THE EFFECT OF NONTRADITIONAL INSTRUCTIONAL TECHNIQUES ON MATHEMATICS ACHIEVEMENT OF NINTH GRADE ALGEBRA I STUDENTS

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Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
In Partial of Fulfillment of
The Requirements for
the Degree of
DOCTOR OF EDUCATION
May, 2005

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ACKNOWLEDGEMENT

I would like to thank my advisor for the encouragement and full support during the course of the study. Also, I thank all committee members for their input and their participation. A special thanks to the parents and the students who voluntarily participated in the study.

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CHAPTER I

INTRODUCTION

Background

For many years, public accusations have been leveled at the American educational system (AES) concerning low achievement by students on tests and general knowledge. Critics were suggesting that students were not learning and their academic level of achievement was less than expected. Standardized test scores fell year after year. Each year also brought a new group of experts theorizing about new teaching methods and objectives. One area heavily criticized and theorized was mathematics learning especially by students of algebra. Blame for low academic achievement in mathematics was aimed at individual perception, students' mathematics anxiety levels, traditional teaching methods, and the diversity of students and their cultural heritage (MSEB, 1989).

Teachers, administrators, parents, and students pointed fingers and accused the others for the failure. What was the problem? Why was mathematics such an area of failure for many students? Why did so many students fail Algebra I? Many years have gone with little attention paid to each previous group of experts, objectives, and/or recommendations. Are there ways to teach students mathematics that are related to their lives which could help them understand the mathematics? Each year new groups of experts presented findings and new solutions to help and cure student academic achievement problems, and the cycle started all over again. Although they presented

similar objectives as each previous group, experts did not suggest different techniques that might help students achieve and understand mathematics (Johnson, D. M.; Smith, B., 1989).

In 1989, the National Council of Teachers of Mathematics (NCTM) developed specific objectives that should be taught in school for all algebra students. These standards stated that "In grades 9-12, the mathematics curriculum should include the continued study of algebraic concepts and methods so that all students can appreciate the power of mathematical abstraction and symbolism." (NCTM, 1989, p. 5). This means: if students of algebra master these objectives and standards their test scores and mathematics achievement levels should improve. The NCTM did not tell teachers how these objectives should be taught. They didn't say what mathematics instructional techniques should be used. They simply listed the objectives and suggested that teachers teach them.

This research study focused on the effect of a non-traditional approach in instructional methods in algebra I on student achievement. The methods used include the use of mathematics manipulatives, cooperative learning, hands-on equations and inequalities, graphing calculators, and computer technology.

Statement of the Problem

The purpose of this study was to investigate the effect of alternative instructional techniques on mathematics achievement of ninth grade students in algebra I. Two groups of students were selected to learn algebra over a time period of nine weeks. One group was to learn algebra in the traditional method used by most textbooks in which the concepts were introduced one at a time with mathematics problems to practice on each

concept done at that time. Pencil and paper were the most common media for students to use for practice. The practiced concepts were not normally practiced again except when a review was called for before a test. The other group was learning algebra via different methods including mathematics manipulatives, graphing calculators, hands-on equations, and computer technology. The scores from pre/post tests for the two groups were compared. Student evaluation was through a pre-test to measure the students' existing knowledge and a post-test to measure the students' achievement after the nine weeks of learning.

Purpose of the Study

The nontraditional method has added an important dimension on how students learn algebra. Students developed their own meaning of the new learning as they interacted, discussed, and analyzed the algebra problems with each other for reaching a common solution. Therefore, focused on students' learning was critical element in the process of the study (Guskey, 1986). According to Piaget, learning is an active process based upon concrete experience (Piaget, 1964). The nontraditional method used in the study was a constructive way in learning algebra. Chapter two talked about constructivist theory as it related to the teaching and learning. Nontraditional method was a different way of teaching than the traditional method. The nontraditional focused on student center rather than teacher lecture (traditional). Students were the ones who explored ideas, discussed and reached a common solution based on their own observation and experiences. Students in the non traditional classroom used manipulatives, graphing calculators, computer tutoring, and small groups to construct knowledge and reached a common goal. The traditional class had the opportunity and access to computer tutoring

in the computer lab after school if they wished. The computer lab was open to all students in the school.

The purpose of this study was to compare the effect of traditional versus non-tradional instructional techniques on mathematics achievement of ninth grade algebra I students. One group of students learned via a traditional method (control group) and the other group (experimental group) learned via a contemporary non-traditional method.

Research Questions

The aim of the study was to see whether nontraditional instructional techniques used in algebra had any effects on ninth grade students' achievement. This research attended to the following questions:

1. Is there a statistically significant difference between the achievement of the ninth grade algebra I students using nontraditional algebra instructional methods when compared to students being taught by traditional instructional methods?
2. Is there an improvement in students' attitude toward Algebra I when using different techniques of instruction?

Importance of the Study

A primary aim of public schools in the United States is to provide opportunities for all students to develop their maximum potential as individuals and members of society. A corresponding goal for education was that all students should be given equal opportunity for educational achievement (Sorensen & Hallinan, 1986). In order for teachers to help prepare students to achieve a higher level of mathematics understanding and for students to understand mathematical concepts that were related to the daily life

situations, it was important that teachers knew each student's learning style and which learning method best fits different students. A high school in the southwest region of the United States was a unique school for this type of study (traditional instruction verses nontraditional) because of the academic and cultural diversity of the students. According to the Student Hand Book (2002-2003): The average socio-economic status (SES) is low. This means students came from families who have low incomes and 95% of the students were qualified for free lunch program. The ethnic belonging of the student population was as follows: 48% African Americans, 33% Whites, 9% Native Americans, 9% Hispanics, and 1% Asians. The high mobility rate of students, low student test scores, and discipline referral records required increased communication with parents, guardians, and the community at large to provide programs, materials, and funds for student needs.

This high school provided the best aspects of a "school within a school" educational facility in that it housed the district's magnet fine arts program and also functions as a neighborhood school. Whether a student attended the school due to geographic location or a desire to concentrate on the fine arts, a number of challenging and enriching opportunities await. Students who desired to attend the school for the arts program may focus on music, visual arts, dance, and theatre. Each student must submit an application and/or portfolio and move successfully through the audition process. The students who were involved in the music program may focus on the major areas of vocal, strings, guitar, wind, brass, percussion and piano. They might take elective courses such as Jazz history, American Musical Theatre, Opera, Baroque Ensemble, Dixieland Band, Saxophone Quartet. Theatre Arts students focus on performance skill classes, plus technical courses in costume and set and lighting design. Elective courses were offered in

History of Film, Shakespeare and Opera. A student participating in the dance program was immersed in ballet, modern dance, jazz, folk dance, ethnic and hip-hop classes. Those attending classes in the visual arts would study color and design, form and design, painting, drawing, sculpture, pottery photography, commercial/graphic arts, and fabric design.

Though the arts were no respecter of academic status, the mission of the school began with high academic standards. The school operated on a seven period schedule with 50-minute classes each day. The school offered traditional as well as advanced placement academic courses in all the core subjects: English, language arts, mathematics, and science. Students had access to a state-of-the-art computer lab for computer science courses and might also take advantage of a full computer lab within the library. The graphic arts lab at the school was considered one of the finest in any of the state's public education facilities. The athletic programs at the school included football, basketball, soccer, golf, track, softball, baseball, volleyball, swimming, tennis and cheer-leading. The various sports teams consistently challenged for top ranking within the state. However, the aim of the study was to see whether nontraditional instructional techniques used in algebra had any effects on ninth grade students' mathematics achievement.

Definition of Terms

The following terms were used for the purpose of this study:

Mathematics Achievement: This term was defined as students' achievement on test scores.

Prentice Hall Textbook, Algebra I: Content in text was used as the basic for the concepts presented in the study. Topics in this book could be taught in both ways

traditional and non-traditional.

Control Group: Consisted of twenty ninth-grade algebra I students at the research-site high school. This class was taught through a traditional approach to learning algebra. This class met in the morning during third period. These students were taught by the researcher who was their regular teacher.

Experimental Group: Consisted of twenty ninth grade algebra I students at the same high school. This class was taught through a non-traditional method. The class met during the fourth period. This class was also taught by researcher.

Traditional Approach: This method of instruction is teacher-centered and is found in most standard algebra I curriculum. The teacher is the most active participant in classroom. The teacher presented the concepts and topics as the "expert" and his answers and solutions were always "correct". The topics covered in the classroom were practiced only once before the review for the test. Students who learn in the traditional way seemed less motivated, and this method did not provide students with problem-solving skills they could apply to other situations (Dewey, 1902). For most of the past century, high school classrooms were taught in this way

(Boyer, 1983; Goodlad, 1984; Powel, Farrar, & Cohen, 1985; Sizer, 1984) and most of today's high schools still follow the same method.

Non-traditional Approach: This method of instruction concentrated on the student as an active learner and the teacher as a facilitator (NAASP, 1996; Cohen, 1988; Conley, 1993; Newmann, Marks, & Gamoran, 1996; Sizer, 1992; Talber & McLaughlin, 1993). The teacher introduced the activity for a short period of time

(10-15 minutes) before students worked on assigned mathematics problems with guidance from the teacher. The same concept was reviewed in the next class period before a new concept was introduced. The students were taught via numerous techniques and activities. A variety of instructional techniques such as the use of graphing calculators, mathematics manipulatives, hands-on materials, computers and small group works were incorporated into the class. The purpose of this method was to allow students to learn by active involvement and not by memorization or direct lecture. This method of instruction might allow students to learn and understand algebra more effectively; therefore, the level achievement might improve.

