005), and interactions between variables?

A three-factor repeated measures design, repeated on one factor (three-way ANOVA) was conducted to analyze the differences between the two treatment schools (Schools A and B), gender, and the 2003 and 2005 Reading/Language State NCE scores. The analysis was restricted to students who received Thinking Maps® instruction for 2 years. In the year 2003, School A had a student population of 80.0 % categorized as economically disadvantaged and School B had a student population of 63.0 % categorized as economically disadvantaged, a difference of 17%.. In the year 2005, School A had a student population of 83.5% categorized as economically disadvantaged and School B had a student population of 70.8% categorized as economically disadvantaged, a difference of approximately 13%. None of the interaction terms of school, gender, and year was significant. The findings showed that the main effects of school and gender were not significant. The effect size for school was small (.01) and the effect size for gender was medium (.09). However, the main effect of year was significant with the effect size for year medium (.41). The mean for the 2005 Reading/Language scores (*M*=60.66) was over eight points higher than the 2003 Reading/Language scores (*M*=52.51). The null hypotheses for school and gender were retained while the null hypothesis for year was rejected.

Research Questions # 3

Were there differences in students' performance on TCAP Mathematics State NCE scores based on school (School A and School B), gender (male and female), year (2003 and 2005), and interactions between variables?

A three-factor repeated measures design, repeated on one factor (three-way ANOVA) was conducted to analyze the differences between the two treatment schools (Schools A and B), gender, and the 2003 and 2005 Mathematics State NCE scores. The analysis was restricted to students who received Thinking Maps® instruction for 2 years. In the year 2003, School A had a student population of 80.0 % categorized as economically disadvantaged and School B had a student population of 63.0 % categorized as economically disadvantaged, a difference of 17%.. In the year 2005, School A had a student population of 83.5% categorized as economically disadvantaged and School B had a student population of 70.8% categorized as economically disadvantaged, a difference of approximately 13%.

None of the interaction terms of school, gender, and year was significant. The findings showed that the main effect of school was not significant, the main effect of gender was not significant, and the main effect of year was not significant. The effect size for school was small (.02) and the effect size for gender was small (.01). The effect size for year was medium (.08). The mean for the 2005 Mathematics scores (M=63.36) was only 3 points higher than the 2003 Mathematics scores (M=60.31). Therefore, the null hypotheses for school, gender, and year were retained.

Research Question # 4

Were there differences in students' performance on TCAP Reading/Language State NCE scores based on school (School B [a treatment intervention site] and School C [a control site]), gender (male and female), year (2003 and 2005), and interactions between variables?

A three-factor repeated measures design, repeated on one factor, was conducted to analyze this research question. The analysis was restricted to students at School B who received Thinking Maps® instruction for 2 years and students at School C who did not receive Thinking Maps® instruction for 2 years. The percentage of students categorized as economically disadvantaged is similar for each of these schools for both the 2002-2003 and 2004-2005 school years. In the year 2003, School B had a student population of 63.0 % categorized as economically disadvantaged and School C had a student population of 62.4 % categorized as economically disadvantaged, a difference of less than one percent. In the year 2005, School B had a student population of 70.8% categorized as economically disadvantaged and School C had a student population of 70.5% categorized as economically disadvantaged, a difference less than three tenths of a percent.

The findings of the study showed that the two-way interaction for Year by School was significant. However, none of the interaction terms involving Gender was significant nor was the main effect of Gender significant. The effect size for Gender was medium (.07). Because the two-way interaction for Year by school was significant, two sets of tests of simple effects were performed. The first set compared the difference between School Band C for each year, while the second set compared the years for each school. The findings of the first set showed that the test of the simple main effect of School for the 2003 Reading/Language scores was not significant. There was also no difference between the 2005 Reading/Language means of Schools B and C. Even though neither of these tests of simple effects showed differences between Schools B and C, the interaction was demonstrated in the second set of tests of simple effects, the mean comparison of 2003 and 2005 Reading/Language means for each school. The findings of these tests of simple effect for the differences between the 2003 and 2005 Reading/Language scores for School B and School C were significant. The mean for the 2005 Reading/Language scores (M=61.17) was over seven points higher than the mean for 2003 Reading/Language scores (M = 53.79) for School B. However, for School C, the 2005 Reading/Language mean (M = 55.77) was six points lower than the mean for 2003 (M = 61.77)..

Research Question # 5

Were there differences in students' performance on TCAP Mathematics State NCE scores based on school (School B [a treatment intervention site] and School C [a control site]), gender (male and female), year (2003 and 2005), and interactions between variables?

