CHAPTER III

METHODOLOGY

Setting

A quasi-experimental study was conducted using data collected from two elementary schools located within a large school division in the southeastern portion of Virginia. This largely suburban school division of 42 individual schools was comprised of approximately 36,000 students in grades K-12. Two elementary schools in the division, designated School A and School B for purposes of this study, have enrollments of 500 and 600 students respectively. School A served grades 3-5 while School B housed grades K-5.

In examining the demographics between the two schools, the researcher selected the two schools as sites for this study because of their comparatively similar student composition. Both School A and School B were located in adjacent school attendance zones in the same section of the city.

According to the school division's records, the free and reduced-price lunch population of School A was 69%. School B had a free and reduced lunch population of 89%. Census information (1990) indicated that the student populations were very similar in demographic composition. The median household income of a student in School A was $25,455.00, the figure in School B was $16, 061 (1990 U.S. Census). Both schools were in an economically depressed area of the city as reflected by the percent of children living below poverty level. School A had 42% of its childhood population below the poverty level, while School B listed 54% of its students at this level.

Populations and Samples

Students involved in the study (selected through non-random assignment) were fourth graders in the two schools that were compared in the experiment. Thus the study compared two populations (fourth-grade students in School A and fourth-grade students in School B) and two samples (two fourth-grade classrooms in School A and two fourth-grade classrooms in School B). Comparison of the populations and samples is depicted in Table 2.

Table 2

Comparison of Populations and Samples

School	Populations		Samples	
	Teachers	Students	Teachers	Students
A	6	165	2	41
B	4	99	2	37

The researcher purposefully selected the fourth grade as the study population and sample because of three reasons. First, the researcher had access to the fourth grade Stanford Achievement Test results from the September 1998 administration in both schools. This test was eligible for further administration in April of 1999. The sub-tests administered were mathematics, language and reading. Second, this sample selection also allowed for students of like background and age to be considered. Third, previous studies involving graphic organizers have concentrated on students of similar age to determine the effectiveness of similar programs (Boothby & Alverman, 1984; Griffin et al., 1995; Hawk, 1986).

The researcher attempted to limit the variables introduced into the study. The students in each of the participating schools are drawn from the same section of the city and demonstrate similar demographic characteristics. This status was confirmed through a United States Census (1990) document review and consultation with the school division's director of planning. Essentially, the two populations and samples have the same general characteristics in regard to racial, gender, and socioeconomic composition.

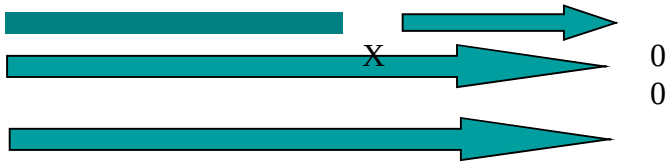
Design of the Study

The researcher employed a nonequivalent control-group design (Gall, Borg, & Gall, 1996) as depicted in Table 3 to test the hypotheses.

Table 3

Nonequivalent Pretest-Posttest Control Group Design

School	Pretest	Treatment	Posttest
A	0	X	0
B	0		0



Time (7months)

X = Thinking Maps® 0 = Stanford Achievement Test

Note. The Stanford Achievement Test cannot be administered more than once in a six-month period. Therefore, the experiment needed to encompass a time period of at least six months between pretest and posttest.

The information in Table 3 depicts the design the researcher selected to investigate the research questions. The treatment that students in School A received was classroom instruction in the use of graphic organizers termed Thinking Maps®. Because only two fourth-grade teachers in School A participated in the training required to implement Thinking Maps® in the classroom, the researcher had to limit the number of classrooms to be studied. In School B, two teachers and their classes of fourth graders were selected as the comparison group. The classrooms were selected by matching the two teachers of each school as closely as possible. This procedure is recommended when small samples are to be used and large differences between the treatment and control group on the dependent variable are not expected (Gall, Borg, & Gall, 1996). Matching the teachers involved in the study assisted in decreasing threats to the study's internal validity. The school principals were involved in this process to ensure the best possible match between the two groups of teachers. Attention to teaching styles, years of experience, and overall attitude were factored in to the final decision for selecting the teachers from the two schools. School A implemented the Thinking Maps® program in the school during the 1998-1999 school year. Teachers were formally trained, and instruction in using the program began in early October 1998. School B did not participate in the program, and since the Thinking Maps® program is copyrighted, teachers in School B were prevented from introducing or applying the

program in the prescribed manner.

