A STUDY OF THE EDUCATIONAL BACKGROUNDS AND ATTITUDES OF
TEACHERS TOWARD ALGEBRA AS RELATED TO THE ATTITUDES
AND ACHIEVEMENTS OF THEIR ANGLO-AMERICAN AND
LATIN-AMERICAN PUPILS IN FIRST-YEAR
ALGEBRA CLASSES OF TEXAS

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DISSERTATION

Presented to the Graduate Council of the North Texas State University in Partial Fulfillment of the Requirements

For the Degree of

DOCTOR OF EDUCATION

By

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CHAPTER I

INTRODUCTION

Statement of the Problem

The problem of this study was to determine the extent to which certain characteristics of teachers of first-year* algebra were related to (a) their pupils' attitudes toward algebra and (b) their pupils' achievements in algebra. An additional aspect of the study was to ascertain and study the differences between Anglo- and Latin-American pupils' attitudes and achievements in algebra.

The specific subproblems involved in the study were the determination of:

1. The relationship that exists between teachers' attitudes toward algebra and pupils' achievements in algebra.

2. The relationship that exists between subject matter preparation in mathematics of algebra teachers and pupils' achievements in algebra.

3. The relationship that exists between the backgrounds in professional education of algebra teachers and pupils' achievements in algebra.

*For purposes of this study, the word "algebra" was used to indicate in all cases "first-year algebra."
4. The relationship that exists between the algebra teachers' judgments concerning the practical value of algebra and the pupils' achievements in algebra.

5. The relationship that exists between the judgments of teachers concerning the practical value of algebra and the end-of-course judgments of pupils regarding the practical value of algebra.

6. The relationship that exists between teachers' attitudes toward algebra and the end-of-course attitudes of pupils toward algebra.

7. The relationship that exists between teachers' attitudes toward algebra and the changes in pupils' attitudes toward algebra.

8. The relationship that exists between the changes in the attitude scores of pupils when taught by teachers with "favorable" attitudes toward algebra and teachers with "unfavorable" attitudes toward algebra.

Hypotheses

This study tested the following hypotheses:

1. That there was a significant relationship between teachers' attitudes and the pupils' achievements in algebra.

2. That there was a significant relationship between subject matter preparation in mathematics of algebra teachers and the pupils' achievements in algebra.
3. That there was a significant relationship between the backgrounds in professional education of algebra teachers and the pupils' achievements in algebra.

4. That there was a significant relationship between the judgments of teachers concerning the practical value of algebra and the pupils' achievements in algebra.

5. That there was a significant relationship between the judgments of teachers concerning the practical value of algebra and the end-of-course judgments of pupils regarding the practical value of algebra.

6. That there was a significant relationship between the teachers' attitudes toward algebra and the end-of-course attitudes of pupils toward algebra.

7. That there was a significant relationship between the teachers' attitudes toward algebra and the changes in pupils' attitudes toward algebra.

8. That there was a significant relationship between the changes in the attitude scores of pupils when taught by teachers with favorable attitudes toward algebra and teachers with unfavorable attitudes toward algebra.

Background of the Study

It was found, after surveying the literature, that no attitude inventories had been designed especially for the purpose of evaluating either teachers' or pupils' attitudes toward algebra (4). In order to pursue the problems
of the study, it was therefore necessary to construct two attitude inventories—one attitude inventory for teachers and another attitude inventory for pupils.

Each of the separate inventories was designed to measure (a) the participants' attitudes toward algebra and (b) their judgments concerning the practical value of algebra. The method used in preparing these two inventories is outlined in the following paragraphs.

The Teacher Attitude Inventory

To construct an attitude inventory for the participating teachers that would serve the twofold purpose outlined above, sixteen statements from Scale A, "A Scale to Measure Attitude toward Any School Subject," of The Purdue Master Attitudes Scales by H. H. Kemmers (13, Appendix C) and thirty statements from the Dutton "Attitude Inventory for Teachers" (7, Appendix D) were first edited and then revised. This preliminary editing of the statements was done in order to divide the forty-six statements into two categories. These categories were (a) statements that pertained to the practical value of algebra and (b) statements that pertained to the place of algebra within the school curriculum, the teaching and presentation of algebra, the benefits derived from taking algebra, and the pleasant or unpleasant feelings that teachers possess toward the subject of algebra.
After the forty-six revised statements were separated into the two categories described in the preceding paragraph, they were submitted to a jury consisting of twenty future mathematics teachers, ten graduate assistants, and ten instructors associated with the Department of Mathematics, North Texas State University, Denton, Texas.

Each juror was first asked to evaluate those selected statements concerning the practical value of algebra. An eleven-point scale was provided for each statement of the prospective inventory. Each juror assigned to each statement a rating from one through eleven, as he felt the statement reflected a favorable or unfavorable judgment that a teacher should possess concerning the practical value of algebra. One point represented a favorable judgment, six points represented an uncertain judgment, and eleven points represented an opposed, or unfavorable judgment.

After the jurors had evaluated each of the thirteen statements pertaining to the practical value of algebra, they were asked to evaluate the remaining thirty-three statements of this prospective inventory. These remaining statements attempted to ascertain the attitudes of teachers concerning the place of algebra within the school curriculum, the teaching and presentation of algebra, and the pleasant or unpleasant feelings that teachers possess.
toward the subject of algebra. Every jury member assigned to each statement a value from one through eleven, as he felt the statement reflected a favorable or unfavorable attitude toward algebra that a teacher should possess. One point represented a favorable attitude, six points represented an uncertain attitude, and eleven points represented an opposed, or unfavorable attitude toward algebra.

The ratings assigned by the forty jurors to each statement of the two sections of the prospective teacher attitude inventory were then tabulated according to the specifications of the Thurston and Chave Method (6) to determine the scale value of each statement. The scale values of the forty-six statements ranged from 1.09 points through 10.75 points.

The Pupil Attitude Inventory

After the jury members had evaluated the statements of the prospective teacher attitude inventory, they were asked to evaluate sixteen statements from the H. H. Kemmers "A Scale to Measure Attitude toward Any School Subject" and twenty-five statements from the Dutton "Attitude Inventory for Pupils."

This total of forty-one statements had been edited, revised, and divided into two separate categories. These categories were (a) statements that pertained to the
practical value of algebra and (b) statements that pertained to the place of algebra within the school curriculum, the pleasant or unpleasant feelings the student derives from the study of algebra, and the benefits to be obtained from the study of algebra.

Each juror was then asked to evaluate those selected statements concerning the practical value of algebra. Every juror assigned to each statement a rating from one through eleven, as he felt the statement reflected a favorable or unfavorable judgment that a pupil should possess concerning the practical value of algebra. One point represented a favorable judgment, six points represented an uncertain judgment, and eleven points represented an opposed, or unfavorable judgment.

After the jurors had evaluated each of the ten selected statements concerning the practical value of algebra, they evaluated the remaining thirty-one statements that pertained to the place of algebra within the school curriculum, the pleasant or unpleasant feeling the pupils derived from the study of algebra, and the benefits the pupils felt they would obtain from the study of algebra. Every jury member assigned to each statement a value from one through eleven, as he felt the statement reflected a favorable or unfavorable attitude toward algebra that a pupil should possess. One point represented
a favorable attitude, six points represented an uncertain attitude, and eleven points represented an opposed, or unfavorable attitude toward algebra.

The ratings assigned by the forty jurors to each statement of the prospective pupil attitude inventory were then tabulated according to the specifications of the Thurston and Chave Method to determine the scale value of each statement. The scale value of all the forty-one statements ranged from 1.58 points through 10.67 points.

The next step in constructing the pupil and teacher attitude inventories was to determine the Inter-quartile Range (Q) of the values assigned by the jury members to each of the seventy-seven statements within the two inventories. These Q values ranged from 0.65 points through 8.21 points, with a mean value of 2.85 points. This mean Q score indicated that, for each statement possessing a Q value of this amount or less, at least 50 per cent of the values assigned by the jurors fell within 2.85 scale points.

The twenty-one statements from the prospective teacher attitude inventory that had Q values less than 2.85, the mean quartile value, were then retained to form the "Attitude Inventory for Teachers of First-Year Algebra" (Appendix B). Similarly, those twenty-two statements from the prospective pupil attitude inventory that had Q
values less than 2.85 were retained to form the "Attitude Inventory for Pupils of First-Year Algebra" (Appendix A). The remaining statements, because of the diversity of values assigned by the jurors, were poorly worded or seemed ambiguous to the jurors. These statements were discarded and not placed in either attitude inventory.

A pilot study on the "Attitude Inventory for Pupils of First-Year Algebra" was conducted by administering this inventory to a total of eighty pupils in Alpine, Fort Davis, Marathon, and Marfa, Texas, on May 8, 1961. Among the data gathered from this pilot study were those used to determine the time required to administer the inventory and to determine the suitability of the wording within the twenty-two statements of the inventory.

To test the reliability of the "Attitude Inventory for Pupils of First-Year Algebra," the test-retest method was chosen. A summary of the correlation of the two sets of scores pertaining to the pupils' attitudes toward algebra is presented in Table 1.

**Table 1**

SIGNIFICANCE OF THE CORRELATION BETWEEN TWO TESTS OF FORTY-EIGHT ALGEBRA PUPILS' ATTITUDES TOWARD ALGEBRA

<table>
<thead>
<tr>
<th>Attitude</th>
<th>$r$</th>
<th>$t$</th>
<th>$p$</th>
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<tr>
<td>Toward Algebra</td>
<td>.684</td>
<td>6.02</td>
<td>&gt;.001</td>
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Data were gathered by the administration of the "Attitude Inventory for Pupils of First-Year Algebra" to twenty-five algebra pupils in the North Texas State University Laboratory School, Denton, Texas, on July 15 and again on July 29, 1961, to thirteen algebra pupils within the public school system at Alpine, Texas, and to ten algebra pupils within the public school system at Marfa, Texas, on June 18 and again on July 2, 1962.