A three-factor repeated measures design, repeated on one factor, was conducted to analyze this research question. The analysis was restricted to students at School B who received Thinking Maps® instruction for 2 years and students at School C who did not receive Thinking Maps® instruction for 2 years. The percentage of students categorized as economically disadvantaged is similar for each of these schools for both the 2002-2003 and 2004-2005 school years. In the year 2003, School B had a student population of 63.0 % categorized as economically disadvantaged and School C had a student population of 62.4 % categorized as economically disadvantaged, a difference of less than one percent. In the year 2005, School B had a student population of 70.8% categorized as economically disadvantaged and School C had a student population of 70.5% categorized as economically disadvantaged, a difference less than three tenths of a percent.

The findings from the analysis of this research question showed that none of the interaction terms was significant nor was any of the three main effects of school, year, or gender significant. The effect size for school was small (.01). The effect size for gender was small (.02) and the effect size for year was small (.03). The mean for the 2005 Mathematics scores (M = 59.05) was only slightly over 2 points higher that the 2003 Mathematics mean (M = 56.91).

Conclusions

Based on the analysis and findings of this study, implementing the Thinking Maps® program in the whole school approach appears to have been a successful step in improving student achievement in the area of Reading/Language but not in Mathematics. With the passage of the *No Child Left Behind Act of 2001,* it is vital for schools and systems to use the most effective programs possible. The Thinking Maps® program appears to have improved achievement in the areas of Reading/Language at the elementary level. The following conclusions emerged from this study:

Conclusion # 1

Based on findings from the study there appears to be a positive relationship between participation in Thinking Maps® for 2 years and Reading/Language achievement.

Reading/Language State NCE scores showed a significant difference between the 2003 and 2005 reading means.

Conclusion # 2

The implementation of the Thinking Maps® program does not appear to statistically reduce differences in test performance in the area of Mathematics for students after 2 years of participation in the Thinking Maps® program. The State NCE mean for the 2005 Mathematics scores was only slightly higher than the mean for the 2003 Mathematics scores. Nor does the implementation of the Thinking Maps® program appear to statistically reduce differences in test performance in the area of Mathematics for students after 2 years of participation in the Thinking Maps® program as compared to students in a school with a similar economically disadvantaged student population who did not participate in the Thinking Maps® program.

Conclusion # 3

Based on the findings of the study, it does not appear that the implementation of the Thinking Maps® program for 2 years affects different student populations more positively for one over the other. The students from the school with a higher percentage of students classified as economically disadvantaged did no better or worse in test performance levels in Reading/Language and Mathematics than the students from the school with a lower percentage of students classified as economically disadvantaged. In other words, the Thinking Maps® program does not appear to benefit one group over the other.

Conclusion # 4

Based on findings from the study there were no statistical differences in students' test performance levels in Reading/Language or Mathematics at the two treatment schools or the control school based on gender.

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Conclusion # 5

Based on the findings from the study, there appears to be a positive relationship between participation in the Thinking Maps® program for 2 years and Reading/Language test performance as compared to students in a school with a similar economically disadvantaged student population who did not participate in the Thinking Maps® program. Noted increases in the Reading/Language mean of State NCE scores were observed in Reading/Language for students who had participated in the Thinking Maps® program. Noted decreases in the Reading/Language mean of State NCE scores were observed in Reading/Language for students who had not participated in the Thinking Maps® program.

Recommendations for Practice

This study provided support to the claims of the Thinking Maps® program regarding increased student achievement in the area of Reading/Language. The following are recommendations for practice:

1. The continuation of using the Thinking Maps® program in the two treatment schools in the school system that participated in the study. The findings of the study showed that there were significant differences between the 2003 and 2005 reading means after 2 years of Thinking Maps® implementation.

2. Other schools within the participating system should consider the adoption of the Thinking Maps® program for Reading/Language. The findings of the study showed that there were significant differences between the 2003 and 2005 reading means after 2 years of Thinking Maps® implementation for the two schools which implemented the Thinking Maps® program..

3. Other school systems should consider the use of the Thinking Maps® program for implementation for Reading/Language. The findings of the study showed that there were significant differences between the 2003 and 2005 reading means after 2 years of Thinking Maps® implementation for the two schools which implemented the Thinking Maps® program.

4. A consistency of training and implementation of the program over time should be established in order to insure the delivery of the Thinking Maps® program in an equal manner to all participants.