To determine how the Thinking Maps® program affects students, the researcher examined three additional independent variables: race, gender, and previous achievement.

The researcher did not find graphic organizer studies that document the effect the use of graphic organizers in the classroom has on the different races. An examination of the school division's free and reduced-price lunch percentage by school revealed that the schools that need to raise standardized test scores the most are often characterized by a high percentage of minority students. The effect of Thinking Maps® on minority students is therefore an important factor to consider. This study was designed to gather data on this aspect of the program's effectiveness.

While a number of studies (Foxworthy, 1995; Stone, 1983; Tate, 1997) have addressed the effect the use of graphic organizers have on gender, the data provided by the authors of Thinking Maps® does not give any categorizations of how the program may affect males and females. Manning (1998) found little difference in ability between the genders of fourth grade students in science and mathematics. His research indicated that significant differences between the sexes did not begin to surface until the adolescent years. The researcher examined this variable to determine if a specific effect exists between the program and gender.

Studies on graphic organizers have been mixed in reporting their effect on previous achievement. Some maintain that high ability students learn better with the use of strategies such as graphic organizers because they incorporate its structured format with their more organized approach to learning (Bernard, 1990, 1995; Boothby & Alvermann, 1984; Foxworthy, 1995). Other studies have indicated that students of low ability learn more efficiently with graphic organizers, since the information is presented in a logical, clear format (Alvermann, 1981a; Dickens, 1988; Griffin & Tulbert, 1995; Herbst, 1995; Lehman, 1992). A few researchers have concluded that graphic organizers help both low and high ability students improve achievement (Alvermann, 1981b; LaFleur, 1992; Stone, 1983). Inclusion of this independent variable in the study was designed to assist in gathering data to help interpret which view is more correct.

Thus, the experimental design consists of a 2x2x2x2 factorial design: Previous Achievement (low and high), gender (male and female), race (black and white), and treatment (experimental and control).

The pretest and posttest that was administered to the students was the Stanford Achievement Test (Ninth Edition). Students in both schools were given the pretest in September of 1998. The posttest was administered to both groups in April of 1999 after the treatment had been given to School A.

Threats to Internal Validity

In order to control for threats to validity (Gall, Borg, & Gall, 1996), the study was conducted as a blind study. As little information as possible was relayed to the teachers regarding the true purpose of the study. The principals of the schools assisted the researcher with shielding the purpose of the study from the teachers participating in the experiment. Administration of the posttest was conducted in a manner as to not divulge connection to the study. Students involved in the experiment were not informed of any aspect of the study.

As a further means to limit threats to the internal validity of the study, the teachers were not told that the interviews conducted at the conclusion of the study to collect information regarding the classroom use of graphic organizers, was connected to an examination of the Thinking Maps® program. Their principals informed them that the study in which they were participating was being conducted to compare the effects of a fall versus spring administration of the Stanford Achievement Test. The researcher had no contact with the instructional programs employed in the classroom in School A or School B. He did not visit the classrooms or have any direct contact with the study participants. The principals of School A and School B assisted the researcher by monitoring the teachers' classrooms to observe their teaching practices.

Aside from the Thinking Maps® program operating in School A, the two schools' organization for instruction was similar. These similarities in the instructional program include the division-wide reading program (Scott-Foresman), a standardized core-subject curricula, textbooks, and division-wide, policy-driven organizational procedures. The instructional day is similar in both schools with each school providing five and one-half hours of organized classroom activities. Both schools assigned students to classrooms in a heterogenous manner.

