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A study comparing two methods of teaching inequalities and polynomials to college prep Algebra 1 students

Kimberly Ann O'Rourke
Rowan College of New Jersey

A STUDY COMPARING TWO METHODS OF TEACHING INEQUALITIES AND POLYNOMIALS TO COLLEGE PREP ALGEBRA I STUDENTS

by
Kimberly Ann O'Rourke

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ABSTRACT

Kimberly Ann O'Rourke, A Study Comparing Two Methods of Teaching Inequalities and Polynomials to College Prep Algebra 1 Students, 1996, J. Sooy, Mathematics Education

The purpose of this study was to determine whether significant differences existed in the learning of inequalities and polynomials by using the traditional Algebra 1 book as opposed to Applied Mathematics units.

The population used for this study was comprised of students from two college prep Algebra 1 classes at Collingswood High School, Collingswood, New Jersey. The experimental group was taught inequalities and polynomials using the Applied Mathematics units and the control group was taught these subjects using the traditional Algebra 1 book. At the beginning of the study, the mean of each group's first marking period grades was used as a pretest to show that the ability level in both groups was comparable. After completing instruction on inequalities, the two groups were given a common posttest. An independent t-test was administered, which determined that there was no significant difference between the two groups. After completing instruction on polynomials, both groups were given a posttest on polynomials. An independent t-test was used, which determined that there was no significant difference berween the groups. The researcher then made a comparison between the males and the females in the experimental group. Their combined inequalities and polynomials scores were used and an independent t-test showed that there was no significant difference.

The conclusion from this study indicated that neither method of teaching inequalities and polynomials in Algebra 1 classes resulted in a significant advantage over the other.

MINI-ABSTRACT

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The purpose of this study was to determine whether significant differences existed in the learning of inequalities and polynomials by using the traditional Algebra 1 book as opposed to Applied Mathematics units. The conclusion from this study indicated that neither method of teaching inequalities and polynomials in Algebra 1 classes resulted in a significant advantage over the other.

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CHAPTER 1

Introduction to the Study

Introduction

Many students have taken a course in algebra by the time they have graduated high school. According to the National Council of Teachers of Mathematics, "In many cases, this is an algebra that is essentially the algebra of earlier decades and not an algebra that will prepare students to enter [our] vibrant and technological world." Algebra should be taught using a method that will transfer its principles to a person's occupation. "...Algebra in its present form filters large numbers of students from the further study of mathematics."[1] In order to be ready to move into the world of work, students need to be mathematically competent. Algebra is a basis for that competency. Mathematics educators need to find a method that allows this competency to grow. "...Many 12th graders display only limited mastery of the major concepts- and often are unable to use their knowledge to solve problems."[2] Solving problems in algebra is the key to understanding its concepts. Unfortunately the algebra taught today is not allowing the students to solve these problems in a "real-life" manner. According to Donald Chambers, former mathematics supervisor in Wisconsin, "We just need to get the right algebra."

Problem

The purpose of this study is to determine whether significant differences exist in the learning of inequalities and polynomials by using the traditional Algebra 1 book as opposed to Applied Mathematics units. To determine whether significant differences exist, the following hypothesis will be tested:

H_O: There is no significant difference in the learning of inequalities between the students who are taught using the traditional Algebra 1 book and those students who are taught using the Applied Mathematics units.

H_O: There is no significant difference in the learning of polynomials between the control group and the experimental group.

H_O: There is no significant difference in the learning of inequalities and polynomials between the control group and the experimental group.

The following hypothesis will also be tested:

H_O: There is no significant difference in the learning of inequalities and polynomials between males and females in the experimental group.

Significance of the Problem

According to Edward A. Silver, "Algebra is sometimes called a gatekeeper to educational opportunity..." Therefore it is important for students to learn algebra in the best possible way. Is the method by which algebra is taught traditionally, using a textbook, appropriate? Or will students get more from a hands-on, reality-based algebra? "The problem rests with the content and teaching methods used in traditional algebra courses."[3] Algebra needs to be taught in a way that will emphasize "...thinking, reasoning, communication, and problem solving- all important goals in the NCTM Standards (1989)."[4]

"Algebra's reputation as arcane is well known and well deserved."[5] Secondary schools must choose a way to teach algebra that will prove most beneficial to all students. It has been stated that the best way to teach mathematics is in a manner that "...stresses hands-on application and real-life problem solving..."[6] This means that the classroom becomes a place in which more materials are used, group learning is incorporated, creative thinking and discussion are part of a daily algebra class, instead of the usual lecture, memorization and drill. "Making math relevant is one of the prime goals of today's trend."[7] In order to do that, we need to change curriculums. It is the intention of this study to determine if the Applied Mathematics units, which will give the students an opportunity to get a more hands-on, real-life approach, will be a superior method of teaching algebra.

Limitations

This study was conducted at Collingswood High School, a school system comprised of approximately 880 students in grades nine through twelve, with a 17% minority population. Two classes of Algebra 1 were used for the experiment. Algebra classes consist of students from all grade levels. The first class, held from 11:09 to 11:50, had 28 students and the second class, held from 11:54 to 12:35, had 16 students. The book used at Collingswood High School is called Algebra 1 by Jan Fair and Sadie C. Bragg. The study took place over a seven week period from January to March 1996 and dealt with the chapters on inequalities and polynomials.

Definition of Terms

Applied Mathematics

A set of modular learning materials prepared to help high school students develop and refine job-related mathematics skills. The emphasis remains on the ability to understand and apply functional mathematics to solve problems in the world of work.

Control Group

The one of two or more groups that is not subjected to the experimental factor or condition introduced into the treatment of the experimental group.[8]

For the purpose of this study, the control group are those students utilizing the traditional Algebra 1 book.

Experimental Group

The one of two or more groups that is subjected to the experimental factor or condition, the effect of which it is the purpose of the experiment to discover.[9]

For the purpose of this study, the experimental group are those students utilizing the Applied Mathematics units.

Inequality

A statement of this form: "x is less than y," written as $x < y$, or "x is greater than y," written as $x > y$. Inequalities containing numbers will either be true or false. Inequalities containing variables will usually be true for some values of the variable.[10]

Polynomial

A polynomial in x is an algebraic expression of the form

$$a_nx^n + a_{n-1}x^{n-1} + \dots + a_3x^3 + a_2x^2 + a_1x + a_0 ,$$

where $a_0, a_1, \dots, a_n$ are constants that are the coefficients of the polynomial.[11]

Procedures

The population used for this study was comprised of students from two college prep Algebra 1 classes at Collingswood High School, Collingswood, New Jersey. This school system consists of approximately 880 students in grades nine through twelve, with a 17%

minority population. The experimental group was taught inequalities and polynomials using the Applied Mathematics units and the control group was taught these subjects using the traditional Algebra 1 book. Both of these classes were taught by the researcher.