Recommendations for Further Research

The data did demonstrate a significant association between Thinking Maps® implementation and Reading/Language achievement but not in Mathematics. No conclusions can be drawn about the interaction between gender and Thinking Maps implementation. The following recommendations are provided for the researcher interested in following up on the findings of this study:

1. Replication of this study in another school system. This study was conducted in a northeast Tennessee school system in three Title I elementary schools. It could be replicated in another northeast Tennessee school system in Title I elementary schools to see if the findings are similar.

2. Replication of this study using a larger population size. Sixty-seven students' scores were examined in this study. A larger population might present different findings.

3. Further longitudinal investigations analyzing more than 2 years of data. This study analyzed data after 2 years of Thinking Maps® implementation. Analyzing data after more than 2 years of Thinking Maps® implementation in a longitudinal study might present different findings. An extended longitudinal investigation would allow the researcher to examine if the effects persist in the area of Mathematics.

4. Further longitudinal investigations analyzing more than 2 years of data. This study analyzed data after 2 years of Thinking Maps® Maps implementation. An analysis of student test data of students at the middle school level who had participated in the Thinking Maps® program during their elementary years would provide a more thorough analysis of longitudinal data.

5. Qualitative research approaches should be conducted to evaluate teachers', parents', administrators', and students', perceptions of the Thinking Maps® program and its impact on student achievement. Numerous comments about the Thinking Maps program from teachers, students, parents, and administrators have been made to the researcher. A study focusing on the perceived impact of the Thinking Maps program would be appropriate.

6. Implementation of a study to determine whether Thinking Maps® are implemented at the same level for both Reading/Language and Mathematics in schools.

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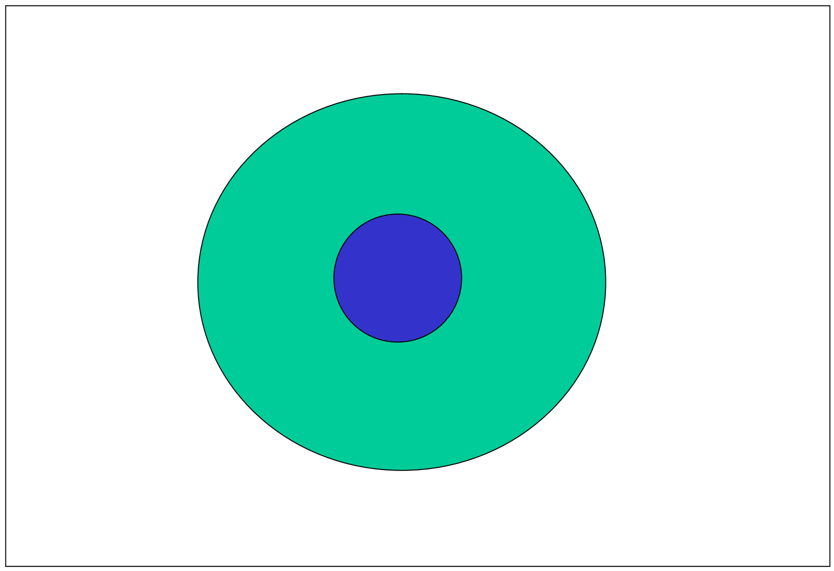
APPENDICES