Description of Treatment

The Thinking Maps® program is an established set of graphic organizers that the authors maintain is based on fundamental thinking processes, designed to be integrated within the current

curriculum. Teachers use these eight graphic organizers to enhance the students' understanding of concepts they present in class through accessing students' visual imagery (Hyerle, 1996a). The maps can be either student or teacher constructed, depending on how the teacher decides to incorporate them into the lesson. Each map is designed to be used with a specific thought process. Hyerle identified eight distinct maps that correspond to the thought processes he outlined in his book, Visual Tools (Hyerle, 1996b). He maintains they comprise a comprehensive model for transferring thinking skills directly to content learning across disciplines and to life long learning (Electronic Resource from Innovative Learning Group, 1997). This results in the outcome of teachers and students utilizing a core set of graphic organizers, or common language, for cognitive development, instruction, and assessment. The function of each of the eight maps is found in Table 4. Diagrams of each of the eight maps are displayed in the Appendix B.

Table 4

Types of Thinking Maps® and Their Function

Map name	Function
Circle	To define in context
Bubble	To describe the attributes
Double-Bubble	To compare and contrast
Tree	To classify and categorize
Brace	To display part/whole reasoning
Flow	To illustrate sequencing
Multi-Flow	To examine cause-effect reasoning
Bridge	To show analogies

The Thinking Maps® program can only be implemented in a school after the prescribed initial training for teachers is completed. This training, prior to the use of the program, consists of at least a one-half day session involving the conceptual basis of Thinking Maps®, including a major segment of the session devoted to the brain-based research. The trainers concentrate on the

brain, especially how it functions, to demonstrate how the Thinking Maps® program correlates with the advances science is making in understanding how the brain is used in the learning process. All of the information presented in the training session is outlined in a carefully formatted manner in the Thinking Maps® training manual.

Participants in School A actively created Thinking Maps® in the training session, learning about their use by constructing them in context. Cooperative learning techniques were used to expedite the learning process, so that all eight maps were introduced in the first training session. Five follow-up sessions, each about an hour in duration, were conducted with the consultants during the school year. The sessions were scheduled throughout the school year at the rate of approximately one every two months. These follow-up workshops generally took place during the teacher's planning bell and were geared to the questions the teachers had about the usage of the maps. The consultants provided additional advice on integrating the maps across the curriculum.

Thinking Maps® was the only instructional strategy or academic initiative School A implemented during the year. All of the other programs follow the format described in the control section.

Interviews

To accurately describe the treatment and control conditions of the classrooms in School A and School B, the researcher conducted interviews with the teachers participating in the experiment after the treatment and control periods were over. The interview questions were constructed to determine how the treatment and control conditions affected the classroom instruction. The researcher administered the interview questions in the same manner to both groups of teachers. To limit contamination of results, the teachers in School B were interviewed prior to those in School A. A one-on-one interview technique was used to limit distractions and to allow the teacher to focus on each specific question the researcher posed. Each interview was conducted within a forty minute time frame. All of the teachers were asked to respond to the same questions in an identical format. The probes which were used to collect more information were stated in the same way. The researcher attempted to assess the degree of ease each teacher felt in complying with the request to be involved in the interview.

The information in Table 5 depicts the interview protocol used with the treatment and control teachers.

Table 5
Interview Protocol to Collect Data From Treatment and Control Teachers

Domain	Interview questions
Quantity of use:	1. Tell me about your instructional program in reading. 2. Tell me about a typical lesson. 3. Tell me about a typical week in your classroom. 4. Tell me about any special activities in your classroom. (Ask same questions for math and language) Probes (used if teacher mentions visual tools): 1. What type of visual tools do you use? 2. How often are they used? 3. How many maps have you used with students?
Quality of use:	1. What types of instructional strategies do you use? 2. Describe some of the strategies you use to assist students in understanding the content. Probe: 1. Describe your experience in using Thinking Maps® in your classroom.
Outcomes of use:	How well do you think your students did in reading, math and language this year? Why?

(table continues)

Table 5 (continued)

Procedure:	How do you structure the use of your instructional strategies? Probe: 1. Is the visual tool used purposively? 2. How does the visual tool relate to the lesson being taught? 3. How did you use the Thinking Maps® in your lesson; to introduce new material, reinforce previously taught material, or provide a framework for processing information?