The study commenced at the beginning of the unit on inequalities, January, 1996, and terminated at the end of the unit on polynomials, March, 1996, encompassing a period of seven weeks. At the beginning of the study, the mean of each group's first marking period grades was used as a pretest to show that the ability level in both groups was comparable. In order to compare the two classes marking period grades, it should be known that both classes used the traditional Algebra 1 book up to the point in which the study began. At the end of the unit on inequalities, each group was given a common posttest on inequalities. After the students' posttests were scored, an independent t-test was used to determine if there was a significant difference between the control group and the experimental group. At the end of the unit on polynomials, each group was given a common posttest on polynomials. After these posttests were scored, an independent t-test was used to determine if a significant difference existed between the two groups. The researcher took a combined score on both the inequalities posttest and the polynomials posttest and used an independent t-test to determine if a significant difference existed between the two groups.

At the beginning of the study, the mean of the males and the females in the experimental group's first marking period grades was used as a pretest to show that the ability level in both groups was comparable. After determining the students' combined score on the inequalities posttest and the polynomials posttest, an independent t-test was used to determine if there was a significant difference between the males and the females in the experimental group.

Notes

[1] Donald L. Chambers, "The Right Algebra for All," Educational Leadership 51, no. 6 (March 1994): 85-86.

[2] Edward A. Silver, "Rethinking 'Algebra for All'," Educational Leadership 52 (March 1995): 30-32.

[3] Ibid.

[4] Ibid.

[5] Donald L. Chambers, 85.

[6] Stephen Buckley and Stephanie Griffith, "Refiguring Math Lessons, 'New, New' Method is More Hands-on," The Washington Post, 7 December 1992, A1.

[7] Ibid.

[8] Carter V. Good, Dictionary of Education (New York: McGraw-Hill Book Co., Inc., 1959).

[9] Ibid.

[10] Douglas Downing, Dictionary of Mathematics Terms (New York: Barron's Educational Series, Inc., 1987).

[11] Ibid.

CHAPTER 2

Related Literature and Related Research

Introduction

This chapter will be devoted to the discussion of related literature and related research. While researching the subject of algebra and curriculum, it was found that the best way to approach this information would be to show a historical background of algebra and mathematics curriculums and how they have changed over the years. As for related research, few studies were found that involved algebra and Applied Mathematics because this program has been recently devised. There were a few peripheral studies that will be discussed.

Related Literature

The review of literature indicates that there have been many changes in the mathematics curriculum over the years. After Sputnik I orbited the Earth in 1957, the United States "...focused national attention on the importance of mathematics."[1] "A sense of urgency surrounded the ever-present task of revising curricula and courses..."[2] This was called the 'new' mathematics and was developed in the 1960's. It is important to understand that a 'new' mathematics was not discovered. In the 'new' math, the emphasis was now given to topics that were not previously treated. It introduced recent and important developments in mathematics and emphasized the structure of mathematics. It was "...essentially a renewed mathematics..."[3] The 'new' mathematics had an "...increased importance in an age and society deeply involved in technology."[4] The new program "...stressed learning and use of mathematics rather than memorization."[5] It involved the use of many experimental materials and physical models in the classroom.

As times moved from the 1960's to the 1970's, more curriculum changes in mathematics were made. "Mathematics has changed; knowledge about how students learn mathematics has also changed."[6] Some recommendations through the mid-1970's included "...stressing the applications of mathematics and incorporating calculators and computers in mathematics programs."[7] "New materials were prepared and various school systems were asked to try the new materials and report their usefulness."[8] At this point, programs were revised and new curriculums were developed.

In the 1980's, extensive recommendations were made regarding the role of problem solving. In 1983 the National Commission on Excellence in Education produced *A Nation At Risk: The Imperative for Education Reform*. This report "...stressed that all high school graduates should understand geometric and algebraic concepts... and applications of mathematics in everyday situations. It advocated the development of new, equally demanding mathematics curricula for all students."[9] In 1984 the National Council of Teachers of Mathematics published *Computing and Mathematics: The Impact on Secondary School Curriculum*. It emphasized developing concepts, relationships, structures, and problem-solving skills.

At this point, it is important to note that the mathematics curriculum must continuously change to keep up with the technology of today. "...It is appropriate to think of curriculum development as having a cycle..."[10] This cycle should be approximately five to seven years long and should hold true for the algebra curriculum as well.

"It is recommended that all students study the equivalent of one full year of algebra during high school."[11] Why? "Algebra offers a unique opportunity to develop linkages among the various parts of mathematics which sometimes appear to be unrelated topics..."[12] Algebra's importance has increased in recent decades. But, "as long as we stick to a traditional interpretation of algebra, we cannot educate our youth as it needs to be in order to face the future with fewer dangers."[13] We need to deepen the students' mastery of skills. "The curriculum must be revised to teach appropriate algebraic ideas and greater access to algebraic competence must be provided to all students."[14] Along with revising the curriculum, teachers must improve instructional strategies to get a well-rounded algebra.

All of these curriculum changes have been taking place and will continue to take place in the future. Applied Mathematics is a program that incorporates many of these changes in one way or another. It could be used to replace algebra since it covers all of the concepts algebra covers. Applied Mathematics will "...emphasize both the technical and higher-order thinking skills students need in today's workplace."[15] Algebra needs practical applications that will motivate students and make them want to learn the skills they will need. It may be possible that the algebra curriculum in the future will include the Applied Mathematics materials which in turn would give the students a more real-life, hands-on approach to algebra.

Related Research

In 1994, Edward Allen Williams compared Applied Mathematics I and II with traditional Algebra 1 in a thesis written for the University of Arkansas. He compared the effects of an applied academic approach to teaching Algebra 1 with the effects of a traditional method of teaching Algebra 1.[16] The subjects were 72 Algebra 1 students and 119 Math Tech II students from Springdale High School. The Math Tech II students made up the control group and the Algebra 1 students made up the experimental group. Mathematics scores from the Stanford Achievement Test were collected and analyzed using an independent t-test. Williams found that the control group showed significantly higher achievement than the experimental group. An analysis of covariance was used to analyze the scores from the National Proficiency Survey Series Algebra 1 Test. This score was the dependent variable, the score from the math section of the SAT was the covariate (independent variable), and the method of teaching was the second independent variable. This analysis showed a significant difference between both groups. Williams found that the Math Tech II group scored significantly higher than the Algebra 1 group.