Pretest: This test consisted of a range of twenty to twenty-five questions covering the topics and algebraic concepts in chapters nine and eleven of a traditional algebra text. The test was criterion based and locally developed.

Post-test: This test consisted of a range of twenty to twenty-five questions covering the topics and algebraic concepts in chapters nine and eleven of a traditional algebra text. The test was criterion based and locally developed.

Constructivist theory: afforded students opportunities to explore ideas and construct knowledge based on their own observation and experiences. Student-centered often called constructivist. Students were allowed numerous opportunities to express themselves, in numerous forms; and classrooms should be characterized as collaborative places where students feel safe to experiment (Newman et al., 1996).

Limitation of the Study

(1) The level of significance might not reached because the sample is relatively small.

(2) The validity of this study could be affected due to possible gain or loss of students in the sample during the time of the study.

(3) The duration of the study.

(4) The topics learned in the study were limited to two chapters, nine and eleven of Prentice Hall Algebra I textbook.

(5) This study was limited to ninth-grade students in Algebra I (n=40). Students are divided into a control group (n=20), and an experimental group (n=20).

(6) The validity could be affected due the bias of researcher regular classroom teacher.

(7) This study could not be generalized to the outside of the geographic region because of the cultural diversity and socio-economic status of the sample used.

(8) Students were already randomly selected and assigned to classes at the beginning of the 2002-2003 school-year prior to the implementation of the study.

In summary, chapter one describes a nine-week study of algebra I in a high school located in southwest region of the United States. Two groups of ninth grade students were involved in the study. One group of twenty students was learning algebra I using the traditional method (treatment group) while a second

group of twenty students was learning algebra I via non-traditional method. The chapter discussed the following: background of the study, statement of the problem, purpose of the study, research question, importance of the study, definition of terms, and finally, the limitation of the study.

The following is a brief description for the next four chapters. Chapter Two discusses the summary of related literature: what types of previous research and studies had found in the area of achievement in algebra. Some previous studies were over the use of manipulatives in algebra , and other studies were over the use of technology and algebra achievement. Chapter Three discusses the methodology of the study that includes: the description of the population, description of the instrumentation used in the study. The pre-post tests were given on each chapter and also given for both chapters combined. Chapter Three also discusses the research design, data collection, and the procedure of data analysis. Chapter Four discusses the results of each student raw score on each test (Table 1), the comparison of students' pre-tests two sample t-test in Table (2) through Table (4), the results of posttests two sample t-test in Table (5) through table (7), the results of correlation between groups' test measures in Table (8), and the results of the pre-post survey in Table (9). Chapter Five describes the summary, conclusion, and recommendation for the study. Keeping in mind, the purpose of the study was to compare the effect of traditional versus non-traditional instructional techniques on mathematics achievement of ninth grade algebra I students.

CHAPTER TWO

SUMMARY OF RELATED LITERATURE

The idea for this study came from the continuous debate of whether the traditional instructional method of algebra could be improved. The change from instructing algebra in traditional methods to a meaningful approach that emphasizes understanding of algebra concepts is possible through the use of non-traditional method. The traditional method (lecture) involves the chalkboard where the teacher dominates the class while students listen and respond to the teacher's questions. The non-traditional approach versus the traditional approach is the topic of research in this study. Two groups of students were compared, one group presents a traditional approach and the second group presents a non-traditional. Pre-post test scores were the data for the study, as well as a pre-post survey completed by students. Better understanding and higher test scores were the goals for this study.

Research on the effects of a varied instruction in algebra has been published. These studies have been done and have been evaluated by researchers, and some of these studies are in included in here. I chose the following three areas for the study because they facilitate the development of concepts, reduce the demand for memorization, provide motivation and encourage discovery, exploring, and creativity (Suydam, 1976, cited in Hambree and Dessart, 1986). The reported studies are divided into three areas: 1) general algebra achievement, 2) use of manipulatives, and 3) use of technology.

The desirability and effects of instructional techniques on mathematics achievement are an intense, ongoing, debated topic. One of the reasons the American education system sought to improve the traditional method of instruction was to provide students with the opportunity to succeed through the use of instructional techniques that matched their leaning styles. Many students had success learning mathematics by just listening to the teachers' lecture. These students learned best by making conjectures based on observation, by discovering mathematical patterns (MSEB, 1989), by reflecting on what they were doing, and by actively thinking about what they doing (Dick, 1988). For the greatest success, instructional techniques used needed to match students' readiness in algebra as closely as possible.

Changing teachers' ways of teaching was not easy because most educators were teaching the way they had been taught. As educators became aware of the diversity in students' learning they attempted to implement new instructional techniques in their classrooms. Educators moved from the traditional way of teaching that is "teacher centered" to the new approach to teaching, which was called "student centered." Algebra learning in the traditional method was criticized heavily by lawmakers, parents, administrators, and students because the traditional methods only supported a few students in becoming better achievers, and the majority of students seemed lost and failed. Educators thought the traditional method did not relate mathematics problems to students' real-life situations, and most students learned better if the problems had functional meaning to their life.

What were schools about? Schools were about many things such as: socialization, dissemination of facts, consumerism, critical thinking, and problem solving. At the very

core, however, school was about perpetuation of our democratic society. If our society was to survive and flourish, we had to educate our children. Schools were not about a basic skill learned through a traditional method, it was about a well-rounded understanding of our world, it was about academic relationships that students can use in student real-life situation (Kieron C, 1992).

What made learning algebra difficult? For many students, algebra was a collection of unrelated skills that should be memorized. To help students build a mathematics structure of ideas and concepts, as well as to show them the relationship between topics were the goals of a new approach implemented to assist them to make mathematical connections that made sense to them. To accomplish this mission a variety of instructional techniques would have to be implemented in every algebra classroom. Successful algebra teachers employed numerous strategies and techniques. Such instructional techniques as the use of manipulatives, computer technology software, calculators, hands-on discovery, small groups, and reinforcement were employed to increase students' mathematics achievement.

The marketplace demands for quality students to be able to compete nationally and globally was in growing. All jobs required basic mathematics skills. International market competition required students who were well-prepared and highly qualified for the best jobs for the United States to remain in power because other countries would hire only the best qualified candidates for their jobs. In order to keep this country strong "economically", students should be taught meaningful mathematics that related to their future jobs. Another area of concern was students' use of technology:

Today's world is technologically based. Strong mathematical knowledge is an

essential characteristic of student learning more now than ever before. Corporate America views public education as nothing more than a place to disseminate information. The market-place believes that the job of the public schools was just to hand out information. Technology should only be used to access information. The consumer world wanted students who were knowledgeable and well-skilled mathematically and technologically. Certainly, the market place wanted students who could make quick decisions and cost less to train.

As researchers tried to find new effective techniques and improve different types of algebra instructional techniques, any technique which promised a considerable result should be practiced and tested. Because if one method of instruction for algebra is, indeed, better than others, then it is reasonable for this method to be employed, to better compare students for mathematics career. The new techniques might help us succeed and be able to compete with the rest of the world, and we become stronger and our local and national test scores would become higher. The students' attitudes toward mathematics might improve and became more positive with a more student-centered approach.

Several instructional methods had been evaluated and compared against the traditional method. Menis et al's, concluded after a three-year study, conducted between 1975-1977, that the use of computers did improve the weaker tenth grade students' averages, but had no impact on the averages of the better mathematics students. (Menis et al., 1980). Same this for chapter five. The study was conducted with a large number of students who had a poor performance in mathematics. Two groups of students were the subject of the study, one group made up the experimental group (n=146) and the other group (n=256) made up the control group. The duration of the research was for three

years. The objectives were to improve the students' grades and their attitudes in mathematics and science, in particular, the students had low grades in both subjects in ninth grade. All students were in the same classroom for the same instructions.

The methods used in Menis' study were to have students' complete mathematics exercises on a computer terminal in the classroom that was connected to a large computer. The classroom teachers who participated in the program developed the curriculum lessons to be taught in their algebra classes. Regular classroom teachers made a list of topics to be taught week-by-week with several practice exercises on each topic and submitted them to trained teachers who were supposed to work with the students. Eight teacher booklets were compiled and used for the study. The booklet exercises were of two types: 1) exercises that utilized the computer as a desk calculator for arithmetic calculations and 2) a set of drill exercises on topics covered in the classroom that reviewed students' work on many homework problems. Students were able to complete their homework assignments in less time using the computers than when they did the mathematical calculations by hand.

The work with the computers was to make mathematics enjoyable and to help students understand mathematics concepts better than doing hand calculations. For example, the function $y = 3x+1$ was one in which few students understood the connection between the function and its graph. The computer could draw the graph and many other graphs of other similar functions to help the students understand the pattern and the properties of the function such as linear functions, intercepts, slopes, and direction.