The inventories were then graded according to the Lickert Method of Summated Ratings (6), and the Pearson product-moment correlation coefficient, r (8), was then computed according to the following divisions of the inventory: (a) those scores made on the selected statements which reflected the pupils' attitudes toward algebra and (b) those remaining statements which reflected the pupils' judgments concerning the practical value of algebra.

A glance at the results of Table I will show that the correlation between the forty-eight pupils' attitudes toward algebra was .684. This correlation was significant at greater than the .1 per cent level. Because of this high level of significance, it was then concluded that this portion of the instrument was sufficiently reliable for use in the study.
The correlation of the two sets of scores which represented the pupils' judgments concerning the practical value of algebra is presented in Table II.

**Table II**

**SIGNIFICANCE OF THE CORRELATION BETWEEN TWO TESTS OF FORTY-EIGHT ALGEBRA PUPILS' JUDGMENTS CONCERNING THE PRACTICAL VALUE OF ALGEBRA**

<table>
<thead>
<tr>
<th>Attitude</th>
<th>r</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical value</td>
<td>.862</td>
<td>8.43</td>
<td>&gt;.001</td>
</tr>
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As shown in Table II, the correlation of the forty-eight pupils' judgments concerning the practical value of algebra was .862. This correlation was significant at greater than the .1 per cent level. Because of this high level of significance, it was then concluded that this portion of the instrument was sufficiently reliable for use in the study.

**Related Literature and Study**

The inventories most nearly designed for use in measuring attitudes toward mathematics were designed by H. H. Kemmers and Wilbur H. Dutton. The Dutton "Attitude Inventory" was constructed from statements made by prospective teachers enrolled in education classes at the University of California at Los Angeles. Two categories
were used: favorable and unfavorable attitudes toward arithmetic. Statements were collected over a five-year period from slightly more than six hundred students. Eighty-three statements were then carefully edited, and forty-three statements were then scaled by the Thurston and Chave Method to determine the scale value of each statement. The reliability of the scale was measured by the test-retest method. The correlation between the two sets of scores was 0.94. The H. H. Remmers "A Scale to Measure Attitude toward Any School Subject" was made by a similar method.

A revised form of the Dutton "Attitude Inventory" was used in research by Virginia M. Stright (15) in 1960 in an attempt to relate the teachers' recent training and educational backgrounds with attitudes toward the teaching of arithmetic in the third, fourth, and sixth grades. This study indicated that the teachers' recent training, educational backgrounds, ages, or years of experience seemed to make no significant differences in their attitudes toward the teaching of arithmetic, nor of the attitudes of the children in the group. Robert W. Smail (14), in conducting another similar investigation, attempted to determine whether there was a significant relationship between the number of courses completed by teachers in higher mathematics and gain in pupils' mean achievement scores in
arithmetic. He concluded that no significant relationship existed.

An investigation involving tenth-grade girls in commercial arithmetic was conducted by Albert L. Hillig (3) to determine the association of favorable, uncertain, or antagonistic attitudes with term grades. He concluded that there is an association which could not have occurred by chance. A similar investigation conducted by A. C. Bendig and J. B. Hughes (2) was designed to show the relationship between the students' attitudes and their achievements in elementary college statistics. By the use of an especially designed instrument, it was shown in two separate college classes that the students' attitudes represented a partial determinant of their achievements. Philip S. Anderson (1) in another investigation attempted to measure the relationship between the teachers' attitudes toward pupils and the pupils' achievements in fourth-grade arithmetic. The teachers' attitudes toward pupils were found not to be related to the pupils' achievements. Another purpose of this study was to measure the teachers' attitudes toward learning theory and then to relate these attitudes to the pupils' achievements in fourth-grade arithmetic. No significant relationship between the two factors could be found.
Further attempts to obtain knowledge pertaining to teachers' attitudes and achievements by pupils have been conducted by Winona M. Perry (11), and by Thomas Poffenberger and D. A. Norton (12). Perry, while investigating students' "dreads" upon their attitudes toward school subjects, found that the students' beliefs in their ability or inability contributed to some extent to their achievements in algebra; the "non-dreaders" regarded the teachers' guidance as the most important contributing factor in their achievements. Poffenberger and Norton, in a pilot study on the University of California campus at Davis, indicated that the teachers who tend to affect students' attitudes and achievements positively have the following characteristics:

1. A good knowledge of the subject.
2. A desire to have children understand the subject.
3. A strong interest in the subject.
4. A good control of the class without being too strict.

Hugh J. McCardle (9) hypothesized that there was no significant relationship between pupils' achievements in first-year algebra and the level of the teachers' attitude scores on the Minnesota Teacher Attitude Inventory (10). On the basis of the Minnesota Teacher Attitude Inventory scores, the teachers were grouped into high-, middle-, and
low-attitude categories. The pupils were tested in such areas as arithmetic understanding, quantitative thinking, functional competence in mathematics, and algebraic achievement. One of the major findings of McCardle's study was that the gain in pupils' mean scores on both quantitative thinking and functional competence in mathematics for the high-teacher-attitude group was significantly higher than the gain in pupils' mean scores for either the middle- or low-teacher-attitude groups.

Although the measurement of the effects of attitudes and educational backgrounds of teachers upon the attitudes and achievements by their pupils has been accomplished by other researchers, the results have been generally inconclusive. The purpose of this study is to throw more light on the subject and to add additional evidence concerning the relationship between teachers' and pupils' attitudes in first-year algebra.

Significance of the Study

No commercial tests were available for measuring either the attitudes held by algebra teachers or algebra pupils. Therefore, a necessary part of the study was to design such instruments. By the use of these developed attitude inventories and the Cooperative Algebra Test, Elementary Algebra through Quadratics (Appendix E), data
were gathered to investigate the outcomes of the pupils' attitudes toward algebra, their judgments concerning the practical value of algebra, and their achievements in algebra when influenced by the educational backgrounds, attitudes toward algebra, and judgments concerning the practical value of algebra of their teachers. It was anticipated that the results from this study might be used to help clarify some of the problems in the guidance, selection, and training of teachers in the field of mathematics.

Definition of Terms

The following terms were used in pursuing this study:

1. **Professional education** was defined as those education courses taken by participating teachers in satisfying minimum requirements for teacher certification in the State of Texas (16, p. 29) and any additional work beyond this minimum level. Only those courses in professional education that were taken to satisfy certification regulations, or were taken for advanced graduate credit, were given consideration in the study.

After obtaining the number of semester hours in professional education of each teacher, the entire group of teachers was divided into three distinct subgroups. These subgroups were the upper-, middle-, and lower-background teachers. For purposes of this study, those ten teachers
who had accumulated thirty-nine or more semester hours in professional education were defined as belonging to the "high" educational group. Those eleven teachers whose backgrounds in professional education did not exceed twenty-four semester hours were defined as belonging to the "low" educational group. These divisional points were established so that the scores of the pupils under the supervision of teachers within the upper one-third high educational group could be compared to the scores of the pupils under the supervision of teachers within the lower one third, which was defined as the low educational group.

2. College mathematics was defined as those mathematics courses taken by participating teachers in satisfying minimum requirements for teacher certification in the State of Texas (16, p. 29) and any additional work beyond this level. Only those courses in mathematics that were taken to satisfy certification regulations, or were taken for advanced graduate credit, were given consideration in the study.

After obtaining the number of semester hours in mathematics of each teacher, the entire group of teachers was divided into three distinct subgroups. These subgroups were the upper-, middle-, and lower-background teachers. For purposes of this study, those fifteen participating teachers who had accumulated less than
twenty-four semester hours in college mathematics were defined as belonging to the "low" mathematical group. Those fourteen teachers who had accumulated more than thirty hours in mathematics were defined as belonging to the "high" mathematical group. These divisional points were established so that the scores of the pupils under the supervision of teachers within the upper one-third high mathematical group could be compared to the scores of the pupils under the supervision of teachers within the lower one-third mathematical group.

3. **Attitude toward algebra of teachers** was determined from those statements within the "Attitude Inventory for Teachers of First-Year Algebra" that attempted to ascertain the attitudes of teachers concerning the place of algebra within the school curriculum, the teaching and presentation of algebra, and the pleasant or unpleasant feelings that teachers possess toward the subject of algebra. Fourteen items on this inventory were selected to measure the teachers' attitudes toward algebra, with the possible score ranging from one through five points for each item. Five points represented a favorable attitude toward algebra, three points represented an uncertain attitude, and one point represented an opposed, or unfavorable attitude. Therefore, the lowest possible total score on the instrument was fourteen. A middle, or
uncertain score was forty-two, and the maximum total score was seventy. The scores which represented the teachers' attitudes toward algebra at the beginning of the academic school year 1961 ranged from forty-nine scale points through seventy points, with an arithmetic mean score of 63.89 scale points. Fourteen teachers attained attitudes toward algebra that were above sixty-five points. For purposes of this study, this upper group of teachers was defined as possessing "favorable" attitudes toward algebra. Fourteen teachers exhibited attitude scores toward algebra that did not exceed sixty-three scale points. This lower group of teachers was defined as possessing "unfavorable" attitudes toward algebra. These divisional points were established so that the scores of the pupils under the supervision of the upper one-third group of teachers could be compared to the scores of the pupils under the supervision of teachers within the lower one-third group of teachers.