Patricia J. R. Chism conducted a similar study that compared the achievement of students who had completed "Applied I and II" with students who had completed one year of algebra.[17] She also compared their attitudes. The subjects were 224 students from seven high schools in Georgia. An analysis of covariance was used to compare the achievement in mathematics, with the SAT-Math section as the dependent variable. This showed a statistically significant difference between the two groups. The "Applied Math" group showed higher gains in mathematics achievement than the algebra group.

The Mathematics Attitude Inventory (MAI) was used to compare the attitudes towards mathematics of the two groups. A t-test was applied and there was no statistically significant difference between the groups on any of the areas measured by the Mathematics Attitude Inventory.

A similar study was done by William Robinson Johnson. He examined the success indicators for the Applied Mathematics Program in Georgia.[18] The following attributes were used to determine if the program was successful: a) student grade and age, b) student attitude, c) teacher education, or years of experience, d) student's previous mathematics courses, and e) student's career aspirations or educational plans.

The study consisted of data collected from 37 urban and rural high schools in Georgia. The measures of student success that were used were the student's grade assigned at the end of the first term and the difference in pretest and posttest scores on two different units. The following variables had no significant influence on either measure: the student's sex, the student's attitude, the student's plans to take more mathematics courses, or the student's plans after graduation to get a job. The student's grade level and confidence had significant influence on both measures. The following had significant influence on only the student's grade at the end of the term: the student's age and attitude towards success in mathematics, the number of mathematics courses taken, and the teacher's experience in industry. Johnson concluded that attitudes do not appear to have a significant influence on success in the Applied Mathematics courses.

Notes

[1] William M. Alexander, The Changing Secondary School Curriculum- Readings (New York: Holt, Rinehart and Winston, Inc., 1967), 131.

[2] Ibid.

[3] Ibid., 136.

[4] Ibid.

[5] William M Alexander, J. Galen Saylor, and Emmett L. Williams, The High School- Today and Tomorrow (New York: Holt, Rinehart and Winston, Inc., 1971), 249.

[6] Wisconsin Department of Public Instruction, A Guide to Curriculum Planning in Mathematics (Wisconsin Department of Public Instruction, 1986), 2.

[7] Ibid.

[8] J. Lloyd Trump and Delmas F. Miller, Secondary School Curriculum Development: Meeting Challenges of the Times, 3rd ed. (Boston: Allyn and Bacon, Inc., 1979), 44.

[9] Wisconsin Department of Public Instruction, 2.

[10] Ibid., 4.

[11] Ibid., 54.

[12] Ibid.

[13] Caleb Gattegno, "On Algebra," Mathematics Teaching 105 (Dec. 1983): 34-35.

[14] Edward A. Silver, "Rethinking 'Algebra for All'," Education Leadership 52 (March 1995): 30-32.

[15] Moody Oswald, "A Math Course Students Can Use," Vocational Education Journal 61 (May 1986): 42-44.

[16] Edward Allen Williams, A Comparative Study of Applied Mathematics I and II Versus Traditional Algebra 1. (ED.D. diss., University of Arkansas, 1994), abstract in Dissertation Abstracts International 55 (1995): 3712.

[17] Patricia Jane Rich Chism, "Applied Mathematics" and Algebra Students' Mathematics Achievement and Attitudes (ED.D. diss., University of Georgia, 1994), abstract in Dissertation Abstracts International 55 (1995): 2654.

[18] William Robinson Johnson, Success Indicators for the Applied Mathematics Program in Georgia (Vocational Attitudes) (Ph.D. diss., Georgia State University, 1993), abstract in Dissertation Abstracts International 54 (1994): 2498.

CHAPTER 3

Procedures

Introduction

This chapter will include an explanation of the population of the study, the development of lessons, and the conducting of the experiment. Two sections of the course entitled college-prep Algebra 1 were utilized for this study. One group of sixteen students was the called the experimental group. The other group of twenty-eight students was called the control group.

Population of Study

The Collingswood School District is comprised of one high school. It is located in Collingswood, New Jersey- part of Camden County. Collingswood School District was started in 1907. The study was conducted at Collingswood High School. This school system consists of approximately 880 students in grades nine through twelve, with a 17% minority population.

The mathematics curriculum at Collingswood High School is designed to meet the needs of every student. The students involved in this study were freshmen, sophomores, juniors, and seniors at Collingswood High School enrolled in college-prep Algebra 1. Recommendations of the teachers and the guidance department were factors in determining the placement of students in this course.

The experimental group consisted of sixteen students from grades nine and ten. The class took place from 11:54 am to 12:35 pm. This group was taught inequalities and polynomials using Applied Mathematics units developed by the Center for Occupational Research and Development. The control group consisted of twenty-eight students from grades nine through twelve. The class took place from 11:09 am to 11:50 am. This group was taught inequalities and polynomials using the traditional Algebra 1 book, which is called Algebra 1 by Jan Fair and Sadie C. Bragg. Both classes were taught by the researcher.

Development of Lessons

A single list of objectives for inequalities and polynomials was written for both the experimental group and the control group. From this list separate lessons were used for each group.

Experimental Group

This group was taught inequalities and polynomials through the use of the Applied Mathematics units designed by the Center for Occupational Research and Development. The units utilized were: Unit 27- Inequalities, Unit 12- Using Scientific Notation, Unit 14- Solving Problems With Powers and Roots, and Unit 23- Factoring. These units have lessons that include a unit video with a real-life video problem the students solve together, reading assignments, class activities and examples, problem solving activities, several hands-on mathematics labs, and a unit test.[1]

Control Group

This group was taught inequalities and polynomials using the traditional Algebra 1 book.[2] The chapters utilized for the study were Chapter 5- Inequalities and Chapter 6- Polynomials. All lessons and problems were taken from this book.[3]

Conducting the Experiment

The study commenced at the beginning of the chapter on inequalities, January, 1996 and terminated at the end of the chapter on polynomials, March, 1996, encompassing a period of seven weeks. At the beginning of the study, the mean of each group's first marking period grades was used as a pretest to show that the ability level in both groups was comparable. In order to compare the two classes' marking period grades, it should be known that both classes used the traditional Algebra 1 book up to the point in which the study began. An independent t-test was utilized to determine whether there was a significant difference between the two groups.

After completing instruction on inequalities, the two groups were given a common posttest on inequalities. After the students' posttests were scored, an independent t-test was used to determine if there was a significant difference between the experimental group and the control group.