APPENDIX A

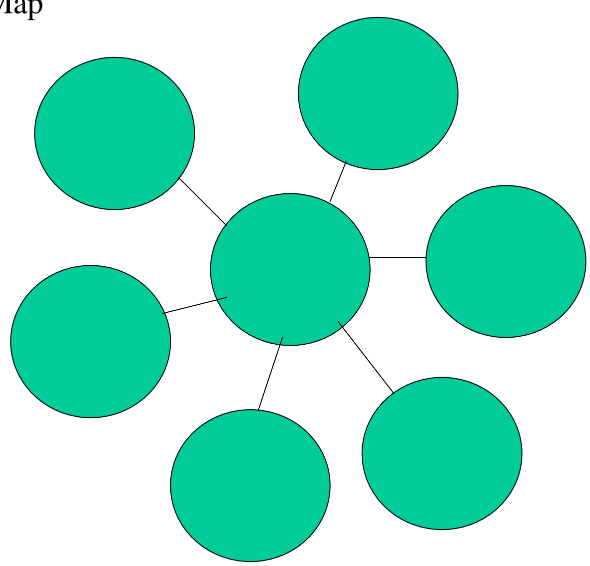
Eight Thinking Maps®

Circle Map and Frame Name ________



Circle Map for Defining in Context * Frame for Frame of Reference

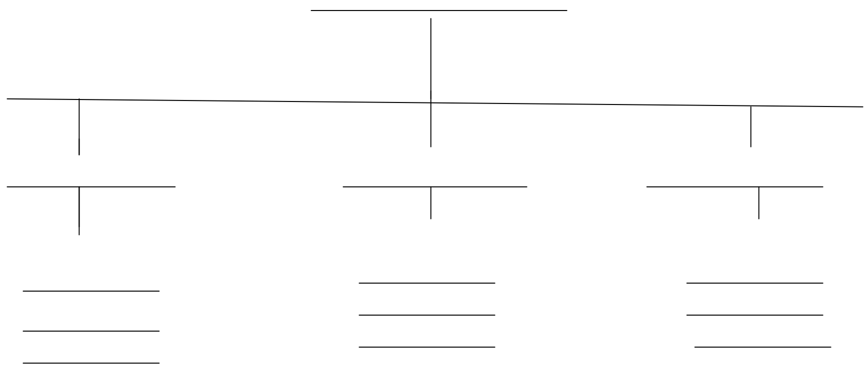
Bubble Map Name __________



Bubble Map for Describing Using Adjectives and Adjective Phrases

Tree Map

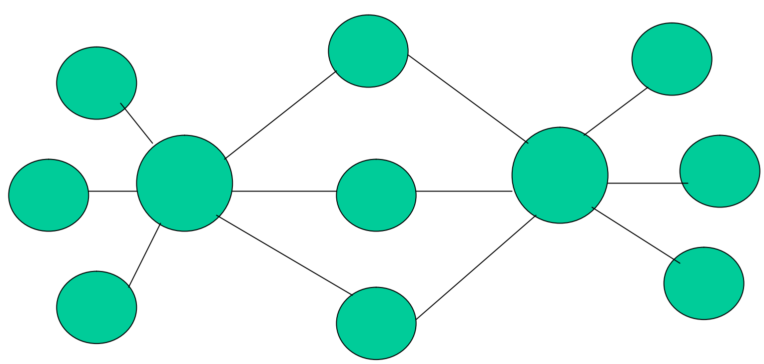
Name ____________



Tree Map for Classifying and Grouping Main Idea, Supporting Ideas, and Details

Double Bubble Map

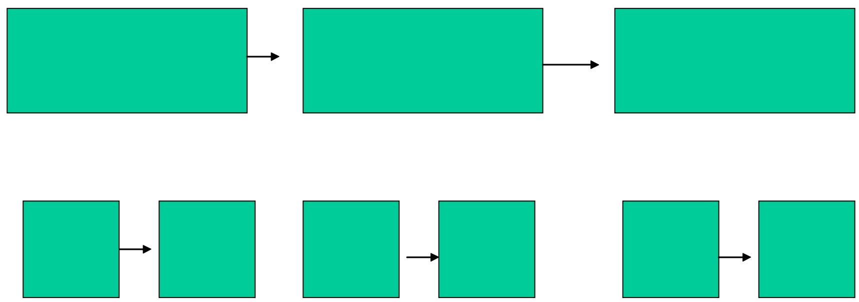
Name ___________



Double Bubble Map for comparing (similarities) and contrasting (differences)