Probes were formulated to proved the researcher with a tool to explore further avenues of questioning involving graphic organizers. If the teachers mentioned graphic organizers during the interview, the appropriate probes were asked in order to describe how the graphic organizer was used in the classroom in relation to the curriculum. Probing questions that were addressed to the teachers related to the duration of the treatment activity in the classroom, the frequency of treatment usage, and total number of maps introduced to the students. The information reported in Table 6 shows the dichotomy which the researcher found in the use of graphic organizers between the two groups of teachers.

Table 6

Frequency of Use of Graphic Organizers in the Classrooms of Treatment and Teachers

Subject	Frequency of Use				
	Low		Middle	High	
Reading	B1[a]	B2		A1	A2
Mathematics	B1	B2		A1	A2
Language	B1	B2		A1	A2

[a]B1, B2: Control teachers ;[b]A1, A2: Treatment teachers

School A teachers used some type of graphic organizer, including Thinking Maps® on a regular basis as part of the prescribed program. Teachers in School B did not use graphic organizers in a structured manner. Rarely was any type of graphic organizer used in any subject other than reading, where program associated visual tools were available to be used with the lesson.

When the researcher interviewed the teachers in School A, the use of graphic organizers was the focus of the interview. Each of the treatment teachers mentioned the use of graphic organizers as an instructional priority within the first five minutes of the interview protocol. Teacher A2 explained how she utilized Thinking Maps® daily to help the students "see" the concepts she introduced. Each teacher cited how they used the Thinking Maps® in all three

subject areas. Teacher A2 was more enthusiastic about the use of Thinking Maps® as she cited how she delighted in finding as many ways to incorporate them into the lessons she wrote as possible. She stated "Thinking Maps® help children see the connections in the material and therefore help them to remember and understand more of the content". She reported that her class was especially adept in using the maps to assist in organizing their thinking during the pre-writing stage of journal or story composition.

While teacher A2 found the Thinking Maps® easy to use in all of the subject areas studied, teacher A1 was more reserved in her assessment of how she employed them in the classroom. She did not use them as frequently as teacher A2, but stated that she found their usage in mathematics to be especially helpful to students. Both teachers used all eight maps during the study period. Teacher A1 stated she used the maps at least once a week or more. Teacher A2 enjoyed using the maps and stated she used them on a daily basis.

When questioned about what factors could cause their students to improve on the achievement test, both teachers concurred that the Thinking Maps® program in their classroom was a significant contributor. Teacher A2 volunteered that Thinking Maps® would account for forty percent of any increase in test scores her students would achieve.

The probing questions developed in the protocol assisted the researcher in learning specific information about the use of the maps in the teachers classroom. The three themes identified in the literature on graphic organizer research emerged during the interviews with the teachers. Those themes, teacher preparation, graphic organizer dynamics, and the instructional context of graphic organizer interventions will be discussed in Chapter Five of the study. (Moore & Readance, 1984).

The information in Table 7 depicts the quantity and quality of graphic organizer usage by the teachers in School A. Both teachers believed that the use of Thinking Maps® by their students was linked to any improvement that the students may have demonstrated on the second administration of the Stanford Achievement Test.

Table 7

Raw Data Matrix: Quantity and Quality of Use of Visual Tools by Teachers and Students in School A

	Use of visual tools	
Teacher	Quantity	Quality
A1	All eight (TM)[a] used Used TM at least once per week or more	TM used as specified in training
A2	All eight TM used Used TM at least once each day	TM used as specified in training

[a]TM: Thinking Maps®

Description of the Control

School B served as the control in the study. The researcher collected information concerning the school's curriculum used in the fourth grade from the school principal. The school division's regular instructional program was in use in this school. In reading, the Scott-Foresman Reading program had been adopted division-wide. This program does include graphic organizers and other visual tools recommended to be used when introducing new material to be taught in context with the prescribed lessons. These organizers are not intended to be used in the same manner as the graphic organizers that accompany the Thinking Maps® program. Most are Venn diagrams, story maps or simple web maps, used to provide an outline for the student to visualize the information presented.

The mathematics curriculum developed by the school division, is manipulative-based, but does not employ graphic organizers as a central focus of instruction. Students transfer skills learned through hands-on activities to performance tasks using paper and pencil. The teachers in the control school reported that they did not use graphic organizers in their mathematics instruction.