Leinnenbach and Raymond suggested that the use of manipulatives versus the use of the traditional methods improved the academic performance in algebra on set of 120

eighth-grade students (Leinenbach & Raymond, 1996). The subjects of the study were students in five classes at a lower class middle school located in an inner city in Indiana. The time for the study was over two phases. The first phase was the first nine-week of the 1994-1995 school-year. Leinenback used the non-manipulative method of a traditional approach algebra textbook. In the second nine-weeks, she used a twenty-six manipulative-lesson program. The material introduced students to solving algebraic equations using manipulatives. Students were allowed to use the manipulatives on tests and quizzes. At the end of the study, a survey was conducted to assess students' and teachers' reflections and teacher's observation. The second phase of the study was conducted during the 1995-1996 school year using the same students who continued to high school. A survey was conducted in 1996 and was mailed to ninety of the students. Only nineteen completed and returned the survey. Eight of the nineteen students were willing to participate in an interview in the summer of 1996 and talk about the middle school manipulative study. The results indicated higher individual scores during the manipulative phase. Some score differences were significant. For instance, 23% of the students went from below "C" scores to scores of 70% or higher, 42% of the students gained an average of "As" during the work with the manipulative compared to 14% of the students who earned "As" during the book phase. Students who did not have higher scores during the manipulatives program were 12.5%. The results also concluded the students could solve algebraic problems and were able to demonstrate understanding of algebra concepts through the use of manipulatives. On the other hand, students may needs the manipulatives to demonstrate what they know on the textbook work. Students were tested after the manipulatives phase. The test was over the book work without the

presence of the manipulatives. Disappointing results showed 77% of the students had a decrease in their individual averages. These results indicated that students might, indeed, need the manipulatives during the test. In general, the data suggested that most students performed better academically and they expressed more positive attitudes about algebra when they were working with manipulatives compared to using only the textbook.

Wilkins (1993) found that the result of utilizing a problem-solving method in algebra increased students' scores on standardized tests. Problem solving involved the use of certain procedures and skills, the student's ability to think and communicate mathematically, and the use of certain strategies to solve mathematical problems; strategies such as cooperative learning, manipulatives, and the use of electronic technology. The purpose of her research was to determine the effect of a problem-solving approach on instruction (PSAI) with eighth grade algebra I students. The participants in the research were 56 eighth-grade students who were enrolled in algebra I. The middle school students who participated in her study were from a suburban middle class and they made up the treatment group. The enrollment of the students was determined on students' success in pre-algebra in seventh grade the previous school year and/or the student's scores on the Stanford Achievement Test in 90^{th} or more percentile or above. A second group of students from a different suburban school with similar economical status, similar school size, and similar test scores were the control group. There were fifty-one eighth grade students in the treatment group and forty-four eighth grade students in the control group in Wilkin's study. In 1992, students who enrolled in the program were required to score in the 85^{th} or higher percentile on the mathematics section of Stanford Achievement Test. In 1991, Wilkin's modeled Rachlin's (1987) teaching method with

changes to reflect the method of a problem-solving approach to instruction (Wilkins, 1991).

The method used in Wilkins' research called the problem solving approach to instruction (PSAI). This approach used several instructional strategies including cooperative group work, application and generalization, reversibility and reflexibility tasks, standard problems, written explanations of process and results, and instructional techniques using games, manipulatives, group projects and activities. Students in the treatment group were instructed using the PSAI approach. Four of the algebra I skills included: translating verbal (word) mathematics problems into mathematical formulas and equations, adding and subtracting algebra monomials and polynomials. The remaining skills grouping used communicating using algebra language; evaluating and simplifying expressions and equations; identifying opposite, reciprocal, and absolute value; solving linear equations; using properties of exponents to simplify monomials; plotting and identifying points on cartesian plane; and graphing linear equations.

In 1993, all Wilkins' algebra skills were taught to the treatment group through a problem solving approach to instruction (PSAI). The control group was instructed using the lecture method in both 1991 and 1993. The results of her study was described by three statistical tables. First, the results indicated that the mean scores in 1991 were significantly higher ($p>.01$) for the four skills instructed via PSAI than the mean scores of the seven skills taught to the control group through the traditional method. Second, the 1993 mean scores of the four skills taught via PSAI ($p>.01$) were not significantly higher when compared to the mean scores of the seven skills which were also taught with the same method (PSAI). Third, the statistical analysis of the mean scores between the seven

skills taught traditionally in 1991 and the same seven skills taught via PSAI in 1993 showed a significant increase in the mean scores ($p > .01$). The comparison of the mean scores of the four skills taught via PSAI in 1991 and in 1993 showed no significant differences at ($p < .05$). Wilkins concluded that the use of the problem solving approach had a positive impact on students' retention and transferability of skills; further research was needed to confirm these results (Wilkins, 1991).

Sharp's (1995) study found no statistical differences between the two groups who used or who did not use algebra manipulatives when assessed using the traditional chapter test. Based on student interviews and their journal comments the use of manipulatives made the students learning easier. The objective of the research was to study the use of algebra tiles as a forum to provide opportunities for high school students in Iowa to acquire traditional algebraic concepts (Sharp, 1995). The subjects of her study were five high school classes of algebra. Two of them were located in a rural town with 100% Anglo population. The other three schools were suburban schools with a population of 85% Anglo, 10% African-American, and 5% Hispanic. The method used for the treatment groups was to use algebra tiles to learn adding, subtracting, multiplying and factoring algebraic expressions. The control groups did not use manipulatives. The teachers used the textbook for the mathematics curriculum and they followed the assignments in the textbook.

Two experiments were employed in the study. The first one was using algebra tiles only during the unit on factoring algebraic expression. The suburban students ($n=11$) ranged in age from fifteen to eighteen and they made up the treatment group. They used algebra tiles only during the first year of the study. The same teacher taught the first

control group (n=13) without any implementation of the algebra manipulatives. A different teacher taught the second control group (n=13) and this group became the control group for both teachers and the manipulative group. All groups worked on the same examples, took the same quizzes, and completed the same textbook assignments. The second experiment was based on a year of using manipulatives. The students involved in the study were two groups from the rural schools ranging in age from thirteen to sixteen and a nine year-old boy identified as gifted and talented. The intention was to compare the experimental group using the manipulatives against the group with no manipulatives experience. The results based on a t-distribution of students showed no statistically significant differences (α=.025 two tailed) for means among groups. The data were analyzed through a t-distribution because the sample sizes of the groups were small. The finding indicated that five students in the treatment group of factoring algebraic expressions scored in an unusual way: three students scored higher after using the tiles compared to their normal scoring in the regular classroom before using the tiles. The scores of two students were below expectation, they scored lower after using tiles than their normal regular classroom higher scoring habit before using tiles. The use of tiles then, helped the students improve and tiles gave them sufficient conceptual understanding to feel a sense of success.

How does the use of technology enhance the learning of algebra? Computer technology is a good reinforcement for all students, but particularly the low achiever. The computer can print positive reinforcers like "good", "excellent", and "try again". These words make students feel better and less intimidated. The reseacher study focused on giving students more opportunity to learn at their own pace. The computer programs had

the capability of providing feedback in the way of clues or hints; students also could back up to an easier level when faced with difficulties. Enrichment activities in a variety of ways helped students who were ahead of the rest of the students, so they were continually challenged and did not become bored. Calculator technology made low achievers in mathematics feel less frustrated. The calculators allowed students to add, subtract, multiply, and divide in less time and without feeling rushed. Calculators and computers seem to enhance student learning, ease their frustrations, and make them feel in control.

Merriweather's and Tharp's (1999) study investigated the effect of instruction with graphing calculators on how general mathematics students naturalistically solve algebraic problems. The study focused on a pre-post survey given to three general mathematics 8 (name of the course) classes located in a suburban, southeastern Virginia middle school to assess their attitude toward graphing calculators and mathematics. Most students came from low to middle socio-economic backgrounds. The students had low to average mathematical aptitude, and they were placed in mathematics 8 based on their grades they received in the previous year. The students were placed in a control (non-calculator) group (n=28) and a treatment (calculator) group (n=52). Two classes were taught using calculators and a third class did not use calculators. The survey included 23 statement and reported the percentages based on the group answers of agree or strongly disagree. The survey used the Mann-Whitney U-Wilcoxon Rank Sum test ($\alpha < .05$) to determine the differences between the experimental and control group. The findings showed 76% of the control group suggested that it is important that students use calculator compared to 55% of the experimental. Four percent (4%) of the control group thought when doing mathematics it is only important to know how to do a process and

not why it works compared to 27% of the experimental group. Zero percent (0%) of the experimental group felt calculators used should be used only when checking work compared to 12% of the control group. One other observation showed 44% of the control group and 46.8% of the experimental group believed they understand mathematics if they solved mathematics problems with pencil and paper first.

Classroom interactions used the nontraditional approach is to say that the students were engaged in an active environment. This study was influenced by the constructivist theory which characterized in teaching and learning algebra for understanding and student-centered. Constuctivist teaching is the notion of students as an active learner and the teacher as a guide or coach in the learning process (Cohen, 1988; Conley, 1993; Newmann, Marks, & Gamoran, 1996; Sizer 1992;Talbert & Mclaughlin, 1993). A constuctivist approach in algebra was to enable students to build connection in algebra learning to develop understanding of math as integrated discipline. The constructivist learning is to build a classroom climate in which students learning is important and students engaged in a variety of experiences (Confrey, 1990).

The nontraditional approach characterized in teaching and learning through students engagement in a variety of experiences such as cooperative learning, algebra manipulatives, graphing calcualtors and computer tutoring. Students organized in groups of 3 to 4. The teacher introduce the class by algebra definitions and a brief introduction and occasionally demonstrate some examples to students. the students often were the ones who called upon to formulate their own examples and counterexamples. The students persuaded each other by arguing over the algebra assigned problems. The students as a team discussed the merit of the solution of the problems using all different

approaches. Students might learn more when they teach themselves or each other. As a researcher I was a facilitator watching students work and argue about how to work the algebra problems and which answers was the correct one. The former description of learning and teaching algebra in a nontraditional approach was a student-centered, approach, also called the costructivist teaching approach.