4. The judgment of teachers concerning the practical value of algebra was determined from the seven statements contained within the "Attitude Inventory for Teachers of First-Year Algebra" that attempted to ascertain the attitudes of teachers regarding the practical value of algebra. The possible score on each item ranged from one through five scale points. Five points represented a
favorable judgment concerning the practical value of algebra, three points represented an uncertain judgment, and one point represented an opposed, or unfavorable judgment. Therefore, the lowest possible total score on the instrument was seven. A middle, or uncertain score was twenty-one, and the maximum total score was thirty-five.

The scores which represented the teachers' judgments concerning the practical value of algebra at the beginning of the academic school year 1961 ranged from sixteen scale points through thirty-five points, with an arithmetic mean score of 30.80 scale points. Sixteen of the participating teachers expressed judgments that were above thirty-two scale points. Thirteen teachers expressed judgments that did not exceed thirty scale points. For purposes of this study, the upper group of teachers was defined as possessing "favorable" judgments concerning the practical value of algebra. The lower group of teachers was defined as possessing "unfavorable" judgments. These divisional points were established so that the scores of the pupils under the supervision of teachers within the upper one-third group could be compared to the scores of the pupils under the supervision of teachers within the lower one-third group.
5. **End-of-course attitude toward algebra** and **end-of-course judgment concerning the practical value of algebra** were obtained from the scores expressed by pupils and teachers on their respective attitude inventories in May, 1962.

The mean end-of-course attitude score of the 873 Anglo-American pupils was 37.70 scale points. Pupils that exhibited attitudes toward algebra that were above this mean attitude score were defined as possessing "favorable" attitudes toward algebra. All other pupils were defined as expressing "unfavorable" attitudes toward algebra.

The mean end-of-course judgment concerning the practical value of algebra for the 873 Anglo-American pupils was 21.79 scale points. Pupils that exhibited judgments above this mean score were defined as possessing "favorable" judgments concerning the practical value of algebra. All other pupils were defined as expressing "unfavorable" judgments.

The 290 Latin-American pupils exhibited a mean attitude toward algebra of 57.62 scale points. The Latin-American pupils that expressed attitudes toward algebra above this mean score were defined as possessing "favorable" attitudes toward algebra. The remaining pupils were defined as possessing "unfavorable" attitudes toward algebra.
The mean end-of-course judgment concerning the practical value of algebra for the 290 Latin-American pupils was 21.79 scale points, the same score as the Anglo-American pupil group. Pupils that exhibited judgments above this mean score were defined as possessing "favorable" judgments concerning the practical value of algebra. All other pupils were defined as exhibiting "unfavorable" judgments.

When the Anglo- and Latin-American pupils were combined to form the total, or composite group of 1,163 pupils, the mean attitude score toward algebra was 57.67 points at the beginning of the academic school year 1961. When the data of this combined group were treated statistically, pupils that expressed attitudes toward algebra above this mean score were defined as possessing "favorable" attitudes toward algebra. The remaining pupils were defined as possessing "unfavorable" attitudes toward algebra.

Similarly, the mean end-of-course judgment concerning the practical value of algebra was 21.79 scale points for the 1,163 Anglo- and Latin-American pupils. Also, the end-of-course judgment for each of the ethnic groups of pupils was this same value. Pupils that expressed judgments above this mean score were defined as possessing "favorable" judgments concerning the practical value of
algebra. The remaining pupils were defined as possessing "unfavorable" judgments.

6. To obtain the pupils' achievements in algebra, the Cooperative Algebra Test was administered to each of the participating pupils at the beginning and again at the end of the academic school year 1961-1962. The scores of each pupil obtained from these two testing periods were then paired, and the differences for each pair obtained. These differences were then defined as the pupils' achievements in algebra.

The mean achievement score for the 873 Anglo-American pupils was 10.09 points. Pupils that achieved higher than this mean achievement score were defined as "high" achievers. Other Anglo-American pupils were defined as "low" achievers in algebra.

The 290 Latin-American pupils had a mean achievement score of 6.57 points. Pupils that achieved higher than this mean achievement score were defined as "high" achievers. Other pupils were defined as "low" achievers in algebra.

When the Anglo- and Latin-American pupils were combined to form the total, or composite group of 1,163 pupils, the mean achievement score was 9.21 points. When the data were treated statistically, pupils that achieved more than this mean score were defined as "high" achievers
in algebra. The remaining pupils were defined as "low" achievers.

Limitations of the Problem

This study was limited to those selected class AAAA, AAA, AA, A, and B public junior or senior high schools located within the West Texas geographical area (Appendices F, G). Proportionally equal groups of teachers from each of the school classifications of the University Interscholastic League (17) were asked to participate in the study.

A total of forty-six algebra teachers were administered the "Attitude Inventory for Teachers of First-Year Algebra" at the beginning of the academic school year 1961. Of the beginning forty-six teachers, forty-five were readministered this same inventory at the end of the academic year 1962.

Teacher selection for participating in the study was based upon the judgments of the local school administrators. If, in the opinion of the administrator, a teacher possessed any physical or mental impairments which would affect his teaching, he was not asked to participate in the study.

No teacher who was beginning his or her first year of teaching was used in the study.
No distinction was made between teachers who taught only mathematics and teachers who taught courses in addition to mathematics.

No correspondence courses, television courses, or courses taken in extension by the participating algebra teachers in the fields of mathematics or professional education that were taken during the academic school year 1961-1962 were considered as a part of the preparation of the teachers used in the study.

Procedure for Treating the Data

The study was designed to investigate the outcomes of the pupils' attitudes toward algebra, their judgments concerning the practical value of algebra, and their achievements in algebra when influenced by the educational backgrounds, attitudes toward algebra, and judgments of their teachers concerning the practical value of algebra.

An additional aspect of the study was to determine the relationship that exists between the pupils' end-of-course attitudes toward algebra and their achievements in algebra. In this particular case, only those attitude scores toward algebra which fell within the upper one-fourth level or the lower one-fourth level of scores were used in the analysis. Similarly, an analysis was made between the pupils' end-of-course judgments concerning the practical value of algebra and their achievements in
algebra to determine if a significant relationship exists between the two factors. As above, only those judgment scores which fell in the upper one-fourth level or the lower one-fourth level of scores were used in the analysis.

It should also be noted that a major part of the study was to ascertain and analyze the differences between Anglo- and Latin-American pupils' attitudes and achievements in algebra.

In pursuing the major goals of the study, three separate areas of the study were established. These broad areas consisted of (a) the teachers' attitudes and backgrounds in mathematics and professional education, (b) the pupils' attitudes and achievements in algebra, and (c) the relationship that exists between those factors of (a) and (b).

In order to gather data for use in the study, two testing periods were established. The first testing period occurred between the tenth and fifteenth class day of school, September, 1961. The second testing period occurred between the 165th and the 170th class day of school, May, 1962. The approximate time for each testing period was fifty-five minutes. Each participating pupil was administered the "Attitude Inventory for Pupils of First-Year Algebra," which was especially designed for use
in the study, and the Cooperative Algebra Test during each of the testing periods. The teachers were administered the "Attitude Inventory for Teachers of First-Year Algebra" during each testing period.

At the beginning of the academic school year 1961, the total number of semester hours accumulated by each teacher in the fields of college mathematics and professional education was obtained from his immediate supervisor.

The mean scores of the pupils under the supervision of teachers expressing favorable attitudes toward algebra were compared to the mean scores of the pupils under the supervision of teachers exhibiting unfavorable attitudes toward algebra. The mean scores of the pupils under the supervision of teachers exhibiting favorable judgments concerning the practical value of algebra were compared to the mean scores of the pupils under the supervision of teachers exhibiting unfavorable judgments. Similarly, the mean scores of the pupils under the supervision of teachers possessing "high" backgrounds in college mathematics or professional education were compared to the mean scores of the pupils under the supervision of teachers possessing "low" backgrounds.
After the data were collected, they were assembled and prepared to test the problems of the study in the following manner:

1. The Lickert Method of Summated Ratings (6) was used to score the "Attitude Inventory for Pupils of First-Year Algebra" and the "Attitude Inventory for Teachers of First-Year Algebra."

2. Whenever applicable, the Pearson product-moment correlation coefficient, \( r (6) \), was determined. The quantity, \( r \), was calculated from the formula

\[
r = \frac{\sigma_{xy}}{\sigma_x \sigma_y},
\]

where \( x \) is the deviation from the mean of the scores from the first testing period, \( y \) is the deviation from the mean of the scores obtained from the second testing period, \( \sigma_x \) is the standard deviation of the scores obtained from the first testing period, and \( \sigma_y \) is the standard deviation of the scores from the second testing period. The level of significance of the correlations was determined from the formula for Fisher's \( t \)

\[
t = \frac{r}{\sqrt{\frac{1 - r^2}{N - 2}}},
\]

where \( r \) is the correlation coefficient and \( N \) is the number of pairs of scores. This method of determining \( r \) is described by Lindquist (8).
3. Each of the subhypotheses of the study was tested by the \( t \) techniques, except the fourth and seventh, which were tested by chi-square (8). The quantity, \( t \), was calculated from the formula
\[
    t = \frac{\bar{M}_d}{\sqrt{\frac{1}{N_1} + \frac{1}{N_2} \left( \frac{1}{\sigma^2_1} + \frac{1}{\sigma^2_2} \right)}}
\]
where the subscript 1 indicates participating pupils under favorable attitude or high background teachers, the subscript 2 indicates the pupils under unfavorable attitude or low background teachers, \( M_d \) is the difference between the arithmetic means of the two groups of scores, \( N \) is the number of pupils, and \( \sigma \) is the standard deviation.

Chi-square was the test of significance for the fourth and seventh subhypotheses of the study. This value was calculated from the formula
\[
    \chi^2 = \sum \frac{(O - E)^2}{E}
\]
where \( O \) was the observed frequency in each cell and \( E \) was the expected frequency in each cell.

The methods exhibited above for determining the value of \( t \) and chi-square are described by Lindquist (8).