After completing instruction on polynomials, each group was given a common posttest on polynomials. After these posttests were scored, an independent t-test was used to determine if a significant difference existed between the two groups. The researcher then took a combined score on both the inequalities posttest and the polynomials posttest and used an independent t-test to determine if there was a significant difference between the two groups on their combined scores.

At the beginning of the study, the mean of the males and the females in the experimental group's first marking period grades was used as a pretest to show that the ability level in both groups was comparable. After determining the students' combined score on the inequalities posttest and the polynomials posttest, an independent t-test was used to determine if there was a significant difference between the males and the females in the experimental group.

Notes

[1] See Appendix A.

[2] Jan Fair and Sadie C. Bragg, Algebra 1 (New Jersey: Prentice Hall, 1993).

[3] See Appendix B.

CHAPTER 4

Analysis of Data

Introduction

Included in this chapter will be an in-depth analysis of the pretest and the different posttests, including the inequalities posttest, the polynomials posttest, and the combined score of the two posttests.

Analysis of Pretest

The two groups of students were taught Algebra 1 using the traditional Algebra 1 book throughout the first marking period. In order to show that these groups were compatible, the researcher used the first marking period grades as the pretest scores. Appendix B contains the raw data for the pretest scores for each group.

An independent t-test was administered to determine if there was any significant difference between the two groups with respect to their ability in Algebra 1. The following formula was utilized in determining the t-score:

$$t = \frac{\overline{x}_1 - \overline{x}_2}{s_p\sqrt{(1/n_1 + 1/n_2)}} \qquad \text{where } s_p = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

In the formula, $\overline{x_1}$ is the mean of the control group and $\overline{x_2}$ is the mean of the experimental group, where s_1 and s_2 are the standard deviations of the control group and experimental group respectively. Table 1 shows a summary of the results about the pretest scores. The t-score was -0.481 which was not significant at the 0.05 level. Therefore we can assume that the control group and the experimental group were at the same ability level before the experiment began.

Table 1

Summary of Pretest Scores

Group	n	Mean	Standard Deviation
Control Group	28	83.107	12.735
Experimental Group	16	88.187	7.670

Table 2 shows a summary of the results about the pretest scores of the experimental group alone, separated into males and females. The t-score was 0.0825 which was not significant at the 0.05 level. We can safely assume that the males and the females were at the same ability level before the experiment began.

Table 2

Summary of Pretest Scores of the Experimental Group
Separated by Males and Females

Group	n	Mean	Standard Deviation
Males	9	88.33	8.874
Females	7	88	6.481

Analysis of Posttest

After completing instruction on inequalities, the two groups were given a posttest. A summary of the results for both groups appear in Table 3. An independent t-test was administered to determine if there was any significant difference between the two groups with respect to the learning of inequalities. The t-score was -0.7912 which was not significant at the 0.05 level. It was concluded that there was no significant difference between the two groups. Therefore the first null hypothesis cannot be rejected.

Table 3

Summary of Inequalities Posttest Scores

Group	n	Mean	Standard Deviation
Control Group	28	72.25	20.381
Experimental Group	16	76.687	12.202

After completing instruction on polynomials, both groups were given a posttest on polynomials. A summary of the results is found in Table 4. An independent t-test was used to determine if there was any significant difference between the two groups with respect to the learning of polynomials. The t-score was -0.518 which was not significant at the 0.05 level. It was concluded that there was no significant difference between the two groups on the learning of polynomials. Therefore the second null hypothesis cannot be rejected.

Table 4

Summary of Polynomials Posttest Scores

Group	n	Mean	Standard Deviation
Control Group	28	84.714	19.806
Experimental Group	16	87.625	13.889

The researcher then found the combined score of the inequalities posttest and polynomials posttest. The raw data can be found in Appendix B. A summary of the results is found in Table 5. An independent t-test was used to determine if there was a significant difference between the control group and the experimental group. The t-score was -0.746 which was not significant at the 0.05 level. It was concluded that there was no significant difference between the two groups on the learning of inequalities and polynomials. Therefore the third null hypothesis cannot be rejected.

Table 5

Summary of Combined Inequalities and Polynomials Posttest Scores

Group	n	Mean	Standard Deviation
Control Group	28	156.964	34.964
Experimental Group	16	164.312	23.804

The researcher then made a comparison between the males and the females in the experimental group. The combined score on the inequalities and polynomials posttests was used to determine if there was a significant difference between the males and the females in the experimental group on the learning of inequalities and polynomials. A summary of the results is found in Table 6. An independent t-test was used. The t-score was 0.605 which was not significant at the 0.05 level. It was concluded that there was no significant difference between the males and females. Therefore the fourth null hypothesis cannot be rejected.

Table 6

Summary of Combined Inequalities and Polynomials
Posttest Scores of Experimental Group
Separated by Males and Females

Group	n	Mean	Standard Deviation
Males	9	167.556	29.407
Females	7	160.143	15.082

CHAPTER 5

Summary of Findings, Conclusions, and Recommendations

Introduction

This chapter will include the summary of findings, conclusions, and recommendations. The purpose of this study was to determine whether significant differences exist in the learning of inequalities and polynomials by using the traditional Algebra 1 book as opposed to the Applied Mathematics units.

Summary of Findings

A t-test was the measuring instrument utilized to determine whether significant differences existed. Six separate t-tests were administered.

The first t-test was given to determine if the ability levels of the control group and the experimental group were compatible. The control group had a mean of 83.107 and the experimental group had a mean of 88.187. At the 0.05 level, the t-score of -0.481 was not significant and the groups' ability levels were compatible.

The second t-test was given to determine if the males and the females of the experimental group were compatible. The males had a mean of 88.33 and the females had a mean of 88. At the 0.05 level, the t-score of 0.0825 was not significant.

After completing the chapter on inequalities, both groups were given a posttest. The mean of the control group was 72.25 and the mean of the experimental group was 76.687. At the 0.05 level, the t-score of -0.791 was not significant.

After completing the chapter on polynomials, both groups were given a posttest. The control group had a mean of 84.714 and the experimental group had a mean of 87.625. At the 0.05 level, the t-score of -0.518 was not significant.

The researcher took a combined inequalities and polynomials score for each group. The mean of the control group was 156.964 and the mean of the experimental group was 164.312. At the 0.05 level, the t-score of -0.746 was not significant.

The researcher then took a combined score from both posttests separated by the males and the females in the experimental group. The mean of the males was 167.556 and the mean of the females was 160.143. At the 0.05 level, the t-score of 0.603 was not significant.