This current study strives to help fill the void in the area of mathematics research, point the way for further investigation, and give additional intuition into the ongoing debate about the future of mathematics instruction. It looks as though, as educators of mathematics, we are a little apprehensive when it comes to changing our instructional method from teacher-centered to student-centered, or from traditional methods to non-traditional methods. This research recognizes this urgent need for validation and the desire to test these different techniques of instructions for manifestation of success. The next chapter provides us with the methodology of how the use of different instructional techniques effects student achievement.

CHAPTER THREE

METHODOLOGY

Chapter Two discussed what research had done in the past on the subject of algebra instruction comparing the traditional methods of instruction versus the nontraditional methods of instruction. The data analysis for this study was based on testing the null hypothesis (Ho). The hypothesis of this study was there a statistically significant difference in the achievement level of the ninth grade algebra I students using nontraditional algebra instruction methods when compared to students being taught by traditional methods; and was there an improvement in students attitude toward algebra I when using different techniques of instruction. This was a quantitative study. The quantitative data consisted of student achievement scores on pre- and post-tests. Two groups of students were randomly selected for the study: an experimental group and a control group. The experimental group received instruction using algebra manipulatives, computer tutoring, cooperative group learning, and graphing calculators (TI-83). Graphing calculators were manufactured by Texas instruments. The TI-83 was used for a variety of classroom activities. Students used them during the introduction of new algebraic concepts and during learning through discovery. The computer program used for tutoring was called Introduction to Algebra, version 3.1 (Faircloth & Lassiter, 1994). This program divided each algebra chapter into sections of concepts. Each section has an introduction, tutoring exercises, practice exercises, and a test. The computer used by

students who needed more practice on any assigned activity. The computer was used during the regular class period and/or after school time. The control group did not use the graphing calculator. This group (control) was using the teacher-centered approach (lecture, pencil and paper) to develop mathematical concepts. Instruction included solving algebraic problems numerically, symbolically, and graphically.

Pre- and post-tests determining students' achievement were developed by the researcher, who was the regular classroom teacher. The instruments consisted of the pre- and post-test for chapter nine only, the pre and post-test was for chapter eleven only, and the pre- and post-test for chapters nine and eleven combined. There were six tests administered to both the control group and the treatment group. Two-sample t-tests were calculated to determine the level of statistically significance at an alpha level .05 for chapter nine pretest only, chapter eleven pretest only, chapters nine and eleven pretest combined. A post-test two sample t-test was calculated for chapter nine, eleven, and chapters nine and eleven combined. A measure of relationship (correlation) was computed between all tests for the purpose of the internal consistency reliability.

The pre- and post-surveys determining students' attitude was developed by the researcher. The survey is comprised of two parts. The first part consisted of twenty statements about the use of manipulatives, computer technology, graphing calculator, small groups, and the student attitude toward the teacher's instruction and the student's algebra learning experience. The five point Likert scale assessed students' attitude toward mathematics. Students responded to each statement by whether they strongly agree, agree, undecided, disagree, or strongly disagree. The second part of the survey consisted of five open-ended responses.

The study was conducted in an urban school located in the southwest region of the United States. The students' population is a mixture of African American, White American, Native American, Hispanic, and Asian. Most students in the school received free or reduced lunches. The majority of teachers are White American. The school format was seven periods per day. The class time was fifty minutes per period for the first four periods, fifty-five minutes for period five with the extra five minutes used for student activities such as distributing school memos to students/parents to take home, assemblies, announcements, tornado drills, disaster drill and general school business. The sixth and seventh period times were forty-five minutes each. Because the school population was about 978 students, three lunches periods were scheduled during the school day and lasted for twenty minutes each.

In order to collect data concerning instruction methodology, a total of forty students (freshmen) were randomly selected for the purpose of the study. The control group (N=20) was taught during third period using a traditional method of instruction. The experimental group (N=20) was taught during the fourth period using a non-traditional method of instruction. Both groups were taught by their regular teacher. The study was performed during regular school days, five times a week, during the Fall of the 2002-2003 school year. The collective artifacts consisted of twenty-five lesson plans, covering the algebra I objectives for chapters nine and eleven. Pre- and post-tests for each of chapter and pre- and post-test for both chapters nine and eleven combined. Each group took six tests during the duration of the study. Each group completed a pre- and post-survey.

Instruments Used

A set of pre- and post-tests were used to collect data for this study. The tests were designed by the researcher and were criterion based. The tests were used for both groups (control and experimental). The chapter nine only pre-post tests consisted of twenty short answer questions, chapter eleven pre-post- tests only included twenty short answer questions, and chapter nine and eleven combined pre-post tests had twenty five short answer problems. The pre- and post-tests were administered during the Fall of the 2002-2003 and during regular class time. The two groups of students took chapter nine only pre-test during the week before the study began. They also took the chapter nine and eleven combined pre-test during the week before the study began. When the students completed the chapter nine objectives they took the post-test. Students then, took the pre-test for chapter eleven only. Chapter eleven instructions began immediately after the chapter nine post-test. When students completed all chapter eleven objectives they took chapter eleven only post-test, followed by the post-test for chapter nine and eleven combined. All tests were administered by the students' regular teacher. The pre-survey was completed by students during the week before the study started. The post-survey was filled in by students at the end of the study. The regular teacher was the administrator. Twenty-five lesson plans were designed for the purpose of this research. The lesson plans covered the following topics derived from the Priority Academic Student Skills (P.A.S.S) and from the National Council of Teacher of Mathematics (NCTM), topics were included in chapter nine and chapter eleven:

A. Find the slope of a line given:

    1. the graph of the line

2. the equation of the line
3. two points of the line
4. a set of data points

B. Write the equation and graph the following linear relationships:

1. slope and y-intercept
2. slope and point on the line
3. two points on the line
4. x-intercept and y-intercept
5. a set of data points

C. Use slope to determine if lines are:

1. parallel
2. perpendicular
3. horizontal
4. vertical

D. Collect and graph real data:

1. determine whether the data is linear or nonlinear
2. write a linear equation which model a set of real data
3. describe the slope and intercepts in the context of the data
4. predict outcomes using a linear model

E. Describe rates of constant change experienced within the context of everyday life as the slope of a linear relation (e.g. cost on hamburger meat on weight, cost of gas based on cost per gallon, telephone charges based on rate plus per minute)

F. Solve linear equations by graphing or using properties of equalities

G. Solve linear inequalities by graphing or using properties of inequalities

H. Match appropriate equations or inequalities (one or two variables) to a graph or situation and vice versa

I. Solve system of linear equations by:

    1. graphing
    2. substitution
    3. elimination

J. Solve routine two-step and three-step problems using concepts such as rules of rate and distance.

The pre- and post-tests for each of chapters nine only and chapter eleven only contained twenty short answer responses. The pre- and post-tests of chapter nine and eleven combined consisted of twenty-five short answer questions. Two forms of the same test questions were used in this research. Chapter nine pre- and post tests were the same, chapter eleven pre- and post tests were the same, and pre- and post-tests of chapters nine and eleven combined were also the same. A student survey was used to compare students' reactions to the two approaches.

Research Design

At each the stage of this study, the researcher made every attempt to maintain equivalence of the two groups. In this research, time, length, and days of instructions were constants. Many variables were present during the study such as: make-up of the two classes motivation level, ability level, and the student knowledge cannot be controlled.

This study was conducted to investigate whether the traditional method of instruction or the contemporary (non-traditional) method had any statistically significant effect on student achievement. The significant effect of instructional techniques on mathematics achievement in Algebra I of ninth grade students was determined by a two-sample t-test. The significance alpha level was set at .05 level in the achievement for both groups. The dependent variable was the difference in levels of achievement between the pre- and post-test. The independent variable was the types of instruction used during the study. The internal reliability was achieved through a set of pre-post tests administered by the researcher that measured the student cognitive level attained from the instruction received during the time of the study.

Data Collection

During the study the data were collected six times for each group (three pre tests and three post-test). During the regular school day the pre-tests for chapter nine only, and the pre-test for chapter nine and eleven combined were administered prior the instruction for each group. During the study, before instructions introduced for chapter eleven a pre-test for chapter eleven only was adminestered. The students were given one hour to finish each test. Each test was scored by the researcher. The results were analyzed by employing a two-sample t-test to determine whether a statistically significant difference existed between the two groups. During the study, lesson materials collected included the method of instruction used and five minutes of students' written reaction to the activity used that day. Twenty-five lesson plans were prepared and used in the study. The experimental group used tiles, cups and counters to demonstrate and model the concept of

solving algebraic equations and model the concept of equality. The students also had the opportunity to use the geoboard to plot points. They used graphing calculators to check their work and to work on harder problems, and they used a computer tutoring program for more practice on algebra problems. The traditional group used pencil and paper. Calculators were not used by the traditional group. The teacher check students' work during the entire study. The data was collected, analyzed, and stored with the mathematics department coordinator.

At the end of each chapter, post-tests for chapter nine only, post-test for chapter eleven only, and post-test for chapters nine and eleven combined were given to both groups to determine the level of difference between the two groups, if any exists. The duration of the test was one hour. To maintain consistency in grading the test was scored by the researcher. A two-sample t-test was performed to determine the statistical level of significance at alpha level of 0.05. In order to learn more about this study and in order to determine which group had performed better in terms of cognitive achievement, the posttest scores was calculated for each group.