3. For a test to be significant, it was arbitrarily decided that \( t \) or chi-square must produce a value of \( P \) that is significant at greater than the 5 per cent level.
4. Conclusions and recommendations were based upon the findings of the study.
CHAPTER BIBLIOGRAPHY


13. Remmers, H. H., "A Scale to Measure Attitude toward Any School Subject," *The Purdue Master Attitude Scales*, Lafayette, Indiana, Purdue Research Foundation, Occupational Research Center, Purdue University, no date given.


17. University Interscholastic League, Austin, Texas, letter, no date given.
CHAPTER II

ANALYSIS OF THE DATA PERTAINING TO TEACHERS

Procedures for Collecting the Data

Four principal types of data were collected from the forty-five teachers who participated in the study. The data were (a) the teachers' judgments concerning the practical value of algebra, (b) their attitudes toward algebra, (c) the semester hours accumulated in the field of college mathematics, and (d) the semester hours accumulated in the field of professional education (Appendix F).

The basic instrument used in the study to ascertain the teachers' attitudes toward algebra and their judgments concerning the practical value of algebra was the "Attitude Inventory for Teachers of First-Year Algebra" (Appendix B). The statements contained within this inventory that pertained to the place of algebra within the school curriculum, the teaching and presentation of algebra, the benefits derived by the pupils in taking algebra, and the pleasant or unpleasant feeling the teacher has toward the subject of algebra were used to ascertain the teachers' attitudes toward algebra. The remaining seven statements of this inventory were used
to obtain the teachers' judgments concerning the practical value of algebra.

The total number of semester hours accumulated by each participating teacher at the beginning of the academic school year 1961 in the fields of college mathematics and professional education was obtained from the immediate supervisor of each teacher. No correspondence courses, television courses, or courses taken in extension by the participating teachers that were being taken during the academic school year 1961-1962 were considered as a part of the preparation of the teachers used in the study.

Between the tenth and fifteenth class day of the academic school year 1961, the "Attitude Inventory for Teachers of First-Year Algebra" was administered to a total of forty-six teachers. Nine of these teachers were from each of the University Interscholastic League classifications (Appendix F) with the exception of Class B, in which ten teachers were administered the inventory. Because of the resignation of one participant, forty-five teachers were re-administered this same inventory between the 165th and 170th class day of school, May, 1962. One algebra teacher declined participation in the study because the local administration feared a possible political reprisal if the tests and inventories were administered.
Methods of Tabulating the Data

The total number of semester hours accumulated by each participating teacher in the field of college mathematics ranged from three hours through fifty hours. There were fifteen participating teachers who had accumulated less than twenty-four hours in mathematics. There were fourteen participating teachers whose backgrounds in mathematics exceeded thirty hours (Appendix F).

For purposes of this study, those teachers whose backgrounds in mathematics were less than twenty-four hours were classified as having "low" mathematical backgrounds. There were 138 Anglo- and 128 Latin-American pupils under the supervision of these teachers.

Those teachers whose backgrounds in mathematics exceeded thirty semester hours were classified as possessing a "high" mathematical background. There were 253 Anglo- and 43 Latin-American pupils under the supervision of these teachers.

The division points established above were selected so that the scores of the pupils under the supervision of the upper one-third portion of teachers could be compared to the scores of the pupils under the supervision of the lower one-third portion of teachers.

The total number of semester hours accumulated by each participating teacher in the field of professional
education ranged from eighteen hours through fifty hours. There were eleven participating teachers whose backgrounds in professional education did not exceed twenty-four semester hours. Ten participating teachers had accumulated thirty-nine or more semester hours in professional education.

The entire group of teachers was divided into three distinct subgroups. These subgroups of teachers were the upper-, middle-, and low-background teachers. For purposes of this study, those eleven teachers whose backgrounds in professional education did not exceed twenty-four semester hours were defined as possessing "low" educational backgrounds. There were 128 Anglo- and 86 Latin-American pupils under the supervision of these teachers. The ten teachers who had accumulated thirty-nine or more semester hours in professional education were defined as possessing "high" educational backgrounds. There were 129 Anglo- and 110 Latin-American pupils under the supervision of these teachers.

The Lickert Method of Summated Ratings (1) was used to score the "Attitude Inventory for Teachers of First-Year Algebra." Those statements that reflected favorable attitudes toward algebra, or favorable judgments concerning the practical value of algebra, were scored by applying the following scale:
Those statements that expressed opposing, unfavorable attitudes toward algebra or unfavorable judgments concerning the practical value of algebra were scored in the opposite manner:

<table>
<thead>
<tr>
<th>Scale Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Agree</td>
</tr>
<tr>
<td>b. Tend to agree</td>
</tr>
<tr>
<td>c. Cannot say (uncertain)</td>
</tr>
<tr>
<td>d. Tend to disagree</td>
</tr>
<tr>
<td>e. Disagree</td>
</tr>
</tbody>
</table>

Fourteen items on the attitude inventory were selected to measure the teachers' attitudes toward algebra, with the possible score ranging from one through five points for each item. Five points represented a favorable attitude toward algebra, three points represented an uncertain attitude, and one point represented an opposed, or unfavorable attitude. Therefore, the lowest possible total score on the instrument was fourteen. A middle,
or uncertain score was forty-two, and the maximum total score was seventy.

A glance at Appendix F will show that, of the possible score of 70.00, the scores which represented the teachers' attitudes toward algebra at the beginning of the academic school year 1961 ranged from 49.00 through 70.00, with an arithmetic mean score of 63.89. The scores which represented the teachers' attitudes toward algebra at the end of the academic school year 1962 ranged from 57.00 through 70.00, with an arithmetic mean score of 64.69.

At the beginning of the academic school year 1961, fourteen of the participating teachers expressed attitudes toward algebra that were above 66.00 scale points. For purposes of this study, this upper group of teachers was defined as possessing "favorable" attitudes toward algebra. There were 255 Anglo- and 146 Latin-American pupils under the supervision of these teachers. The attitude scores of fourteen teachers did not exceed 63.00 scale points. This lower group of teachers was defined as possessing "unfavorable" attitudes toward algebra. There were 216 Anglo- and 61 Latin-American pupils under the supervision of these teachers.

To test the reliability of the inventory, the test-retest method was selected, using the scores obtained during the first and second testing periods. The pairing
of the scores of each teacher permitted the differences for each pair to be obtained. This procedure was the basis for determining the correlation and for determining the significance of the correlation.

A summary of the correlation of the teachers' beginning- and end-of-course attitudes toward algebra is presented in Table III.

Table III

SIGNIFICANCE OF THE CORRELATION BETWEEN THE FORTY-FIVE TEACHERS' BEGINNING- AND END-OF-COURSE ATTITUDES TOWARD ALGEBRA

<table>
<thead>
<tr>
<th>Correlation</th>
<th>r</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation</td>
<td>.671</td>
<td>5.94</td>
<td>&gt;.001</td>
</tr>
</tbody>
</table>

A glance at the results in Table III shows that the correlation between the teachers' beginning- and end-of-course attitudes toward algebra was .671. This correlation was significant at greater than the .1 per cent level. Because of this high level of significance, it was then concluded that this portion of the instrument was sufficiently reliable for use in the study.

A total of seven items within the "Attitude Inventory for Teachers of First-Year Algebra" was selected to measure the teachers' judgments concerning the practical value of algebra, with the possible score ranging from one
through five points for each item. Five points represented a favorable judgment concerning the practical value of algebra, three points represented an uncertain judgment, and one point represented an opposed, or unfavorable judgment. Therefore, the lowest possible total score on the instrument was seven. A middle, or uncertain score was twenty-one, and the maximum total score was thirty-five.

Upon referring to Appendix F, it can be seen that of the possible score of 35.00, the scores which represented the teachers' judgments concerning the practical value of algebra at the beginning of the academic school year 1961 ranged from 16.00 through 35.00, with an arithmetic mean score of 31.67 scale points.

At the beginning of the academic school year 1961, sixteen of the participating teachers expressed judgments concerning the practical value of algebra that were above 32.00 scale points. For purposes of this study, this upper group of teachers was defined as possessing "favorable" judgments concerning the practical value of algebra. There were 194 Anglo- and 88 Latin-American pupils under the supervision of these teachers. Thirteen teachers possessed scores concerning the practical value that did not exceed 30.00 scale points. This lower group of teachers was defined as possessing "unfavorable" judgments
concerning the practical value of algebra. There were 184 Anglo- and 96 Latin-American pupils under the supervision of these teachers.

The reliability of this portion of the attitude inventory was determined by the test-retest method, using those scores obtained during the first and second testing periods. The pairing of the scores of each teacher permitted the differences for each pair to be obtained. This procedure was the basis for determining the correlation and for determining the significance of the correlation.

A summary of the correlation of the teachers' beginning- and end-of-course judgments concerning the practical value of algebra is presented in Table IV.

<table>
<thead>
<tr>
<th>Correlation</th>
<th>$r$</th>
<th>$t$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation</td>
<td>.756</td>
<td>7.64</td>
<td>&gt;.001</td>
</tr>
</tbody>
</table>

From the results found in Table IV, it can be seen that the correlation between the teachers' beginning- and end-of-course judgments concerning the practical value of
algebra was .756. This correlation was significant at greater than the .1 per cent level. Because of this high level of significance, it was concluded that this portion of the instrument was sufficiently reliable for use in the study.

Summary

1. The basic instrument used for ascertaining the scores that represented the teachers' attitudes toward algebra and their judgments concerning the practical value of algebra was the "Attitude Inventory for Teachers of First-Year Algebra." This attitude inventory was especially designed for use in this study.