Conclusions

Neither method of teaching inequalities and polynomials in Algebra 1 classes resulted in a significant advantage over the other. Both methods of teaching resulted in an increase in mathematical achievement. The researcher concludes that either method of teaching inequalities and polynomials would be acceptable in an Algebra 1 class and one is not any better than the other.

Recommendations

In comparing the two methods of teaching inequalities and polynomials, the researcher felt that some techniques used were better than others. The experimental group watched videos dealing with inequalities and polynomials which helped them to see where these topics are used in the real world. They also completed labs on these topics which allowed them to receive a hands-on approach and to work in cooperative groups.

Since the results of this study show that there was no significant difference between the learning of inequalities and polynomials using a traditional method as compared to the Applied method, the researcher felt that there were several areas that could be further studied. One major area is the length of time of the experiment. This experiment took place over a period of seven weeks encompassing only the chapters on inequalities and polynomials. It is recommended that the study be made over a longer period of time and include many more topics in the Algebra 1 curriculum. This may have different effects on the results of the study.

Another area is the size of the sample. The sample in this study consisted of 44 students. It is also recommended that a study be made using a larger sample of students. This may also have different effects on the results of the study.

APPENDICES

APPENDIX A

Lesson Plans for the Experimental Group

Lesson #1

Unit 27- Inequalities

A. Objectives:
   1) To introduce inequalities.
B. Procedures:
   1) Read and discuss the introduction pages of the unit.
   2) Complete examples on board.

Lesson #2

A. Objectives:
   1) To understand how to order all types of numbers.
   2) To solve and graph simple equations and inequalities.
B. Procedures:
   1) Read and discuss ordering section of the unit.
   2) Read and discuss solving and graphing simple equations and inequalities.
   3) Complete all examples and study activities.

Lesson #3

A. Objectives:
   1) To solve inequalities involving addition, subtraction, multiplication, and division.
B. Procedures:
   1) Watch and discuss unit video dealing with real-life situations in which inequalities are used.
   2) Review the graphing of simple equations and inequalities.
   3) Read and discuss solving inequalities.
   4) Complete all examples and study activities.

Lesson #4

A. Objectives:
   1) To solve and graph combined inequalities involving "and" (conjunctions) and "or" (disjunctions).
B. Procedures:
   1) Read and discuss solving and graphing combined inequalities involving "and" and "or".
   2) Discuss intersections and unions.
   3) Discuss differences between "and" and "or" combined inequalities.
   4) Complete all examples and study activities.
   5) Practice.

Lesson #5

A. Objectives:
   1) To solve absolute value equations.

Lesson #5 Continued

B. Procedures:

1) Review the meaning of absolute value.
2) Discuss how to solve absolute value equations.
3) Examples and practice.

Lesson #6

A. Objectives:

1) To solve and graph absolute value inequalities.

B. Procedures:

1) Discuss how to solve absolute value inequalities.
2) Examples and practice.

Lesson # 7

A. Objectives:

1) To use inequalities to help solve word problems.

B. Procedures:

1) Read and discuss using inequalities in word problems.
2) Complete all examples and study activities.

Lesson #8

A. Objectives:

1) To solve real-life problems using inequalities.

B. Procedures:

1) Use word problems at the end of the unit to help students see where inequalities are used in real-life situations.
2) Read and complete ten word problems from various areas including Healthcare Occupations, Industrial Technology, Business and Management, and Home Economics.

Lesson #9

A. Objectives:

1) To complete the lab on inequalities. (See Appendix C)

B. Procedures:

1) Read and discuss lab in detail.
2) Break students into groups of three or four to complete the lab.

Lesson #10

TEST- Inequalities (See Appendix C)

Lesson #11

Unit 12- Scientific Notation

A. Objectives:

1) To introduce scientific notation.

Lesson #11 Continued

B. Procedures:

1) Watch and discuss unit video involving real-life situations in which scientific notation is used.
2) Solve video problem.
3) Read and discuss introduction section of the unit.

Lesson #12

A. Objectives:

1) To understand positive, negative, and zero exponents.
2) To write numbers in scientific notation.

B. Procedures:

1) Read and discuss positive, negative, and zero exponents.
2) Read and discuss how-to write numbers in scientific notation.
3) Complete all examples and study activities.

Lesson #13

A. Objectives:

1) To convert numbers written in scientific notation to decimal form.
2) To use calculators to work with numbers written in scientific notation.

B. Procedures:

1) Read and discuss converting numbers from scientific notation to decimal form.
2) Read and discuss using calculators when working with numbers in scientific notation.
3) Complete all examples and study activities.

Lesson #14

A. Objectives:

1) To add, subtract, multiply, and divide numbers written in scientific notation.

B. Procedures:

1) Read and discuss how-to add, subtract, multiply, and divide numbers written in scientific notation.
2) Complete all examples and study activities.

Lesson #15

A. Objectives:

1) To complete the lab on scientific notation. (See Appendix C)

B. Procedures:

1) Read and discuss lab in detail.
2) Break students into groups of three or four to complete the lab.

Lesson #16

Unit 14- Using Powers and Roots

A. Objectives:

1) To introduce powers and roots.

Lesson #16 Continued

B. Procedures:

1) Watch and discuss unit video dealing with real-life situations in which powers and roots are used.
2) Solve video problem.
3) Read and discuss the introduction of powers and roots.

Lesson #17

A. Objectives:

1) To use the calculator to work with numbers that have exponents.
2) To solve problems that involve the multiplication and division of numbers that have exponents.

B. Procedures:

1) Read and discuss how-to work with numbers that involve powers.
2) Complete all examples and study activities.

Lesson #18

A. Objectives:

1) To identify monomials.
2) To raise a monomial to a power.

B. Procedures:

1) Read and discuss monomials.
2) Complete all examples and study activities.

Lesson #19

Unit 23- Factoring

A. Objectives:

1) To introduce polynomials and multiplying polynomials.

B. Procedures:

1) Read and discuss the introduction to polynomials.
2) Watch and discuss the unit video.
3) Solve the video problem using algebra tiles.

Lesson #20

A. Objectives:

1) To identify polynomials, binomials, and trinomials.
2) To multiply a polynomial by a monomial.

B. Procedures:

1) Read and discuss all types of polynomials.
2) Read and discuss how to multiply a polynomial by a monomial.
3) Complete all examples and study activities.

Lesson #21

A. Objectives:

1) To multiply two binomials.

Lesson #21 Continued

2) To multiply any two polynomials.