Description of Population

The purpose of this study was to investigate the effects of non-traditional instructional techniques on mathematics achievement of ninth grade algebra I students. Data was collected six times for each group to determine the academic success.

A sample of 40 ninth-grade algebra I students who had been randomly selected at the beginning of the 2002-2003 school year were the subjects of the study. Twenty students in one class were identified as in the experimental group and the twenty students in the other class were assigned to the control group. The assignment of each of the two

groups of students was randomly selected by the school counselors to the individual class periods. The two groups were matched as closely as possible based on academic achievement, age, race, and gender. All students came from the inner city with comparable socio- economic status. All regular ninth-grade students and magnet students (students who were enrolled in the art program) were enrolled in the same algebra I classes except students who are in special needs classes for remedial mathematics and were enrolled in algebra prep classes. The eligibility for enrollment in algebra I was based on successfully having completed a pre-algebra course the previous school year.

Procedure of Data Analysis

This study investigated the following hypotheses that, the null hypothesis Ho for the pre-test data would demonstrate no statistically significant difference at alpha level .05 in the achievement of the two groups. The alternative hypothesis H_1 was that there was a statistically significant difference at alpha level .05 in the achievement level of the pre-test of the two groups. For the post-test analysis Ho was that there is no statistically significant difference at alpha level .05 in the achievement of the two groups. For the difference between the pre- and post-test scores Ho was that there was no statistically significant difference at .05 of alpha level in the two groups' achievement levels. For the difference between the pre- and post-test scores H_1 was that there was a statistical significant difference at alpha level .05 in the achievement level of the two groups.

Data collection from the study was analyzed with two-sample t-tests to see if a statistically significant difference exists at alpha level of .05. The pre-test scores and

post- test scores were each analyzed to determine if there was a statistical difference. A correlation between all group tests measure was also computed to determine the internal consistency reliability and the relationship between all tests (pre- and post for chapter nine, chapter eleven, and chapters nine and eleven combined). A t-score was calculated for each set of scores and it was examined to see if it fell within the rejection region at .05 alpha level. If the results fall within the rejection region, the null hypothesis Ho was rejected and the alternative hypothesis H_1 was accepted. If the t-scores did not fall within the rejection region the null hypothesis Ho was accepted.

Also used in the study were journals in which students kept their lesson materials and worked exercises. Written responses were also used to provide students an opportunity to write about what they have learned. For example, one student said "to solve problem like $y + 7 = 3$ means to isolate the variable having a coefficient of 1 on one side of the equation. This could be done by using the addition property of equality." Another student answered the question: how did you use the graphing calculator to graph and make a solution table for the equation $y = 3x + 1$? She answered: "I went to the button where it said y= and I pushed, the calculator screen displayed a list of y's, I put the $3x + 1$ in their, then I pressed the graph button, I saw the graph, to display the solution table, I pressed on 2^{nd} then table and I so the list of x's and y's."

A typical lesson plan for the nontraditional group was to use an equation model to solve : $p - 2 = 3$. Students used cups and negative counters to solve for p. teacher reminded students that subtracting a number is the same as adding its opposite. So, subtracting 2 from x is the same as adding (–2) to x. students then were able to write the

equation in the form: p + (-2) = 3. They used one cup and 2 negative counters on one side and place 3 positive counters on the other side of the equation. Notice that it was not possible to remove same kind of counters from each side. Add two counters to each side . then group the counters to form zero pairs. Then remove all the zero pairs. The cup on the left was matched with 5 positive counters. Therefore, p = 5.teacher assigned more problems for student to explore and practice using algebra tiles and cups.

Another typical lesson plan was using the graphing calculator. It was to draw a graph that represents the solutions to the equation y = -x + 2. The students selected the standard viewing window, pressed "y=" key to enter the equation then pressed "graph" key to view the graph of the equation. A complete graph was displayed. To find sample solutions for the line, students used two methods: one was to press the "Trace" key. The cursor appeared as a flashing square and the approximate coordinates of the location of the cursor appeared at the bottom of the screen. Students used the right and left arrows to move the cursor along the line. New coordinate appeared for each location of the cursor. These order pairs were approximate solutions for the equation. Sample solution were (0,2), (0.42553191, 1.5744681). the other method was to obtain the exact solutions by pressing "2^{nd}" then "Table". A table of x and y values for the equation appeared. Students used the up and down arrow keys to scroll through the list of values. Sample solutions were: (-3, 5), 3, -1). And (0, 2).

In summary, the study was conducted with twenty students in the control group (traditional instructional procedures) and twenty students in the experimental group (non-traditional instructional procedures) to investigate whether the method of instruction for both groups had any statistically significant effect on students achievement. The data

was collected six times for each group. Tests were prepared and administered by the regular classroom teacher who was also the researcher. These data were analyzed. Twenty-five lesson plans were used during the study. Pre- and post-surveys were completed by students during the study. Students also kept journal. The following chapter describes and discusses the data analysis for this study.

CHAPTER FOUR

DATA ANALYSIS

The purpose of this study was to determine if there was a statistically significant difference at alpha level .05 in the achievement level of the two groups of ninth-grade algebra I students when the control group was given instruction in a traditional method and the experimental group was given instruction in a nontraditional method. The scores on the pre-tests, the post-tests, and the Pearson's correlation between the two scores were analyzed for statistically significant differences. Another focus on the study was to assess the students' attitude toward algebra with pre- and post-surveys designed for that purpose.

Results

The results (Table 1) showed each student raw test scores for chapter nine only (Pre-post-tests), chapter eleven only (pre-post-tests), and chapter nine and eleven combined (pre-post-tests). The data showed the number of correct items a student scored on each test. The total items (short answers) for test for chapter nine only and chapter eleven only were twenty questions for each chapter, and twenty-five short answers questions for chapter nine and eleven combined. The showed group 1 (control group) and group 2 (experimental group). The students were numbered from 1 through 15 (control group) and from 16 through 31 were the individuals in the experimental group. For example, student number 3 was in group 1 and his raw scores on chapter nine only

(pre-test) were 4 (correct answers) out of twenty total test items. His/her raw scores on the post-test of chapter nine only were 7 correct items out of twenty total test items. A second example, student number 18 in group 2 (experimental group) scored 5 out of twenty-five on his/her pre-test for chapter nine and eleven combined and he/she scored 16 out of twenty-five on post-test for chapter nine and eleven combined.

Table 1

Control Group and Experimental Group Raw Scores

N was based on students who had posttest scores

	Group#	Pre-9	Post-9	Pre-11	Post-11	Pre-combined	Post-combined
1.	1	5	5	2	8	4	15
2.	1	3	6	2	4	3	13
3.	1	4	7	10	15	4	18
4.	1	5	6	5	4	3	10
5.	1	5	8	13	13	4	14
6.	1	5	4	6	13	8	12
7.	1	4	7	6	11	3	14
8.	1	4	5	8	6	11	11
9.	1	6	13	5	14	3	15
10.	1	4	4	2	5	5	12
11.	1	3	6	4	11	14	14
12.	1	5	6	6	10	2	9
13.	1	4	7	6	6	3	16
14.	1	5	6	7	2	3	14
15.	1	4	10	4	5	6	6
16.	2	5	6	3	7	3	9
17.	2	3	10	5	9	4	14
18.	2	5	10	2	6	5	16
19.	2	4	6	7	6	14	19
20.	2	8	6	7	16	6	14
21.	2	4	3	9	7	5	7
22.	2	5	5	5	7	3	10
23.	2	7	5	6	6	4	11
24.	2	3	9	3	5	13	11
25.	2	7	10	7	16	5	13
26.	2	2	8	3	11	11	15
27.	2	5	5	3	11	4	13
28.	2	4	3	3	12	5	8
29.	2	7	10	3	7	4	15
30.	2	6	7	2	6	9	8
31.	2	5	14	7	10	8	11

The results (Table 2) showed that the t-test (- 1.394) of the chapter 9 only pretests for the traditional and nontraditional groups was smaller than the t-critical value of 2.045. Therefore, there was no statistical significant difference in the groups' performance on the pretests at alpha level .05. The experimental group's average scores were higher than the average scores for the control group.

Table 2

(Chapter 9 only)

Comparison of Students' Pre-test Two Sample t-Test

	N	Mean	Standard Deviation
Traditional (Control)	15	4.33	0.82
Nontraditional (Experimental)	16	5.00	1.67

t-calculated = -1.394; DF = 29

t-critical = 2.045, SE = 0.42

The results (Table 3) of the t-test (1.107) for the pretest scores that was performed on the score for the control and the experimental groups for chapter 11 only found that the score of the t-critical value 2.045 was higher than the t-calculated value. Therefore, the results concluded that at alpha level .05, there was no statistically significant difference in the performance of the two groups on the chapter 11 only pre-test. The control group's mean score was higher than the experimental group's mean score. Table 3 below shows the results of the chapter 11 only pretests.

Table 3

(Chapter 11 only)

Comparison of students' Pre-test Two Sample t-Test

	N	Mean	Standard Deviation
Traditional (Control)	15	5.73	3.01
Nontraditional (Experimental)	16	4.69	2.21

t-calculated = 1.107

DF = 29

t-critical = 2.045

SE = 0.55

The results (Table 4) of the t-test (- 1.100) for chapter 9 and 11 combined pretests scores for the traditional and nontraditional groups found that it was smaller than the critical value 2.045. Therefore, there was no statistically significant difference in students' performance for the two groups on the pretests on chapter 9 and 11 combined. However, the nontraditional mean scores were higher than the traditional group's mean scores. Table 4 shows the results of the chapter 9 and 11 combined pretests scores.