2. A total of forty-five teachers participated in the study.

3. It was found that the correlation between the teachers' beginning- and end-of-course attitudes toward algebra was significant at greater than the .1 per cent level. Similarly, it was found that the correlation between the teachers' beginning- and end-of-course judgments concerning the practical value of algebra was significant at greater than the .1 per cent level. These two levels of significance seemed to indicate that the "Attitude Inventory for Teachers of First-Year Algebra" was sufficiently reliable for use in the study.
CHAPTER BIBLIOGRAPHY

CHAPTER III

ANALYSIS OF THE DATA PERTAINING TO THE ANGLO- AND LATIN-AMERICAN PUPILS

Procedures for Collecting the Data

In the pursuit of this study, three types of data were gathered from 873 Anglo- and 290 Latin-American pupils who were tested on two occasions during the 180-day academic school year 1961-1962. All of these pupils resided within twenty-four distinct school districts of the West Texas geographical area (Appendices F, G). The three types of data were (a) the pupils’ attitudes toward algebra and their judgments concerning the practical value of algebra, each measured at the beginning and the end of the academic year, (b) the pupils’ scores made on the Co-operative Algebra Test (1) at the beginning of the academic school year, and (c) their achievements in algebra that were accomplished during the academic year as measured by the scores made on the second administration of this same test when compared to their first test scores.

The basic instrument developed in order to ascertain the pupils’ attitudes toward algebra and their judgments concerning the practical value of algebra was the
"Attitude Inventory for Pupils of First-Year Algebra" (Appendix A). The statements that pertained to the place of algebra within the school curriculum, the pleasant or unpleasant feeling the pupil derives from the study of algebra, and the benefits the pupils felt they would obtain from the study of algebra were used to ascertain the pupils' attitudes toward algebra. The six remaining statements were used to ascertain the pupils' judgments concerning the practical value of algebra.

To determine the reliability of the inventory, the test-retest method was used. Data were gathered by administering the inventory to twenty-five algebra pupils in the North Texas State University Laboratory School, Denton, Texas, on July 15 and again on July 29, 1961, to thirteen algebra pupils in Alpine, Texas, and to ten algebra pupils in Marfa, Texas, on June 18 and again on July 2, 1962. The Pearson product-moment correlation coefficient (r) was then determined from these two sets of scores.

The scores of the pupils obtained from the first administration of the "Attitude Inventory for Pupils of First-Year Algebra" were paired with the scores obtained from the second administration of the inventory. The pairing of the scores permitted the differences for each pair to be obtained. This was the basis for determining
if the correlation of the two groups of scores differed from zero.

It may be noted in Tables I and II (pages 9 and 11) that the correlation between the scores that represented the pupils' attitudes toward algebra was .684. The correlation between the scores that represented their judgments concerning the practical value of algebra was .862. The significance of each correlation was greater than the .1 per cent level. These high levels of significance seemed to indicate that the attitude inventory was sufficiently reliable for use in the study.

The Treatment of the Data

It should be noted that the two prominent ethnic groups of pupils that reside within the West Texas geographical area are Anglo- and Latin-American (Appendix F). The judgment of which pupils belonged in each group was based upon the surnames of those participating in the study.

In order that no bias would exist within the data concerning the two ethnic groups of pupils, the pupils' scores obtained at the beginning of the academic school year 1961 were separated into ethnic groups and then analyzed to determine if significant differences existed between the arithmetic mean scores of the two groups. The scores of each of the two ethnic groups were
categorized into the following three areas: (a) their judgments concerning the practical value of algebra, (b) their attitudes toward algebra, and (c) the scores made on the Cooperative Algebra Test at the beginning of the academic school year.

To obtain the pupils' attitudes toward algebra, the "Attitude Inventory for Pupils of First-Year Algebra" was administered to each of the 1,163 participating pupils at the beginning and the end of the academic school year 1961. This inventory also contained those selected statements pertaining to the pupils' judgments concerning the practical value of algebra.

The Lickert Method of Summated Ratings (2) was used to score the "Attitude Inventory for Pupils of First-Year Algebra." Those statements that reflected favorable attitudes toward algebra or favorable judgments concerning the practical value of algebra were scored by applying the following scale:

<table>
<thead>
<tr>
<th>Scale Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Agree</td>
</tr>
<tr>
<td>b. Tend to agree</td>
</tr>
<tr>
<td>c. Cannot say (uncertain)</td>
</tr>
<tr>
<td>d. Tend to disagree</td>
</tr>
<tr>
<td>e. Disagree</td>
</tr>
</tbody>
</table>
Those statements that expressed opposing, or unfavorable attitudes toward algebra or unfavorable judgments concerning the practical value of algebra were scored in the opposite manner:

<table>
<thead>
<tr>
<th>Scale Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Agree</td>
</tr>
<tr>
<td>b. Tend to agree</td>
</tr>
<tr>
<td>c. Cannot say (uncertain)</td>
</tr>
<tr>
<td>d. Tend to disagree</td>
</tr>
<tr>
<td>e. Disagree</td>
</tr>
</tbody>
</table>

A total of sixteen items on the attitude inventory (Appendix A) was selected to measure the pupils' attitudes toward algebra, with the possible score on each item ranging from one through five points. Five points represented a favorable attitude toward algebra, three points represented an uncertain attitude, and one point represented an opposed, or unfavorable attitude. Therefore, with sixteen items in the entire pupil inventory and the lowest possible score for each item one, the lowest possible total score on the instrument was sixteen. A middle, or uncertain score was forty-eight, and the maximum total score was eighty.

A summary of the comparison between the scores of the Anglo- and Latin-American pupils' attitudes toward algebra...
at the beginning of the academic school year 1961 is presented in Table V.

TABLE V

SIGNIFICANCE OF THE MEAN DIFFERENCE BETWEEN THE 873 ANGLO- AND 290 LATIN-AMERICAN PUPILS' ATTITUDES TOWARD ALGEBRA

<table>
<thead>
<tr>
<th>Mean</th>
<th>Anglo-American Group</th>
<th>Latin-American Group</th>
<th>$M_p$</th>
<th>$t$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>63.03</td>
<td>61.11</td>
<td>1.92</td>
<td>3.91</td>
<td>.001</td>
</tr>
</tbody>
</table>

A closer analysis of the data presented in Table V reveals that, of the possible total score of 80.00, the mean score that represented the Anglo-American pupils' beginning attitudes toward algebra was 63.03 scale points. The mean score for the Latin-American pupils' beginning attitudes toward algebra was 61.11 scale points. The mean difference between the two groups of scores was 1.92 scale points in favor of the Anglo-American pupil group. The difference obtained was significant at greater than the .1 per cent level. It was then concluded that, at the beginning of the academic school year 1961, there was a significant difference in the attitudes of the pupils toward algebra in favor of the Anglo-American pupils.

Six items on the "Attitude Inventory for Pupils of First-Year Algebra" were selected to measure the pupils'
judgments concerning the practical value of algebra. The possible score on each item ranged from one through five points. Five points represented a favorable judgment, three points represented an uncertain judgment, and one point represented an opposed, or unfavorable judgment. Therefore, with six items in the entire section of the inventory and the lowest possible score for each item one, the lowest possible total score was six scale points. A middle, or uncertain score was eighteen, and the maximum total score was thirty scale points.

A summary of the data pertaining to the Anglo- and Latin-American pupils' judgments concerning the practical value of algebra at the beginning of the academic school year 1961 is presented in Table VI.

### Table VI

**Significance of the Mean Difference Between the 873 Anglo- and 290 Latin-American Pupils' Judgments Concerning the Practical Value of Algebra**

<table>
<thead>
<tr>
<th>Mean</th>
<th>Anglo-American Group</th>
<th>Latin-American Group</th>
<th>MD</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>24.62</td>
<td>23.47</td>
<td>1.15</td>
<td>2.09</td>
<td>&gt;.05</td>
</tr>
</tbody>
</table>

The data found in Table VI point to the fact that, of the possible maximum score of thirty, the mean score which represented the Anglo-American pupils' beginning judgments
concerning the practical value of algebra was 24.62 scale points. The mean score for the Latin-American pupils was 23.47. The mean difference between the two groups of scores was 1.15 points in favor of the Anglo-American pupils. The difference obtained was significant at greater than the 5 per cent level. Since this level fell within the arbitrarily selected levels of the study, it was then concluded that, at the beginning of the academic school year 1961, there was a significant difference in favor of the Anglo-American pupils concerning their attitudes as to the practical value of algebra.

To obtain a measure of the pupils' competencies in mathematics, the Cooperative Algebra Test was administered to each participating pupil at the beginning of the academic school year 1961. There were fifty-nine items on this test. Each item was assigned a value of one point. One point was awarded for each item worked correctly. There were no deductions for problems skipped or missed by the participating pupils. Therefore, the lowest possible total score was zero, and the maximum total score was fifty-nine. These scores ranged from zero through thirty-eight for the Anglo-American pupils and from zero through twenty-nine for the Latin-American pupils at the beginning of the academic school year 1961.
To obtain the pupils' achievements in algebra, this same test was re-administered to each participating pupil at the end of the academic year 1962. The scores of each pupil were then paired, and the differences for each pair were obtained. These differences were then defined as the pupils' achievements in algebra.

A summary of the scores that represented the Anglo- and Latin-American pupils' competencies in mathematics at the beginning of the academic school year 1961 is presented in Table VII.

<table>
<thead>
<tr>
<th>Mean</th>
<th>Anglo-American Group</th>
<th>Latin-American Group</th>
<th>M_D</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>14.82</td>
<td>11.25</td>
<td>3.57</td>
<td>9.52</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

In order to ascertain whether there was a significant difference in the responses on the Cooperative Algebra Test, the t test was applied to the data summarized in Table VII. It was noted that the mean score for the Anglo-American pupils was 14.82. This mean score represented the number of problems worked correctly at the beginning of the academic school year 1961. The mean
score for the Latin-American pupils was 11.25. The mean difference was 3.57 points in favor of the Anglo-American pupils. The difference obtained was considered significant at greater than the .1 per cent level, a level considered highly significant. It was then concluded that, at the beginning of the academic school year 1961, the competencies in mathematics of the Anglo-American pupils were significantly higher than the competencies of the Latin-American pupils.