B. Procedures:

1) Read and discuss multiplying two binomials- geometrically and algebraically.
2) Read and discuss multiplying any two polynomials.
3) Complete all examples and study activities.
4) Use algebra tiles to practice multiplying two binomials.
5) Use FOIL method to multiply two binomials.

Lesson #22

A. Objectives:

1) To add and subtract polynomials.

B. Procedures:

1) Review combining like terms.
2) Read and discuss adding and subtracting polynomials.
3) Examples and practice.

Lesson #23

A. Objectives:

1) To complete the lab on multiplying polynomials. (See Appendix C)

B. Procedures:

1) Read and discuss lab in detail.
2) Break students into groups of three or four to complete the lab.

Lesson #24

TEST- Polynomials (See Appendix C)

APPENDIX B

Lesson Plans for the Control Group

Lesson #1

Chapter 5- Inequalities

A. Objectives:

1) To graph the solution sets of equations and inequalities on a number line.

B. Procedures:

1) Solve equations and graph the solutions on a number line.
2) Solve inequalities and graph the solutions on a number line.
3) Practice the above concepts.

Lesson #2

A. Objectives:

1) To solve inequalities using the addition and subtraction properties and to draw graphs of the solution sets.

B. Procedures:

1) Review addition and subtraction properties of equations.
2) Discuss addition and subtraction properties of inequalities.
3) Examples and practice.

Lesson #3

A. Objectives:

1) To solve inequalities using the multiplication and division properties and to draw graphs of the solution sets.

B. Procedures:

1) Review multiplication and division properties of equations.
2) Discuss multiplication and division properties of inequalities.
3) Examples and practice.

Lesson #4

A. Objectives:

1) To solve inequalities using more than one inequality property.

B. Procedures:

1) Review solving equations that involve more than one equation property.
2) Examples and practice.

Lesson #5

A. Objectives:

1) To solve combined inequalities and to draw graphs of the solution sets.

B. Procedures:

1) Review meaning of inequalities.
2) Discuss definitions of conjunctions and disjunctions.
3) Examples that involve solving and graphing combined inequalities.
4) Practice.

Lesson #6

A. Objectives:
   1) To solve equations involving absolute value.

B. Procedures:
   1) Review absolute value.
   2) Examples and practice.

Lesson # 7

A. Objectives:
   1) To solve and graph inequalities involving absolute value.

B. Procedures:
   1) Review conjunctions and disjunctions.
   2) Examples and practice.

Lesson #8

A. Objectives:
   1) To use inequalities as a problem solving strategy.

B. Procedures:
   1) Examples and practice.

Lesson #9

TEST - Inequalities (See Appendix C)

Lesson #10

Chapter 6- Polynomials

A. Objectives:
   1) To identify monomials.
   2) To multiply monomials.

B. Procedures:
   1) Review exponents.
   2) Discuss the definition of a monomial.
   3) Discuss the property of exponents for multiplication.
   4) Examples and practice.

Lesson #11

A. Objectives:
   1) To divide monomials.
   2) To identify zero exponents.

B. Procedures:
   1) Review reducing simple fractions.
   2) Discuss the property of exponents for division.
   3) Examples and practice.

Lesson #12

A. Objectives:
1) To raise a monomial to a power.
2) To raise a quotient of monomials to a power.

B. Procedures:
1) Review multiplying monomials.
2) Discuss the property of raising a monomial to a power.
3) Examples and practice.

Lesson #13

A. Objectives:
1) To simplify expressions containing negative exponents.
2) To write numbers in scientific notation.
3) To multiply and divide numbers written in scientific notation.

B. Procedures:
1) Discuss the meaning of a negative exponent.
2) Discuss the definition of a number written in scientific notation.
3) Examples and practice.

Lesson #14

A. Objectives:
1) To identify polynomials, binomials, and trinomials, and the degree of a monomial and a polynomial.
2) To simplify polynomials by combining like terms and writing them in ascending or descending order of exponents.

B. Procedures:
1) Review combining like terms.
2) Discuss the meaning of the degree of a monomial and a polynomial.
3) Examples and practice.

Lesson #15

A. Objectives:
1) To add polynomials.
2) To subtract polynomials.

B. Procedures:
1) Review combining like terms.
2) Examples and practice.

Lesson #16

A. Objectives:
1) To multiply a polynomial by a monomial.
2) To simplify algebraic expressions that involve multiplication of a polynomial by a monomial.

B. Procedures:
1) Review the distributive property.

Lesson #16 Continued

2) Examples and practice.

Lesson #17

A. Objectives:

1) To multiply two binomials.
2) To multiply any two polynomials.

B. Procedures:

1) Discuss the FOIL method for multiplying two binomials.
2) Use the distributive property to multiply two polynomials.
3) Examples and practice.

Lesson #18

A. Objectives:

1) To find the square of a binomial.
2) To find the product of the sum and the difference of two terms.

B. Procedures:

1) Review raising a monomial to a power.
2) Discuss the steps on how-to square a binomial.
3) Discuss the steps on how-to find the product of the sum and difference of the same two terms.
4) Examples and practice.

Lesson #19

TEST- Polynomials (See Appendix C)

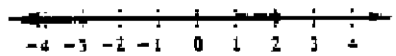
APPENDIX C

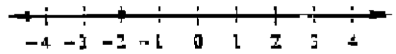
NAME:______________________ DATE:______________________

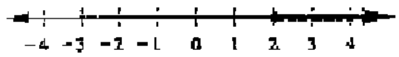
INEQUALITIES TEST MRS. O'ROURKE

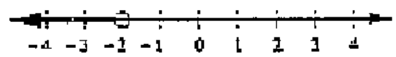
ALGEBRA 1 PERIOD:________

#1-4, Match each equation or inequality with its graph in a-d.

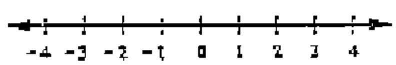
1. $x = -2$ a.  1.____________

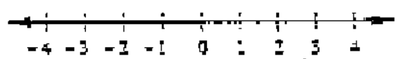
2. $y \geq 2$ b.  2.____________

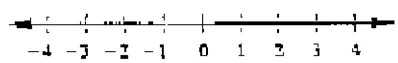
3. $n < -2$ c.  3.____________

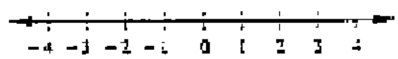
4. $t \leq 2$ d.  4.____________

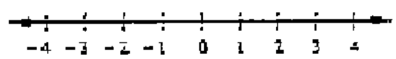
#5-11, Solve each inequality. Draw a graph of the solution set.