Table 4

(Chapter 9 & 11 combined)

Comparison of Students' Pre-test Two Sample t-Test

	N	Mean	Standard Deviation
Traditional (Control)	15	5.07	3.41
Nontraditional (Experimental)	16	6.44	3.52

t-calculated = -1.100

DF = 29

t-critical= 2.045

SE = 0.88

The results (Table 5) showed that the t-test (- 0.667) of the chapter 9 only posttests for the traditional and nontraditional groups was smaller than the t-critical value of 2.045. therefore, there was no statistically significant difference in the groups' performance on the posttests at alpha level .05. the experimental group' average scores (7.31) were higher than the average scores (6.67) for the control group.

Table 5

(Chapter 9 only)

Comparison of Students' Post-test two Sample t-Test

	N	Mean	Standard Deviation
Traditional (Control)	15	6.67	2.32
Nontraditional (Experimental)	16	7.31	3.01

t-calculated = -0.667

DF = 29

t-critical = 2.045

SEM = 0.75

$\alpha = .05$

The results (Table 6) of the t-test (- 0.295) for the posttest scores that was performed on the score for the control and the experimental groups for chapter 11 only found that the score of the critical value 2.045 was higher than the t-calculated value. Therefore, the results concluded that at alpha level 0.05, there was no statistically significant difference in the performance of the two groups on the chapter 11 only pretest. The experimental groups' mean score was higher than the control groups' mean score. Table 6 below shows the results of chapter 11 only posttests.

Table 6

(Chapter 11 only)

Comparison of Students' Post-test Two Sample t-Test

	N	Mean	Standard Deviation
Traditional (Control)	15	8.47	4.23
Nontraditional (Experimental	16	8.88	3.50

t-calculated = -.295

DF = 29

t-critical = 2.045

SEM = 0.87

$\alpha = .05$

The results (Table 7) of the t-test (0.651) for chapters 9 and 11 combined posttest scores for the traditional and nontraditional groups found that it was smaller than the critical value 2.045. Therefore, there was no statistically significant difference in students' performance for the two groups on the posttests on chapter 9 and 11 combined. However, the traditional mean scores were slightly higher than the nontraditional group's mean scores. Table 3 shows the reslts for the chapter 9 and 11 combined posttest scores.

Table 7

(Chapter 9 and 11 combined)

Comparison of Students' Post-test Two Sample t-Test

	N	Mean	Standard Deviation
Traditional (Control)	15	12.87	2.99
Nontraditional (Experimental)	16	12.13	3.32

t-calculated = 0.651

DF = 29

t-ctitical = 2.045

SEM = 0.83

$\alpha = .05$

The data presented in Table 8 is a computation of the Pearson Correlation between all groups' tests measure. Pre9 means Chapter Nine pre-test, pre11 means Chapter Eleven pre-test, precomb means Chapter Nine and Eleven combined. The same is for the posttest. A significant Pearson Correlation is one equal or larger than the tabled value with N – 2 degrees of freedom. The degree of freedom was 29. When the 2-tailed test was performed, an observed Pearson Correlation above +.3494 or less than - .3494 is required to reject the null hypothesis at 2-tailed .05 level. All correlational levels obtained in the study (Table 8) involving ninth grade students were not significant (correlations were not between + .3494 and - .3494) at that level of significance with the

exception of pre-post chapter 11 only tests (correlation was .366*) which made the correlation significant. The value of correlation indicates the degree of relationship between the variables. A low correlation always indicates a low relationship. The results in Table 8 indicated low correlation which yields to a low relationship with one exception (pre-post 11). The low correlation suggested that the teacher could predict student satisfaction at a greater level than by chance. This prediction had a weak relationship with the actual student satisfaction.

Table 8

Correlations

The data represent Pearson Correlation; N = 31

*Correlation is significant at the 0.05 level (2-tailed)

	pre9	post9	pre11	post11	precomb	postcomb
pre9	1					
post9	.139	1				
pre11	.168	.014	1			
post11	.265	.168	.366*	1		
precomb	- .335	.029	- .057	- .021	1	
poscomb	- .056	.223	.153	.246	.102	1

The following Table (9) was part of a pre- and post-survey. The table shows the results of the comparison of students' beliefs and attitude toward algebra I. This table was designed for both groups: the experimental and the control group. This table showed the percentages of agree and strongly agree. The pre-survey was given at the beginning of the study and it was based on students' experiences in the past. The students' participation was totally as volunteers. The class size began with 20 students for the control group and 20 students for the experimental group. Eighteen students participated in the pre-survey in the control group and twenty students participated from the experimental group (See Appendix A/B for entire surveys).

Table 9

(Pre-post-Survey)

Comparison of Students' Beliefs Using the Percentages of Student Who Agree / Strongly Agree

C=Control and E=Experimental

	Pre		Post	
	C N=18	E N=20	C N=15	E N=16
- I had the opportunity to work in groups, so, I didn't feel isolated in algebra class.	61%	65%	40%	75%
- I feel algebra is useful in my life.	50%	80%	67%	81%
- Word problems were very difficult.	20%	25%	28%	38%
- The teacher explained the lesson clearly.	67%	50%	83%	75%
- I had the opportunity to work with manipulatives.	22%	55%	53%	80%
- We did a lot of drill and practice in class.	56%	60%	87%	69%
- The teacher accept only one method to answer the question.	33%	30%	13%	13%
- I felt that I cannot keep up with other classmates.	17%	44%	13%	25%
- I felt algebra is not related to real life.	6%	45%	13%	25%
- I lack the understanding of the scientific/graphing calculators.	6%	45%	13%	25%
- I feel better when I used the computer to work mathematics assignments.	28%	38%	53%	55%
- Over all my algebra experience was good.	50%	60%	53%	89%

Students had to complete both a pre- and post-surveys. They were asked a variety of questions, twenty questions of the type strongly agree, agree, undecided, disagree, and strongly disagree. Five essay questions as follow were also addressed:

1. Which one of the instructional techniques helps you the most? Why?
2. Which technique was easy to learn? Why?
3. Which technique was the most difficult to learn? Why?
4. How do feel about the nontraditional instructional techniques?
5. Would you recommend nontraditional learning techniques to be taught to all algebra students? Why?

Students provided answers such as:

Group work:

"I like the group working. If you don't get you ask your partner [sic] . I don't work well with all people but when he lets us choose our groups, we can get with people we know and understand and its easier to work with people you know"

"I enjoy working in groups. It has made math a little easier. But I am still having trouble with something. I know you get a little disappointed at me when I talk instead of working. May be you get angry. I don't know. I will try to work more and less talking"

"My group work well together, we show each other how to do the problems we don't understand" [sic]

"Working with groups is fun. If you need help you don't always have to ask the teacher, the other group member might know that save the teacher time from explaining everything more than once. Sometimes the group get on nerves! The thing I don't like with in groups is that when only one person does the work and others copy" [sic]

"the positive thing that went in my group is everyone helped each other in a politely way. Our group had patience and we waited until we get the correct answer. Also if we don't know what's the answer we raise our hand patiently until the teacher come and help us"

"This group can get a little to loud because I am a loud outgoing person but we should get along pretty well"

"I liked this group but I am not a group person, I am a one on one person, because if some thing happen my attention goes elsewhere that's why it is better for me to work alone. I get more done."

Calculator Usage:

The calculator is faster, help to graph makes the work easier, fractions: go to math and click fraction and push enter

The calculator helps me because its much easier to do than to write on paper or add with finger, it does the graph for you, you don't waste time, when not using it you have to write down every step and takes to long

I think the calculator are very cool we should continue using them cause it's great

The calculator helps me, because it makes it faster and easier to do the problems because I've always had a problem in math classes, because I am slow than most people. the calculator, if you do the procedure correctly gives you the right answers every time. And if you don't have a good memory it helps you get better at math, I learn how to graph linear equation

The graphing calculator helps me to understand a lot better. I can get a lot done better and faster with my work. Its great when graphing linear equations. The table gives

information. It helps me quicker working with the fractions

The graphing still over my head, but I believe I will understand soon, I still would like to work with groups

I think they should let us use calculators on testing.

Computer usage:

Its easier than the book

I like it cause it helps me practice

I pass the practice test with 75%

I think it helps me practice and repeat the mistakes I made

I feel I still need pencil and paper, we should work more on the computer

I like the tutoring part

I feel better when I score and tells me good job

I feel better

computer is fun

I always get the wrong answer (stink)."

Manipulatives:

I use my hands

algebra is easy

I hate math

I always score high

easy to understand

now I know more algebra

no homework!

manipulatives are helpful

they were fun

too noisy

easier than the book

I had some like this before

you see what you doing

just give the book

can I take it home.

After the students completed the pre-post-survey (Table 10), the results were analyzed by calculating the percentages for both groups and compared the results. The five-point scale measured the students' attitude towards algebra. The experimental group showed an improvement in attitude toward algebra. The survey indicated a major increase in student's positive experience during the study. In some cases, for instance, the control group survey showed a decline in "I had the opportunity to work in groups." The control group felt almost the same in the pre-post-survey when it came to over-all algebra experience during the study. Word-problems were difficult for both groups. This might be caused by the lack of the students' background in that area.