An analysis of the pupils' end-of-course attitudes toward algebra and their achievements in algebra was made to determine whether a significant relationship existed between the two factors. The method of treating the scores was by chi-square. A summary of this analysis is presented in Table VIII.

**TABLE VIII**

SIGNIFICANCE OF THE RELATIONSHIP BETWEEN THE ANGLO- AND LATIN-AMERICAN PUPILS' ATTITUDES TOWARD ALGEBRA AND THEIR ACHIEVEMENTS IN ALGEBRA

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>$\chi^2$</th>
<th>D.F.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anglo-American</td>
<td>435</td>
<td>49.57</td>
<td>1</td>
<td>&gt;.001</td>
</tr>
<tr>
<td>Latin-American</td>
<td>151</td>
<td>6.68</td>
<td>1</td>
<td>&gt;.01</td>
</tr>
<tr>
<td>Composite group</td>
<td>586</td>
<td>43.92</td>
<td>1</td>
<td>&gt;.001</td>
</tr>
</tbody>
</table>
The scores that represented the pupils' end-of-course attitudes toward algebra and their achievements in algebra were used to make the analysis presented in Table VIII. Only those attitude scores toward algebra which fell in the upper one-fourth or the lower one-fourth portion of scores were used in the analysis.

The Anglo-American pupils whose achievements in algebra were above 10.09, the mean achievement score for the Anglo-American pupils, and those Latin-American pupils whose achievements were above 6.59, the mean achievement score for the Latin-American pupils, were defined as "high" achievers. All other pupils were defined as "low" achievers in algebra.

When the two groups of pupils were combined to form a composite group, the pupils whose scores fell above 8.92, the mean achievement score for this combined group, were defined as "high" achievers. All other pupils were defined as "low" achievers.

Table VIII exhibits the fact that, when the chi-square statistic was applied to the scores of the Anglo-American pupils, the chi-square value was 49.57. The pupils that exhibited favorable end-of-course attitudes toward algebra achieved more than the pupils that exhibited unfavorable attitudes toward algebra. This
value of chi-square was considered significant at greater than the .1 per cent level.

The chi-square value for the scores of the Latin-American pupils was 6.68. The pupils that exhibited favorable end-of-course attitudes toward algebra achieved more than the pupils that exhibited unfavorable attitudes toward algebra. Chi-square was considered significant at greater than the 1 per cent level.

When the 435 Anglo- and 151 Latin-American pupils were combined to form a composite group of 586 pupils, the chi-square value was 43.92. The pupils that expressed favorable end-of-course attitudes toward algebra achieved more than the pupils that expressed unfavorable attitudes toward algebra. Chi-square was considered significant at greater than the .1 per cent level.

An analysis of the pupils' end-of-course judgments concerning the practical value of algebra and their achievements in algebra was made to determine if a significant relationship existed between the two factors. The method of treating the scores was by chi-square. A summary of these analyses is presented in Table IX.

The scores which represented the pupils' end-of-course judgments concerning the practical value of algebra and their achievements in algebra were used in the analysis presented in Table IX. Only those judgment
scores which fell in the upper one-fourth level of scores or the lower one-fourth level of scores were used in the comparisons.

TABLE IX
SIGNIFICANCE OF THE RELATIONSHIP BETWEEN 500 ANGLO- AND 133 LATIN-AMERICAN PUPILS' JUDGMENTS CONCERNING THE PRACTICAL VALUE OF ALGEBRA AND THEIR ACHIEVEMENTS IN ALGEBRA

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>$\chi^2$</th>
<th>D.F.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anglo-American</td>
<td>500</td>
<td>43.87</td>
<td>1</td>
<td>&gt;.001</td>
</tr>
<tr>
<td>Latin-American</td>
<td>133</td>
<td>.614</td>
<td>1</td>
<td>NS</td>
</tr>
<tr>
<td>Composite group</td>
<td>633</td>
<td>31.01</td>
<td>1</td>
<td>&gt;.001</td>
</tr>
</tbody>
</table>

The Anglo-American pupils whose achievements were above 10.09, the mean achievement score for the Anglo-American group, and those Latin-American pupils whose achievements were above 6.57, the mean achievement score for the Latin-American group, were defined as "high" achievers in algebra. All other pupils were defined as "low" achievers.

When the two groups of pupils were combined to form a composite group of 633 Anglo- and Latin-American pupils, the pupils whose achievements were above 8.92, the mean achievement score for this combined group, were defined as "high" achievers. All other pupils were defined as "low" achievers.
It can be noted that when the chi-square statistic was applied to the data summarized in Table IX, the scores of the Anglo-American pupils produced a chi-square value of 43.87. The pupils that expressed favorable end-of-course judgments concerning the practical value of algebra achieved more than the pupils that expressed unfavorable judgments. This value of chi-square was significant at greater than the .1 per cent level.

The chi-square value for the scores of the Latin-American pupils was .614. The pupils that exhibited favorable end-of-course judgments concerning the practical value of algebra achieved more than the pupils that expressed unfavorable judgments. However, this value of chi-square that was produced by the Latin-American pupils was not large enough to be considered significant.

When the 500 Anglo- and 133 Latin-American pupils were combined to form a composite group of 633 pupils, the analysis produced a value of chi-square of 31.01. Because of the greater number of Anglo-American pupils, this value of chi-square was still significant. The pupils that expressed favorable judgments concerning the practical value of algebra achieved more than the pupils that expressed unfavorable judgments. The obtained chi-square value was considered significant at greater than the .1 per cent level.
An analysis of the 1,163 pupils' beginning- and end-of-course attitudes toward algebra was made to determine if a significant gain or loss occurred during the academic school year 1961-1962. The method of treating the data was by the $t$ technique. A summary of these changes in attitudes toward algebra is presented in Table X.

### Table X

**Significance of the Mean Change of the 873 Anglo- and 290 Latin-American Pupils' Attitudes Toward Algebra**

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>$M_1$</th>
<th>$M_2$</th>
<th>$M_D$</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anglo-American</td>
<td>873</td>
<td>63.03</td>
<td>57.70</td>
<td>-5.33</td>
<td>2.96</td>
<td>&gt;.01</td>
</tr>
<tr>
<td>Latin-American</td>
<td>290</td>
<td>61.11</td>
<td>57.62</td>
<td>-3.49</td>
<td>2.42</td>
<td>&gt;.02</td>
</tr>
<tr>
<td>Composite group</td>
<td>1,163</td>
<td>62.05</td>
<td>57.67</td>
<td>-4.38</td>
<td>2.81</td>
<td>&gt;.01</td>
</tr>
</tbody>
</table>

Sixteen items on the "Attitude Inventory for Pupils of First-Year Algebra" were selected to measure the pupils' attitudes toward algebra. The lowest possible total score was sixteen and the maximum total score was eighty.

Table X exhibits the fact that, of a possible maximum total of 80.00 points, the mean score of the 873
Anglo-American pupils' attitudes toward algebra was 63.03 at the beginning of the academic school year 1961. The mean score of this same group of pupils was 57.70 at the end of the academic school year 1962. The mean difference represented a loss of -5.33 scale points that occurred between the beginning and the end of the academic school year. This difference was considered significant at greater than the 1 per cent level. However, it should be noted that although a significant loss occurred during the academic school year, the mean end-of-course attitude toward algebra still represented a favorable attitude, since the scale value was still well above the unfavorable range.

The mean score of the 290 Latin-American pupils' attitudes toward algebra was 61.11 at the beginning of the academic school year 1961. The mean score of this same group of pupils was 57.62 at the end of the academic school year 1962. This mean attitude score of 57.62 points toward algebra was still considered as a favorable attitude toward algebra. However, the mean difference represented a loss of -3.49 points that occurred between the beginning and the end of the academic school year. The difference obtained was significant at greater than the 2 per cent level. It was then concluded that, between the beginning and the end of the academic school year, a
significant loss occurred in the Latin-American pupils' attitudes toward algebra.

When the Anglo- and Latin-American pupils were combined to form a composite group of 1,163 pupils, the mean attitude toward algebra was 62.05 scale points at the beginning of the academic school year. The end-of-course attitude toward algebra of this same group of pupils was 57.67 points. The mean difference represented a loss of -4.38 points that occurred between the beginning and the end of the academic school year. However, although a significant loss occurred during the academic school year, the mean end-of-course attitude toward algebra was still a favorable attitude. The difference obtained was significant at greater than the 1 per cent level.

A summary of the changes of the Anglo- and Latin-American pupils' judgments concerning the practical value of algebra is presented in Table XI.

Six items on the "Attitude Inventory for Pupils of First-Year Algebra" were selected to measure the pupils' judgments concerning the practical value of algebra. The lowest possible total score was six, and the maximum total score was thirty.

Table XI exhibits the fact that the mean score of the 873 Anglo-American pupils' judgments concerning the practical value of algebra was 24.62 at the beginning of the
academic school year 1961. The mean score of this same group of pupils was 21.79 at the end of the academic school year 1962. The mean difference represented a loss of -2.83 points that occurred between the beginning and the end of the academic school year. The difference obtained was significant at greater than the 5 per cent level. On the basis of these findings, it seems logical to conclude that between the beginning and the end of the academic school year, a significant loss occurred in the Anglo-American pupils' judgments concerning the practical value of algebra. However, it should be noted that the mean end-of-course judgment was still a favorable judgment, since the scale value was still well above the unfavorable range.