The language program is similar to the reading program, but does not have a graphic organizer component attached to the lessons. Teachers concentrate on journal writing, modeling correct sentence construction, grammar lessons, and the writing process.

During the interviews with the teachers from School B, the researcher followed the interview protocol in attempting to assess the instructional climate of the classroom. Neither teacher mentioned graphic organizers or visual tools in describing their instructional program in any of the three subject areas studied. Activities such as group work, play acting, repetitive tasking, and working with manipulatives were cited as the mainstays of the instructional day.

Teacher B2 stated that any improvement demonstrated by her students could be attributed to the amount of repetition she employs. Teacher B1 was less enthusiastic about the improvement capabilities of her students. She could not identify one aspect of the instructional program that may lead to improved test scores. When asked to specify one reason that test scores may be higher on the second administration, she cited the attention given to test taking strategies in her classroom. Neither teacher attributed any perceived improvement in test scores to any

usage of graphic organizers or visual tools.

The only mention of graphic organizers by either of the control group teachers came after the researcher introduced the probing questions designed to assess graphic organizer or visual tool usage. When asked directly, the teachers responded that they did use the graphic organizers that accompanied the Scott-Foresman reading series that the division had adopted. However, they volunteered that they did not use the available graphic organizers or other visual tools with each lesson. They had the freedom to use the graphic organizers as often or seldom as they chose. Both of the teachers stated that when graphic organizers were used in the classroom, they were selected from a menu provided by the teacher's guide and used to introduce new material. Story maps and Venn diagrams were used most often by the teachers to illustrate the material covered in the lesson. These were used only on the day the reading series specified to introduce new material to the students. They seldom used graphic organizers in math or language.

The information presented in Table 8 shows that the teachers in School B, while having the availability of graphic organizers through the reading program, seldom used them to provide more than a strategy to introduce new material during reading class.

Table 8

Raw Data Matrix: Quantity and Quality of Use of Visual Tools by Teachers and Students in School B

	Use of visual tools	
Teacher	Quantity	Quality
B1	Did not use graphic organizers other than story maps Used infrequently to introduce new material	No training in the use of any graphic organizers
B2	Did not use graphic organizers other than story maps and Venn Diagrams (Scott-Foresman) Some usage of graphic organizers to introduce new material	No training in the use of any graphic organizers

Note: Teachers did not mention any type of visual tool or graphic organizer during the interview. Only with the use of probes did the researcher uncover any use of graphic organizers in the classroom.

Data Collection

Both schools administered the Stanford Achievement Test (Primary 3/TA) in September of 1998 and a different form of the same test (Primary 3/SA) was given in April 1999 to the two groups of fourth-grade students. These tests served as the pre and post test instruments. The researcher used the scaled scores the students received in the areas of reading, mathematics, and language on the tests to make comparisons. Data to formulate sample comparisons of the two groups was gathered from the established student data base in each school. The researcher collected statistical information regarding race, gender, and previous achievement level (low and high) on all students in the study. The students' scaled scores on the Stanford Achievement Test were used to rank the students into two groups, low and high. Replacement sampling was not used.

Data collected from various sources is represented in two major types of tables. In Table 9 one set of descriptive statistics are depicted. The data in Table 10 shows the cell numbers, means, and Standard Deviations for each of the dependent variables. Tables 11 through 13 were constructed to illustrate the findings from the analysis of variance on each of the dependent variables of reading, mathematics, and language scores.

Data Analysis

Students in the treatment group and the control group were compared using the Stanford Achievement Test in reading, mathematics and language. The tests were administered in September 1998 and then re-administered in April of 1999 as a posttest. Analysis of the test data generated by the two groups was done with the Statistical Package for the Social Sciences (Norusis, 1994) Three four-way ANOVAs, with treatment, race, gender, and previous achievement level as independent variables and reading, math, and language total scores as dependent variables, were conducted on the data.

In addition, t-tests were conducted on the pretest scores for each school in reading, mathematics, and language. This was done to determine if the pretest means on each dependent variable were different. Since they were not significantly different, an univariate analysis of variance was preformed on each dependent variable. These results are reported in Appendix A.