Flow Map

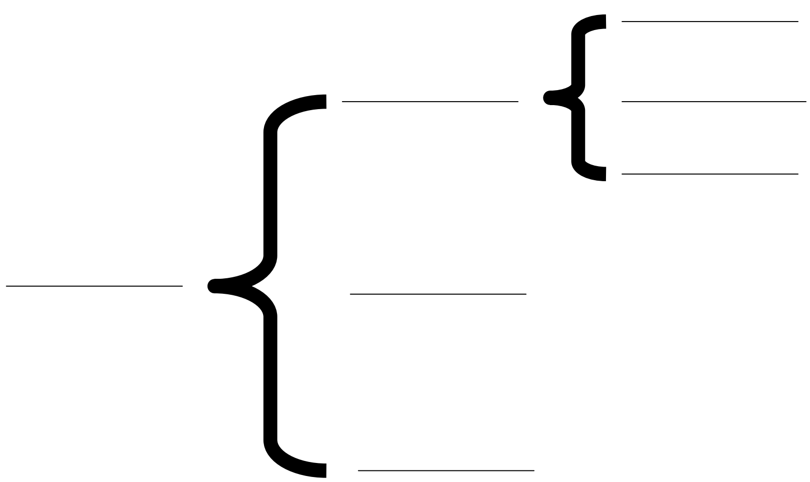
Name ___________



Flow Map for Sequencing Stages and Substages of Events

Brace Map

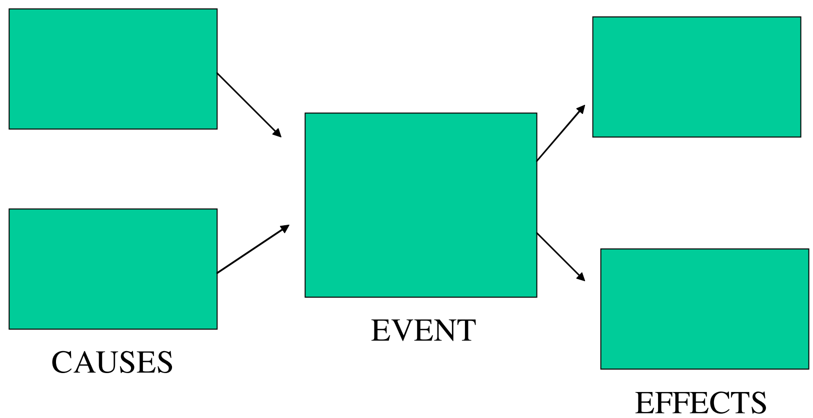
Name ___________



Brace Map for Physical Analysis of Whole, Parts, and Subparts of Objects

Multi-Flow Map

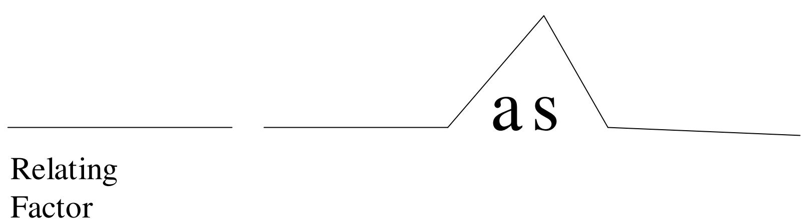
Name ___________



Multi-Flow Map for Causes and Effects

Bridge Map

Name ____________



Bridge Map for Seeing Analogies (similar relationships between ideas)

APPENDIX B

Letter to the Director of Schools

728 Maryland Avenue
Bristol, Tennessee 37620
MM/DD/YYYY

Dear ____________________________,
(Director of Schools)

As a student at East Tennessee State University, I am currently involved in the dissertation phase of the Educational Leadership and Policy Analysis doctoral program. My dissertation, *An Examination of Student Performance on Standardized Assessments in Reading/Language and Mathematics after 2 Years of Thinking Maps® Implementation in 3 Tennessee Schools,* will explore the association between Thinking Maps® implementation and instruction and student achievement in 3 Title I elementary schools.

I would like your permission to access and utilize non-identifiable State NCE scores on the TCAP Achievement Test from the years 2002-2003 and 2004-2005 for the students selected for the study. Random numbers will be used to protect the identity of all participants.

In preparation for the study, I will contact the Director of Federal Projects of your school system and arrange for the collection of all necessary data with a minimum of disruption.

I believe the results of my study will be helpful in providing valuable data regarding the possible impact of Thinking Maps® instruction and use on student achievement. Upon completion, I will be happy to share the results of the study with you.

I have included a self-addressed, stamped envelope so that you may return this form to me. Thank you for your cooperation. If you have any further questions, please do not hesitate to call me at ###-###-####.

Sincerely,

Katharine M. Hickie

Enclosure

Permission is hereby granted to Katharine M. Hickie to access and use 2002-2003 TCAP scores for students in grade 3 and 2004-2005 TCAP scores for students in grade five in the 3 Title I elementary schools.

____________________________________ ____________________________

Signature Date

VITA

KATHARINE MABIE HICKIE

Personal Data:	Date of Birth: July 3, 1947
	Place of Birth: Pittsfield, Massachusetts
	Marital Status: Married
Education:	Furman University, Greenville, South Carolina; Elementary Education, B.A., 1969
	Georgia State University, Atlanta, Georgia; Elementary Education, M.Ed., 1972
	East Tennessee State University, Johnson City, Tennessee, Educational Leadership, Ed.D., 2006
Professional Experience:	Teacher, Rehoboth Elementary School, DeKalb County Schools, Atlanta, Georgia, 1969-1974
	Teacher, Douglass Elementary School, Bristol Virginia Public Schools, 1974-1976
	Teacher, St. Anne's Catholic School, Bristol, Virginia, 1983-1992
	Program Director, St. Anne's Summer Enrichment Program, Bristol, Virginia, 1991 and 1992
	Program Director, King Scholars Summer Academy, King College, Bristol, Tennessee, 1992 and 1993
	Teacher, Central Elementary School, Bristol Tennessee City Schools, 1992-2004
	Teacher, Vance Middle School, Bristol Tennessee City Schools, 2004-2006