**TABLE XI**

SIGNIFICANCE OF THE MEAN CHANGE OF THE 873 ANGLO- AND 290 LATIN-AMERICAN PUPILS' JUDGMENTS CONCERNING THE PRACTICAL VALUE OF ALGEBRA

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>$M_1$</th>
<th>$M_2$</th>
<th>$M_D$</th>
<th>t</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anglo-American</td>
<td>873</td>
<td>24.62</td>
<td>21.79</td>
<td>-2.83</td>
<td>2.01</td>
<td>&gt;.05</td>
</tr>
<tr>
<td>Latin-American</td>
<td>290</td>
<td>23.47</td>
<td>21.79</td>
<td>-2.68</td>
<td>1.58</td>
<td>NS</td>
</tr>
<tr>
<td>Composite group</td>
<td>1,163</td>
<td>24.24</td>
<td>21.79</td>
<td>-2.45</td>
<td>1.63</td>
<td>NS</td>
</tr>
</tbody>
</table>
The mean score of the Latin-American pupils' judgments concerning the practical value of algebra was 23.47 at the beginning of the academic school year 1961. The mean score of this same group of pupils was 21.79, the same mean score as that of the Anglo-American pupils, at the end of the academic school year. This end-of-course judgment was still a favorable judgment concerning the practical value of algebra. The mean difference represented a loss of -2.68 points that occurred between the beginning and the end of the academic school year. However, this loss was not great enough to be considered significant.

When the Anglo- and Latin-American pupils were combined to form a composite group of 1,163 pupils, the mean score of their judgments concerning the practical value of algebra was 24.24 at the beginning of the academic school year 1961. The mean score of this same group of pupils was 21.79 at the end of the academic school year 1962. This end-of-course judgment concerning the practical value of algebra was still a favorable judgment. However, the loss of -2.45 points was not great enough to be considered significant.

An analysis by the t technique was made to determine if the Anglo-American pupils achieved more than the
Latin-American pupils. A summary of this analysis is presented in Table XII.

<table>
<thead>
<tr>
<th>Mean</th>
<th>Anglo-American Group</th>
<th>Latin-American Group</th>
<th>MD</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>M₁</td>
<td>14.82</td>
<td>11.25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M₂</td>
<td>24.91</td>
<td>17.82</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M₃</td>
<td>10.09</td>
<td>6.57</td>
<td>4.52</td>
<td>10.73</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

A closer analysis of the data presented in Table XII shows that the Anglo-American pupils' achievements in algebra ranged from a loss of seven points through a gain of thirty-four points. The Latin-American pupils' achievements ranged from a loss of nine points through a gain of twenty-five points.

The data in Table XII reveal that the Anglo-American pupils worked 14.82 problems on the Cooperative Algebra Test correctly at the beginning of the academic school year 1961. The average number of problems worked correctly at the end of the academic school year 1962 was 24.91. The mean difference was 10.09 problems. This mean gain represented the average achievement for the 873 Anglo-American pupils.
It was further noted that the average number of problems worked correctly by the Latin-American pupils was 11.25 at the beginning of the academic school year 1961. The average number of problems worked correctly by this same group at the end of the academic school year 1962 was 17.82. The mean difference was 6.57 problems. This mean gain represented the average achievement for the 290 Latin-American pupils.

The difference between the mean achievement scores of the Anglo- and Latin-American pupils was 4.52 points in favor of the Anglo-American pupil group. The difference provided was significant at greater than the .1 per cent level. On the basis of these findings, it was concluded that the Anglo-American pupils' achievements in algebra were significantly higher than the achievements of the Latin-American pupils.

Summary

1. An analysis of the mean difference was made between the 873 Anglo- and 290 Latin-American pupils' beginning attitudes toward algebra. Of a possible total score of 80.00 points, the Anglo-American pupils provided a mean attitude toward algebra of 63.03 scale points. The Latin-American pupils provided a mean attitude toward algebra of 61.11 points. The mean difference was 1.92
points in favor of the Anglo-American pupils. The difference obtained was significant at greater than the .1 per cent level.

2. An analysis of the mean difference was made between the 873 Anglo- and 290 Latin-American pupils' beginning judgments concerning the practical value of algebra. Of a possible total score of 30.00 points, the Anglo-American pupils provided a mean judgment of 24.62 points. The mean judgment of the Latin-American pupils was 23.47 points. The analysis showed a difference of 1.15 points in favor of the Anglo-American pupils. The difference was significant at greater than the 5 per cent level.

3. The analysis of the 873 Anglo- and 290 Latin-American pupils' competencies in mathematics at the beginning of the academic school year showed the Anglo-American pupils worked an average of 3.57 problems more than the Latin-American pupils. The mean number of problems worked by the Anglo-American pupils was 14.82. The mean number of problems worked correctly by the Latin-American pupils was 11.25. The difference, 3.57, was significant at greater than the .1 per cent level.

4. An analysis of 435 Anglo-American pupils' end-of-course attitudes toward algebra and their achievements in algebra produced a chi-square value of 49.57. The pupils that expressed favorable attitudes toward algebra achieved
more than the pupils that expressed unfavorable attitudes toward algebra. Chi-square was significant at greater than the .1 per cent level.

The analysis of 151 Latin-American pupils' end-of-course attitudes toward algebra and their achievements in algebra produced a chi-square value of 6.68. The pupils that expressed favorable attitudes toward algebra achieved more than the pupils that expressed unfavorable attitudes. Chi-square was significant at greater than the 1 per cent level.

When the Anglo- and Latin-American pupils were combined to form a composite group of 586 pupils, chi-square was 43.92. The pupils that expressed favorable attitudes toward algebra achieved more than the pupils that expressed unfavorable attitudes toward algebra. Chi-square for this combined group was significant at greater than the .1 per cent level.

5. The chi-square statistic was also applied to determine if a significant relationship existed between 500 Anglo- and 133 Latin-American pupils' end-of-course judgments concerning the practical value of algebra and their achievements in algebra. The analysis of the Anglo-American pupils' end-of-course judgments concerning the practical value of algebra and their achievements in algebra produced a chi-square value of 43.87. The pupils
that expressed favorable judgments achieved more than the pupils that expressed unfavorable judgments. This chi-square value was significant at greater than the .1 percent level.

The analysis of the Latin-American pupils' end-of-course judgments concerning the practical value of algebra and their achievements in algebra produced a chi-square value of .614. The pupils that exhibited favorable end-of-course judgments achieved more than the pupils that exhibited unfavorable judgments. However, chi-square was not large enough to be considered significant.

When the Anglo- and Latin-American pupils were combined to form a composite group of 633 pupils, chi-square was 31.01. Because of the greater number of Anglo-American pupils, this value was significant at greater than the .1 percent level. The pupils that expressed favorable judgments achieved more than the pupils that expressed unfavorable judgments concerning the practical value of algebra.

6. An analysis was made by the t technique of the mean differences between the 873 Anglo- and 290 Latin-American pupils' beginning and end-of-course attitudes toward algebra. Of a possible total score of 80.00, the mean score of the Anglo-American pupils' attitudes toward algebra was 63.03 points at the beginning of the academic
school year. The mean score of this same group of pupils was 57.70 at the end of the academic school year 1962. This change produced a loss of -5.33 scale points between the beginning and the end of the academic school year. The difference obtained was considered significant at greater than the 1 per cent level. Although a significant loss occurred, the mean end-of-course attitude toward algebra still represented a favorable attitude.

The mean score of the 290 Latin-American pupils' attitudes toward algebra was 61.11 scale points at the beginning of the academic school year. The mean score of this same group of pupils was 57.62 at the end of the academic school year 1962. This change produced a loss of -3.49 scale points between the beginning and the end of the academic school year. The difference obtained was considered significant at greater than the 2 per cent level. Although a significant loss occurred, the mean end-of-course attitude toward algebra still represented a favorable attitude.

When the Anglo- and Latin-American pupils were combined to form a composite group of 1,163 pupils, the mean score of the pupils' attitudes toward algebra was 62.05 points at the beginning of the academic school year and was 57.67 points at the end of the academic school year. The loss provided, -4.38 scale points, was significant at
greater than the 1 per cent level. However, the mean end-of-course attitude toward algebra of the 1,163 pupils still represented a favorable attitude.

7. The analysis of the mean differences between the 873 Anglo- and 290 Latin-American pupils' beginning and end-of-course judgments concerning the practical value of algebra was made by the t technique. Of a possible total score of 30.00 scale points, the mean score of the Anglo-American pupils' judgments was 24.62 points at the beginning of the academic school year. The mean score of this same group of pupils was 21.79 at the end of the academic school year. This mean change produced a loss of -2.83 scale points. This difference was considered significant at greater than the 5 per cent level. Although a significant loss occurred, the mean end-of-course judgment still represented a favorable judgment concerning the practical value of algebra.

The mean score of the 290 Latin-American pupils' judgments concerning the practical value of algebra was 23.47 scale points at the beginning of the academic school year. The mean score of this same group of pupils was 21.79 at the end of the academic school year. This change produced a loss of -2.68 scale points. However, this loss was not great enough to be considered significant.
When the Anglo- and Latin-American pupils were combined to form a composite group of 1,163 pupils, the mean score of the pupils' judgments concerning the practical value of algebra was 24.24 points at the beginning of the academic school year and was 21.79 at the end of the academic school year. The loss provided, -2.45 scale points, was not great enough to be considered significant. However, the mean end-of-course judgment of the 1,163 pupils still represented a favorable judgment concerning the practical value of algebra.