In conclusion, Chapter Four discussed and analyzed the results of data for the study. The results of data were shown in Table 2 through Table 8. The calculated data showed no statistically significant difference in the achievement of the nontraditional group over the traditional group at alpha level of .05. However, the results of the survey showed an improvement in students' attitude toward algebra. Samples of students' writing comments over group work, calculator usage, computer usage, and manipulatives

were included in this chapter.

The finding results of the study allow us to draw conclusions and make recommendations which lead us to the next chapter (Chapter Five).

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATION

Summary

The purpose of this study was to compare the effect of a traditional instructional approach to nontraditional instructional techniques on mathematics achievement of ninth grade algebra I students. One group of students was taught using a traditional method (identified as the control group) and the other group was given instruction using a nontraditional method (identified as the experimental group).

This study was conducted during Fall of 2002-2003 school year and began with forty students. Twenty pupils made up the control group (traditional), and the other twenty were in the experimental (nontraditional). Due to students transferring to other districts and student absenteeism, the traditional group lost five students and the nontraditional lost four students. The control group was left with fifteen students and the experimental retained sixteen students. The researcher was the instructor for both classes. The procedures for and the purpose of the study were explained to each class. The duration of the study was for nine weeks during the fall semester.

The control group was given instructions with the traditional method involving lecture and pencil and paper using a standard algebra textbook. The experimental group was given instruction with a series of nontraditional methods such as manipulatives, graphing calculators, cooperative group learning, and computer tutoring. The time, days,

and length of instruction were the same for the two groups.

A pre-test and a post-test which covered the concepts presented in Chapter Nine and Chapter Eleven were given to the students. Each class had to take six tests, three pre-tests and three post-tests. The tests required short answers covering the chapter's topics. A pre- and post-survey to assess students' attitude toward there algebra learning experience were also given to students. The pre-survey was completed during the week before the study began and the post-survey was completed the last day of the study. A two-sample t-test was performed on the pre-post tests (data).

The results of Table 1 showed the students raw scores for all tests of both chapters (pre- and post-tests of Chapter Nine only, Chapter Eleven only, and Chapters Nine and Eleven combined). Test scores were based on how many correct answer the student score on each test. The students of group 1 represent the control group and they were numbered from 1 though 15 (Table 1). Students of group 2 represent the experimental group and the were numbered from 16 though 31 (Table 1). One primary concern in teaching the course was that students learn and understand algebra based on covering a list of prescribed topics. With this in mind, and using the constructivist approach, the time necessary to cover all topics was short and limited to nine weeks. The students' scores were low due to the limited time of the study.

The results of the study on Chapter Nine pretest raw score only indicated the nontraditional group's mean score was 5.00 compared to the mean score 4.33 of traditional group. The mean scores for the nontraditional group was a little more than the mean score for the traditional group. The difference was not significant. There was no statistical significant difference in the two groups' performance on the Chapter Nine

pretest. The calculated t-value was -1.394 compared to the value of the t-critical 2.045 with a degree of freedom 29. The standard deviation is the measure where the student's scores deviates from the mean. The standard deviation for the traditional group was 0.82 compared to 1.67 for nontraditional group.

Chapter Eleven only Pretest results indicated the traditional group's mean scores was 5.73 compared to 4.69 for the nontraditional group. The difference was not significant. The t-value calculated was 1.107 compared to t-critical 2.045. This means, there was no statistically significant difference in the groups' performance on Chapter Eleven pretest only with alpha level 0.05 and a degree of freedom of 29. Standard deviation was 3.01 for traditional group and was 2.21 for the nontraditional group.

The results of Chapter Nine and Eleven Pretest Combined indicated the nontraditional groups' mean score was 6.44 compared to the traditional group mean score of 5.07. The difference was not significant. The t-calculated was - 1.100 compared to t-critical 2.045. There was no statistically significant difference at alpha level 0.05 and degree of freedom 29. The results of the posttest of Chapter Nine only was calculated and showed the traditional group mean score was smaller (6.67) compared to the nontraditional mean scores (7.31). The t-calculated (-0.667) was less than the t-critical. This yields to no statistical significant difference in students' performance with alpha level 0.05.

The results shown in Table 6 was a comparison of students post-test of Chapter Eleven only. The mean score for the traditional was 8.47 compared to little higher mean score of the nontraditional group 8.88. the t-calculated was smaller than t-critical. Therefore, there was no statistically significant difference in students' performance for

the two groups on the post test of Chapter Eleven only. The results of the posttests of Chapter Nine and Eleven Combined showed in Table 7. The mean score for the traditional (12.87) was slightly higher than the mean score of the nontraditional group (12.13). The t-calculated (0.651) was smaller than the t-critical (2.045) for the posttest of Chapters Nine and Eleven combined, therefore, there was no statistically significant difference in students' performance. The Internal consistency reliability on all measures was computed. The results showed low correlation, which yields to a low relationship between groups except in the case of pre-post tests of Chapter Eleven Only. The correlation indicated no statistical significance except in pre-post-test chapter 11 which was .366* (Table 8).

The results of the pre-post-surveys, in general, indicated both groups, the traditional group and the nontraditional group, possessed positive attitudes toward their algebra learning experience. The nontraditional group seemed to enjoy and had more fun during the study. Their (nontraditional group) comments during and at the end of the study indicated improvement in their performance. There was no statistically significant difference between pre- and post-test for the nontraditional group over the traditional group at alpha level .05 on difference between pre-post test on Chapter Nine Only. The same for Chapter Eleven Only, there was no statistically significant difference between pre- and post-test for the nontraditional group over the traditional group. There was no statistically significant difference between pre- and post-test for Chapter Nine and Eleven combined for the nontraditional group over the traditional group. A t-test was performed as a comparison on the pre-tests and the post-tests of the two groups and found that there was no statistically significant difference on the student performance at alpha level .05.

Conclusions

The researcher has taught algebra for 10 years, along with pre-calculus, calculus, trigonometry, mathematics analysis, and geometry. He has used this approach four times in different locations in the United States. The researcher was giving more considerable amount of time the cover the same topics in those location. This approach was very challenging to cover all topics in a short period of time.

There has been a major concern from the state department of education and the school district about falling algebra scores on standardized tests. A new state mandate prescribed that all algebra I students are required to take a test at the completion of their algebra I course at the end of the school year called the End of Instruction Test. This mandate added to the existing low score problem in mathematics by requiring schools to complete certain objectives in algebra prior to the end of the academic year and that students would pass the end of Instruction Test. Mathematics teachers are frustrated because they think the state mandate is difficult to accomplish due to the students' ways of learning an algebra concept, some students need more time to accomplish their required class assignment, and this itself might make a delay in the completion of state objectives on time and get the students ready for the end of the course test. Another problem of delay to accomplish the state objectives is class size. Some teachers teaches 30-40 students in one classroom. Because of these reasons, when students take the state test and encounter a test question they can't do, because they have not seen anything like it before or the objective was not covered, the student has two choices: 1) he/she can skip the question, or 2) guess the answer. Certainly, when students miss questions on tests their scores become lower than expected. This study presented an alternative form of

instructing students through a variety of techniques that could improve student achievement in algebra. Techniques such as manipulatives, graphing calculators, computer program, and small group, were to be incorporated and employed into the students' learning of algebra concepts. Students who participated in the study believed that different instructional techniques had helped them understand algebra better than just when a teacher lectures. That is based on the teacher explaining a few examples, asking question and assigning students to answer problems by him/herself, and finally assigning 20-30 problems for students to practice as homework.

This research supported the Menis (1980) study that described how the use of computers helped to improve the achievement of the weaker tenth grade students, but had no impact on the achievement of the better mathematics students. The results of this study seemed to indicate that the non traditional learning approach method did not make statistically significant difference on students' achievement in algebra I the pr-test scores indicate that the control group had a higher level understanding the material of Chapter Eleven Only, the students in both groups seemed to have the same understanding of the objectives in Chapter Nine Only. The comparison of students' pre-test scores t-test showed no statisticall significant difference (see Tables 4,5,6). The results of this study then did not supported Leinenbach's & Reymond's studies (1996) when they suggested the use of manipulatives improved academic performance in algebra for a set of 120 eighth-grade students. This research found no statistically significant difference on students achievement using the nontraditinal method (see Chapter four). These results finding supported Sharp (1995) whose findings also suggested that there was no statistical differences between the two groups who used or who did not used

manipulatives when a traditional chapter test was given to students to determine the level of student learning.

The results in this research suggested a nontraditional approach in teaching algebra I made no significant difference on student achievement. While the data found no significant difference on the over-all pre-test scores for both groups also, the pre-test scores for Chapters Nine and Eleven indicate that the experimental group may have a better understanding at the beginning of the study, but not significantly. On the other hand, the pre-test scores on Chapter Eleven indicate that the traditional group may has a little better understanding about the material at the beginning of the study, but not significantly. The result of a little higher scores on pre-tests indicated that students may already knew the information. The non-statistically significance results of the study might be that the tests were more traditional than nontraditional or the nontraditional students did not want to put more effort into their learning by checking their work. The reliability of the test was low on all measures except on pre-post-test of Chapter Eleven.

The post-survey data suggested that most ninth grade students expressed a more positive attitude about their algebra experience when working with groups, manipulatives, and technology such as graphing calculators and computer tutoring. Students' seem to enjoy cooperative group learning the most. This showed in their journal writing because they were actively involved. Students became more responsible in terms of finishing their work, they were able to communicate, read and write mathematically more effectively. Students learned how to cooperate with each other and make decisions over a mathematical problem by explaining their thinking and sharing their ideas on how to solve the mathematics problem and get to the answer. Today's

marketplace depends on sharing ideas and make a group decision is an essential factor to success and making profits. The students' responses on the attitude survey indicated a decline in students' attitudes for the control group when it came to working with a group moving from 61% to 40% agree. This decline may have been because the students were taught through a traditional approach. Both groups felt algebra was useful in their life because of their exposure to real-world problems. For example, they worked solving problems that dealt with money and distance, even though most students thought word problems were very difficult.