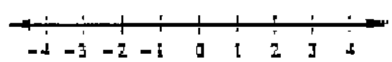
5. $x + 12 < 15$  5.____________

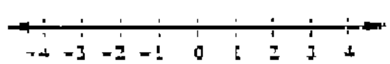
6. $3m - 5 \geq 4$  6.____________

7. $5x - (x - 8) > 9 + 3(2x - 3)$  7.____________

8. $3x + 4 < 10$  8.____________

9. $-2x + 3 < -2$  9.____________

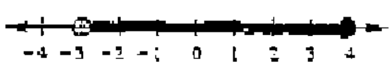
10. $-3 > (2x - 3) \geq 5$  10.____________

11. $16 - 8n < 0$ or $-14 < -7n$  11.____________

#12-14, Match each graph with its inequality in a-c.

12.  a. $-3 < x \leq 4$ 12.____________

13.  b. $-2 < x$ and $x \leq 2$ 13.____________

14.  c. $2 > x > -3$ 14.____________

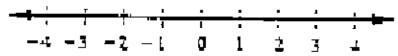
#15-16, Solve each equation.

15. $|t| = 12$ 15.____________

16. $|x + 4| = 9$ 16.____________

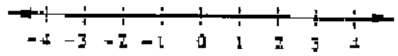
#17-19, Solve each inequality. Draw a graph of the solution set.

17. $|n| < 3$



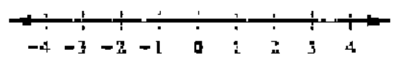
17.______________

18. $|x| + 2 > 5$



18.______________

19. $|2x - 2| > 3$



19.______________

#20-23, Write an inequality to represent each situation. DO NOT SOLVE!!

20. "z is less than or equal to the product of twice y and the square of x." 20.______________

21. "the sum of 3 times a number added to 4 times another number is greater than 50." 21.______________

22. Luis has \$1.00 in his piggy bank and Jess has \$1.50 in hers. Each week Luis deposits 50 cents in his bank and Jess deposits 40 cents in hers. If w represents the number of weeks, write an inequality that should be used to determine when Luis will have more money in his piggy bank than Jess. 22.______________

23. A city has a population of 115,000. The population is increasing at the rate of 900 residents per year. If you let y equal the number of years, write an inequality that can be used to find when the population will be more than 125,000. 23.______________

#24-25, Write an inequality to represent each situation. THEN SOLVE!!

24. Lisa's grades on four exams were 80, 92, 86, and 78. What is the lowest grade she can receive on the next exam to have an average greater than 85? 24.______________

25. Joanie received commissions of \$175 and \$245. How much must she receive from a third sale so her total commission will exceed \$600? 25.______________

NAME:____________________ DATE:____________________

POLYNOMIALS TEST MRS. O'ROURKE

ALGEBRA 1 PERIOD:________

#1-2, Simplify. Assume that no variable equals zero.

1. $(3x^3)(2x^2)$ _______________

2. $\dfrac{15\,a^3b^4}{3a^2b^6}$ _______________

#3-6, Write each number in scientific notation.

3. 750,000,000 _______________

4. 0.0000351 _______________

5. $(1.6 \times 10^2)(8 \times 10^3)$ _______________

6. $\dfrac{128 \times 10^6}{32 \times 10^3}$ _______________

#7-8, Write each number in decimal form.

7. 1.11×10^{-2} _______________

8. 3.5×10^7 _______________

#9-10, State the degree.

9. $10x^2y^3z$ _______________

10. $4a^2b - 7a^3b^2 + 8ab^3$ _______________

#11-12, Simplify and write each polynomial in descending order.

11. $12b^2 + 7b - 6b^2 + 4b^3 + 3b$

____

12. $x^2 + 21 - 3x + 7x + 2x^2 - 17 + x$

____

#13-14, Add or subtract, as indicated.

13. $(m^2 - 6m + 4) + (7m^2 + 2m - 8)$

____

14. $(4t^3 - 4t^2 + 9) - (7t^2 + 3t - 4)$

____

#15-20, Simplify.

15. $4m^2(5m^2 - 2m + 6)$ _______________

16. $(5a + 4)(a + 3)$ _______________

17. $(7x - 2)^2$ _______________

18. $(y + 8)(y - 8)$ _______________

19. $(x - 6)(3x - 4)$ ______________

20. $(3t - 1)(4t^2 + 2t + 5)$ ______________

#21-25, Identify whether the given set of terms is a monomial (M), a binomial (B), or a trinomial (T).

21. $y + 16$ ______________

22. $x^2 + 5x - 7$ ______________

23. $12a^2 - 1$ ______________

24. 10,245 ______________

25. $3z^3$ ______________

<u>EXTRA CREDIT: (3 pts)</u>

A) Suppose you have 120 objects that you want to arrange in a rectangular-shaped pattern. You want the finished pattern to be as close to the shape of a square as possible. What number of objects should you place along each side?

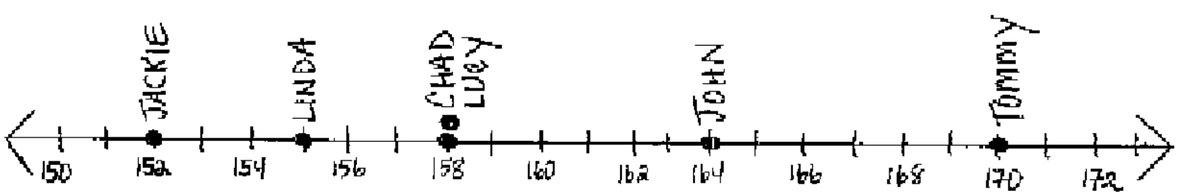
LAB - UNIT 27 - ACTIVITY 1
The distribution of student heights

Name: ______________________________ p. 34-35
Group #:__________
Date:__________

Equipment: Tape measure with metric scale
Graph paper
Calculator

Statement of Problem: The heights of the students in the class can be plotted on a number line. Inequality comparisons are made on the measurements of the group, and on the distribution of the measurements of the class.

Procedure: a. Use your graph paper to create a number line that includes all the height measurements for your group. Plot the height measurements on your number line, and place each member's name above the point. An example is shown below. (If two members have the same height, "stack" the points and their names above each other.)



b. Using each of the three inequality relationships (<, >, and =) in turn, write an inequality expression relating various pairs of height measurements. Use measurements for every member of your lab group at least once. For example, using the sample number line data above, you could write "Liz > Judy".

1)

2)

3)

c. Select three heights from your measurements and write a combined "less than" inequality, using all three measurements. Select another three measurements and write a combined "greater than" inequality. For example, using John, Pat, and Bob from the sample number line data, you could write "Bob < John < Pat".