The students in both groups had a positive attitude toward the instructor. For the control group, the percent agree to strongly agree went from 67% approval to 83% approval at the end of the study. The experimental groups' approval went from 50% (pre-survey) approval to 75% approval (post-survey). The control groups' approval went from 56% approval (pre-survey) to 87% (post-survey) approval even though they felt they had complete too many drill and practice exercises in class. On the other hand, the experimental group's approval of drill and practice exercise in class went from 60% (pre-survey) approval to 69% (post-survey) approval. The experimental group felt that the completion of drill exercises was easy because they worked in small groups, they used manipulative, and calculators to finish their assignments. The control group answers to the statement "I felt algebra was not related to real life" went from 6% agree to strongly agree (pre-survey) to 13% (post-survey) agree to strongly agree. This result was a little disappointing, and might be because the instruction did not involve a variety of techniques. For the experimental group "I felt algebra was not related to real life" went from 45% (pre-survey) approval to 25% (post-survey) approval because students' thought

the possibility to use manipualtives at work is not to happen. This was interesting in both groups and this result showed a more positive attitude in the experimental group. The students comments and suggestion (Journals) in general seem to indicate that the experimental group learned more in the duration of the study based.

Recommendation

The purpose of any instructional method is to provide students with a sense of success in their learning. Since students vary in their learning styles and their backgrounds, there is no single approach that will work successfully for all students. The following are recommendations for future study:

1) Recommendations for further investigation would be to include a larger sample to reach significance of effectiveness, so that the results found in this study could be generalized.
2) A study would be warranted for a longer duration since nine weeks are not enough. If the experimental group continued their progress, their achievement might be higher than the control group. They built more confidence in their ability to solve problems that required higher thinking skills. Students become more familiar with technology, and the graphing calculator, in particular, should be utilized all the time to help students when graphing linear functions.
3) Recommendations for further study are to create a method of student evaluation that would identify the type of instructional technique that best fit each student. Students who performed better by using manipulatives should be grouped together and work with more manipulative based techniques. Students who performed better within cooperative groups should continued to work with groups. Students who preferred

and performed better when using graphing calculators or the computer should be allowed to use the technology appropriately.

4) Recommendations for further research are to apply the same instructional techniques elsewhere with different geographic regions and same socio-economic status for the purpose of generalization.
5) Recommendations for future investigation are to group the "normal" students who were not fine art students together as a group and to group the fine art students together as a second group, then apply the same instructional techniques with these group of students.
6) Recommendation for future study might include changing the techniques from several all at once to only one technique incorporated at a time. Use computer tutoring in the first 9 weeks, graphing calculators in the second 9 weeks, manipulatives in the third 9 weeks, then cooperative learning in the fourth 9 weeks. In this way students may understand the use of each technique in depth. This recommendation helps students learn algebra more effectively, especially low achievers so they can learn effectively.
7) The validity of the study could be effected due to the bias of the researcher, who was the regular teacher. Two different teachers would minimize the bias.
8) Low correlation means low relationship. This means low reliability and replication of this study is recommended. This might be caused by the lack of students' background in the are of algebra I.

What didn't come too easy was working through some of my rigid paradigms. For instance, I have a high need for structure and strong preference for low noise. The students small group work drove me crazy at the beginning of the study. I felt I would

lose control if I let students work in groups. I was honest with my students about my teaching preferences. I had to let go and I found that was the way to let student learn and I think that's what teaching is all about. I believe students could learn algebra based on nontraditional method if more time is given to the students. I would like to see students learn algebra using the traditional method in less structure classes with two different teachers (male/female) who like informal teaching environment. I feel that the teacher should be a facilitator for the learning process. I would like to see support from all faculty and administrators because some informal (small groups) learning might lead to student discipline and get them in trouble because of the loud noise in school. This study needs further research and future investigation with larger sample of students and a longer duration than nine weeks.

In conclusion, this chapter discussed three area: summary of the study, conclusion, and recommendations. The entire study was of five chapters. Chapter One was the Introduction of the study, Chapter Two discussed the Review of Literature, Chapter Three explained the Methodology of the study, Chapter Four discussed the Analysis of Data, and Chapter Five discussed the Summary, Conclusion, and Recommendations.

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APPENDIX A

Table 10
(Pre-Survey)

Comparison of Students' Beliefs Using the Percentages of Student Who Agree / Strongly Agree

	Control N=18	Experimental N=20
1. I had the opportunity to work in groups, so, I didn't feel isolated in algebra class.	61	65
2. I feel algebra is useful in my life.	50	80
3. In algebra class I still lack an understanding of the vocabulary used.	28	45
4. Word problems were very difficult.	20	25
5. The teacher explained the lesson clearly.	67	50
6. I felt confident when I asked questions.	61	47
7. No body made fun of me when I asked questions.	67	55
8. I had the opportunity to work with manipulatives.	22	55
9. We did a lot of drill and practice in class.	56	60
10. The teacher accept only one method to answer the question.	33	30
11. I had enough time to finish tests.	53	60
12. I felt that I cannot keep up with other classmates.	17	44
13. I felt algebra is not related to real life.	6	45

14. I lack the understanding of the scientific/graphing calculators.	6	45
15. I don't feel the fear of algebra.	61	55
16. I feel that boys are better than girls in algebra.	28	15
17. I feel that I don't have to memorize mathematics rules any more.	22	10
18. I feel better when I used the computer to work mathematics assignments.	28	38
19. I had no mathematics teachers who didn't like mathematics.	56	40
20. Over all my algebra experience was good.	50	60

Please, answer the following questions based on the instructional techniques during the nine-week experience. (Techniques such as cooperative learning, mathematics manipulative, graphing calculators, and/or computer tutoring).

1. Which one of the instructional techniques helps you the most in learning algebra? Why?
2. Which technique was easy to learn? Why?
3. Which technique was the most difficult to learn? Why?
4. How do feel about non-instructional techniques? Were they helpful?
5. Would you recommend nontraditional instructional techniques to be taught to all algebra students? Why?

APPENDIX B

Table 11
(Post Survey)

Comparison of Students' Beliefs Using the Percentages of Student Who Agree and Strongly Agree

	Control N=15	Experimental N=16
1. I had the opportunity to work in groups, so, I didn't feel isolated in algebra class.	40	75
2. I feel algebra is useful in my life.	67	81
3. In algebra class I still lack an understanding of the vocabulary used.	20	44
4. Word problems were very difficult.	28	38
5. The teacher explained the lesson clearly.	83	75
6. I felt confident when I asked questions.	67	63
7. No body made fun of me when I asked questions.	83	69
8. I had the opportunity to work with manipulatives	53	80
9. We did a lot of drill and practice in class.	87	69
10. The teacher accept only one method to answer the question.	13	13
11. I had enough time to finish tests.	78	69
12. I felt that I cannot keep up with other classmates.	13	25
13. I felt algebra is not related to real life.	13	25

14. I lacked the understanding of the scientific/graphing calculators.	13	25
15. I don't feel the fear of algebra.	67	50
16. I feel that boys are better than girls in mathematics.	13	13
17. I feel that I don't have to memorize mathematics rules and more.	33	19
18. I feel better when I used the computer to work mathematics assignments.	53	55
19. I had no mathematics teachers who didn't like mathematics.	67	50
20. Over all my algebra experience was good.	53	89

Please, answer the following questions based on the instructional techniques during the nine-week experience. (Techniques such as cooperative learning, mathematics manipulative, graphing calculators, and/or computer tutoring).

1. Which one of the instructional techniques helps you the most in learning algebra? Why?
2. Which technique was easy to learn? Why?
3. Which technique was the most difficult to learn? Why?
4. How do feel about non-instructional techniques? Were they helpful?
5. Would you recommend nontraditional instructional techniques to be taught to all algebra students? Why?

Oklahoma State University
Institutional Review Board

Protocol Expires: 10/30/2003

Date: Thursday, October 31, 2002 IRB Application No ED0247

Proposal Title: THE EFFECT OF NONTRADITIONAL INSTRUCTIONAL TECHNIQUES ON MATHEMATICS ACHIEVEMENT OF NINTH GRADE ALGEBRA I STUDENTS

Principal Investigator(s):

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Reviewed and Processed as: Expedited (Spec Pop)

Approval Status Recommended by Reviewer(s): Approved

Dear PI :

Your IRB application referenced above has been approved for one calendar year. Please make note of the expiration date indicated above. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved projects are subject to monitoring by the IRB. If you have questions about the IRB procedures or need any assistance from the Board, please contact Sharon Bacher, the Executive Secretary to the IRB, in 415 Whitehurst (phone: 405-744-5700, sbacher@okstate.edu).

Sincerely,

Carol Olson

Carol Olson, Chair
Institutional Review Board

VITA

Thabet S. Abdallah

Candidate of the degree of

Doctor of Education

Dissertation: THE EFFECT OF NONTRADITIONAL INSTRUCTIONAL TECHNIQUES ON MATHEMATICS ACHIEVEMENT OF NINTH GRADE ALGEBRA I STUDENTS

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