1) 2)

d. Be prepared to share your inequalities with the class.

e. Your teacher will prepare a number line at the front of the class where all the groups can record their results. One member of your group should go forward and add your group's data to the class number line.

f. Determine how many students from your class would represent 80% of all the members in the class. That is, for a class with n members, calculate $0.8n$. Then write an inequality statement that describes a range of heights that includes at least 80% of the students in your class. For example, "153 cm < Height < 166 cm", or "Height < 164 cm". Compare your answer with the rest of the class.

1)

g. How do you think your answer in Step **f** could be used to predict the heights of other students of the same age group in your school? Explain.

LAB - UNIT 12 - ACTIVITY 3

Measuring water molecules

Name: ______________________

Group #: __________

Date: __________

Equipment: Graduated cylinder, 500-milliliter capacity
String
Spring scales with a 5000-gram capacity
Water supply and drain
Calculator

Statement of Problem: In this activity, you measure the volume and weight of a sample of water and use this data to calculate the **number of molecules** in the sample and the **average volume and weight of each molecule**.

Procedure: **a.** Tie a string around the top of the graduated cylinder as shown by the teacher. Weigh the empty graduated cylinder and string by hooking the loop on the spring scales. Write this weight below:

WEIGHT: __________

b. Measure out a 500-milliliter volume of water in the graduated cylinder. Weigh the water and graduated cylinder together on the spring scales. Write this combined weight below.

WEIGHT: __________

c. Subtract the weight of the empty graduated cylinder and string from the combined weight of the water and graduated cylinder. This is the weight of the water sample. Write this weight below.

WEIGHT: __________

d. There are 6.02×10^{23} molecules of water in 18 grams of water. Set up a proportion to determine the number of molecules in your 500-milliliter sample. Write your answer below in **scientific notation.**

PROPORTION: __________

OF MOLECULES: __________

e. Based on the data in Step d, calculate the average volume per molecule, and the average weight per molecule. Write your answers below in **scientific notation**.

AVERAGE VOLUME PER MOLECULE:______________

AVERAGE WEIGHT PER MOLECULE:______________

LAB - UNIT 23 - ACTIVITY 1
Working with polynomials and math tiles

Name: ______________________________ p. 33-34

Group #: ____________

Date: ____________

Equipment: Set of math tiles, sheet of graph paper

Statement of Problem Multiplying polynomials is often easier if you can picture the product as an "area". This lab will give you a chance to make a picture of a polynomial using math tiles.

Procedure

a. Begin by sorting the three types of tiles into separate piles: the 1-tiles, the x-tiles, and the x^2-tiles. Remember, the x^2-tiles are the large squares, the 1-tiles are the small squares, and the x-tiles are the long, rectangular-shaped tiles.

b. Multiply the following polynomials together by forming a rectangle of math tiles (as shown earlier by the teacher). Write your answers besides each problem.

$(x + 5)(2x + 2)=$

$(3x + 1)(x + 1)=$

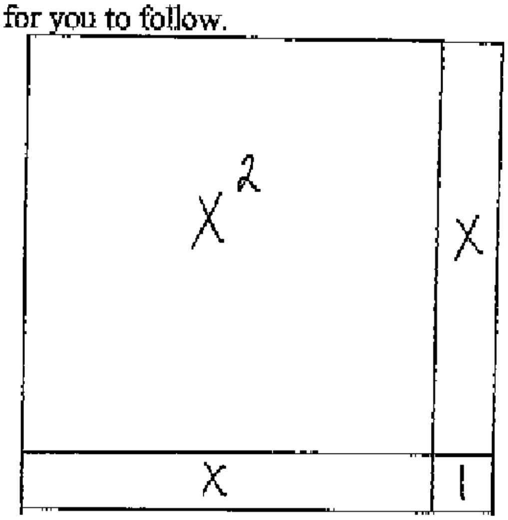
$(x + 4)(x + 3)=$

$(2x + 4)(2x + 1)=$

$(4x + 1)(x + 2)=$

c. On the graph paper, copy the rectangle you formed for each product and label each piece. An example is shown below for you to follow.

$(x+1)(x+1) =$
$x^2 + 2x + 1$



d. Check each of your answers using the FOIL method. Do the answers agree? Should the answers agree? Please write your answer below.

APPENDIX D

Raw Data for the Control Group

1st Marking Period Grades-Pretest	Inequalities Posttest	Polynomials Posttest	Combined Score
96	90	102	192
38	63	69	132
94	84	97	181
78	78	102	180
88	91	89	180
93	88	100	188
87	87	95	182
74	76	101	177
93	74	97	171
84	77	87	164
77	82	89	171
66	38	25	63
86	73	95	168
91	91	95	186
94	94	80	174
78	56	72	128
96	95	103	198
80	68	52	120
94	96	104	200
77	70	72	142
68	48	59	107
72	63	43	106
96	71	103	174
97	72	92	164
88	76	86	162
81	70	85	155
74	0	83	83
87	52	95	147
n = 28	n = 28	n = 28	n = 28
mean = 83.107	mean = 72.25	mean = 84.714	mean = 156.964
s.d. = 12.735	s.d. = 20.381	s.d. = 19.806	s.d. = 34.964

Raw Data for the Experimental Group

1st Marking Period Grades-Pretest	Inequalities Posttest	Polynomials Posttest	Combined Score
92	74	92	166
90	74	70	144
87	92	103	195
66	42	61	103
88	75	99	174
83	78	90	168
97	82	91	173
93	83	99	182
92	71	62	133
90	75	72	147
96	78	101	179
89	81	84	165
77	65	94	159
87	81	92	173
90	77	91	168
94	99	101	200
n = 16	n = 16	n = 16	n = 16
mean = 88.187	mean = 76.687	mean = 87.625	mean = 164.312
s.d. = 7.67	s.d. = 12.202	s.d. = 13.889	s.d. = 23.804

Raw Data for the Males in the Experimental Group

<u>1st Marking Period Grades-Pretest</u>	<u>Combined Score</u>
92	166
90	144
87	195
66	103
88	174
93	182
96	179
89	165
94	200
n = 9	n = 9
mean = 88.33	mean = 167.556
s.d. = 8.874	s.d. = 29.407

Raw Data for the Females in the Experimental Group

<u>1st Marking Period Grades-Pretest</u>	<u>Combined Score</u>
83	168
97	173
92	133
90	147
77	159
87	173
90	168
n = 7	n = 7
mean = 88	mean = 160.143
s.d. = 6.481	s.d. = 15.082

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