8. An analysis by the *t* technique was made between the mean differences of the 873 Anglo- and 290 Latin-American pupils' achievements in algebra. The mean achievement score of the Anglo-American pupils was 10.09. The mean achievement score of the Latin-American pupils was 6.57. The analysis showed a difference of 4.52 points in favor of the Anglo-American pupils. The difference obtained was significant at greater than the .1 per cent level.
CHAPTER BIBLIOGRAPHY


CHAPTER IV

TEACHER-PUPIL RELATIONSHIPS

Reasons for Comparison

The major theme of the study was to find the extent to which certain characteristics of teachers of first-year algebra were related to (a) their pupils' attitudes toward algebra and (b) their pupils' achievements in algebra.

The study was designed to investigate the outcomes of the pupils' attitudes toward algebra, their judgments concerning the practical value of algebra, and their net achievements in algebra when influenced by the educational backgrounds, attitudes toward algebra, and judgments concerning the practical value of algebra of their teachers.

In following this major theme, four types of data were gathered from the forty-five teachers who participated in this study. The four types of data were (a) the teachers' attitudes toward algebra, (b) the teachers' judgments concerning the practical value of algebra, (c) their backgrounds in mathematics, and (d) their backgrounds in professional education.

Similarly, three types of data were gathered from the 873 Anglo- and 290 Latin-American pupils who participated
in the study. These data were (a) their attitudes toward algebra, (b) their judgments concerning the practical value of algebra, and (c) their achievements in algebra.

The teachers' attitudes toward algebra and their judgments concerning the practical value of algebra were obtained from the scores of the "Attitude Inventory for Teachers of First-Year Algebra" (Appendix B), an attitude inventory designed especially for use in the study. To gather the teachers' backgrounds in mathematics and professional education, the immediate supervisor of each teacher was asked to provide the number of semester hours in each field.

The pupils' attitudes toward algebra and their judgments concerning the practical value of algebra were gathered from the "Attitude Inventory for Pupils of First-Year Algebra" (Appendix A). To obtain the pupils' achievements in algebra, the Cooperative Algebra Test (1) was administered to each of the participating pupils at the beginning and again at the end of the academic school year 1961-1962. The scores of each pupil were then paired, and the differences for each pair obtained. These differences were then defined as the pupils' achievements in algebra.

After the data were collected, they were assembled and prepared to test the subhypotheses of the study by the
In pursuing the major theme of the study, particular attention was given to the following subhypotheses to determine the teacher-pupil relationships:

1. That there was no significant relationship between teachers' attitudes toward algebra and the pupils' achievements in algebra.

2. That there was no significant relationship between subject matter preparation in mathematics of algebra teachers and the pupils' achievements in algebra.

3. That there was no significant relationship between the backgrounds in professional education of algebra teachers and the pupils' achievements in algebra.

4. That there was no significant relationship between judgments of teachers concerning the practical value of algebra and the pupils' achievements in algebra.

5. That there was no significant relationship between the judgments of teachers concerning the practical value of algebra and the end-of-course judgments of pupils regarding the practical value of algebra.

6. That there was no significant relationship between teachers' attitudes toward algebra and the end-of-course attitudes of pupils toward algebra.
7. That there was no significant relationship between teachers' attitudes toward algebra and the changes in pupils' attitudes toward algebra.

8. That there was no significant relationship between the changes in the attitude scores of pupils when taught by teachers with favorable attitudes toward algebra and teachers with unfavorable attitudes toward algebra.

The Results of the Comparisons

A summary of the outcomes of testing the first sub-hypothesis, that there was no significant relationship between teachers' attitudes toward algebra and the pupils' achievements in algebra, is presented in Table XIII.

**TABLE XIII**

**SIGNIFICANCE OF THE MEAN DIFFERENCE IN ACHIEVEMENTS OF PUPILS WHEN UNDER THE SUPERVISION OF TEACHERS WITH FAVORABLE OR UNFAVORABLE ATTITUDES**

<table>
<thead>
<tr>
<th>Teachers</th>
<th>Anglo-American</th>
<th>Latin-American</th>
<th>Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M</td>
<td>N</td>
</tr>
<tr>
<td>Favorable attitude</td>
<td>255</td>
<td>9.52</td>
<td>146</td>
</tr>
<tr>
<td>Unfavorable attitude</td>
<td>216</td>
<td>10.74</td>
<td>81</td>
</tr>
<tr>
<td>M&lt;sub&gt;D&lt;/sub&gt;</td>
<td>.</td>
<td>1.22</td>
<td>.</td>
</tr>
<tr>
<td>P</td>
<td>.</td>
<td>NS</td>
<td>.</td>
</tr>
</tbody>
</table>
A glance at the results in Table XIII shows that the mean achievement score of the 255 Anglo-American pupils under the supervision of teachers who expressed favorable attitudes toward algebra was 9.52. The mean achievement score of the 216 pupils under the supervision of teachers expressing unfavorable attitudes was 10.72. The mean difference was 1.22 points in favor of the pupils under the supervision of teachers expressing unfavorable attitudes toward algebra. Although there was a slightly greater gain in the mean score of the pupils under the supervision of teachers expressing unfavorable attitudes toward algebra, the difference did not approach the 5 per cent level of significance. Therefore, from the results of this analysis, it seems justified to accept the null hypothesis of no relationship.

It was further noted that the mean achievement score of the 146 Latin-American pupils under the supervision of teachers who expressed favorable attitudes toward algebra was 5.94. The mean achievement score of the 81 pupils under the supervision of teachers expressing unfavorable attitudes was 5.96. The mean difference was .02 points in favor of the pupils under the supervision of teachers expressing unfavorable attitudes toward algebra. However, the difference obtained was not large enough to be considered significant. On the basis of these results, it
seems justified to accept the null hypothesis of no relationship.

A closer analysis of the data found in Table XIII reveals that when the Anglo- and Latin-American pupils were combined to form composite groups under favorable or unfavorable attitude teachers, the mean achievement score of the 401 pupils under the supervision of teachers possessing favorable attitudes toward algebra was 8.22. The mean achievement score of the 297 pupils under the supervision of teachers expressing unfavorable attitudes toward algebra was 9.43. The mean difference was 1.21 points in favor of the pupils under the supervision of teachers expressing unfavorable attitudes toward algebra. Although there was a slightly greater gain in the mean score of the pupils under the supervision of teachers expressing unfavorable attitudes toward algebra, the difference obtained did not approach the 5 per cent level of significance. Therefore, the null hypothesis of no relationship was accepted.

In the search for an explanation why the pupils under the supervision of teachers expressing unfavorable attitudes made greater gains, it was found that the pupils of three teachers who expressed unfavorable attitudes toward algebra ranked among the upper 25 per cent in achievement. These pupils were able to influence the data sufficiently
so that a greater achievement was shown by pupils under the supervision of teachers exhibiting unfavorable attitudes toward algebra.

The outcomes of testing the second subhypothesis, that there was no significant relationship between subject matter preparation in mathematics of algebra teachers and the pupils' achievements in algebra, are presented in Table XIV.

**TABLE XIV**

**SIGNIFICANCE OF THE MEAN DIFFERENCE IN ACHIEVEMENTS OF PUPILS WHEN UNDER THE SUPERVISION OF TEACHERS WITH HIGH OR LOW BACKGROUNDS IN MATHEMATICS**

<table>
<thead>
<tr>
<th>Teachers</th>
<th>Pupils</th>
<th>N</th>
<th>M</th>
<th>N</th>
<th>M</th>
<th>N</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anglo-American</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High background</td>
<td>253</td>
<td>11.37</td>
<td>43</td>
<td>7.67</td>
<td>296</td>
<td>10.06</td>
<td></td>
</tr>
<tr>
<td>Low background</td>
<td>138</td>
<td>9.24</td>
<td>128</td>
<td>6.37</td>
<td>266</td>
<td>7.04</td>
<td></td>
</tr>
<tr>
<td>MD</td>
<td>.</td>
<td>2.13</td>
<td>.</td>
<td>1.30</td>
<td>.</td>
<td>3.02</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>.</td>
<td>&gt;.01</td>
<td>.</td>
<td>NS</td>
<td>.</td>
<td>&gt;.001</td>
<td></td>
</tr>
</tbody>
</table>

The data found in Table XIV point to the fact that the mean achievement score of the 253 Anglo-American pupils under the supervision of teachers with high mathematical backgrounds was 11.37. The mean achievement score
of the 138 Anglo-American pupils under the supervision of low mathematical background teachers was 9.24. The mean difference was 2.13 points in favor of the pupils under the supervision of teachers with high mathematical backgrounds. The difference obtained was significant at greater than the 1 per cent level. On the basis of this analysis, the null hypothesis of no relationship was rejected.

A further look at Table XIV reveals the fact that the mean achievement score of the 43 Latin-American pupils under the supervision of teachers with high mathematical backgrounds was 7.67. The mean achievement score of the 128 Latin-American pupils under the supervision of teachers with low mathematical backgrounds was 6.37. The mean difference was 1.30 points in favor of the pupils under the supervision of teachers with high backgrounds. Although there was a slightly greater gain in the mean score of the pupils under the supervision of teachers possessing high backgrounds, the difference obtained did not approach the 5 per cent level of significance. Therefore, it seems justified to accept the null hypothesis of no relationship.

It was also noted from Table XIV that when the Anglo- and Latin-American pupils were combined to form composite groups under high or low background teachers, the mean
achievement score of the 296 pupils under the supervision of teachers with high backgrounds was 10.06. The mean achievement score of the 266 pupils under the supervision of teachers with low backgrounds in mathematics was 7.04. The mean difference was 3.02 points in favor of the pupils under the supervision of teachers with high backgrounds. The difference obtained was significant at greater than the .1 per cent level. Therefore, the null hypothesis of no relationship was rejected.

A summary of the third subhypothesis, that there was no significant relationship between the backgrounds in professional education of algebra teachers and the pupils' achievements in algebra, is presented in Table XV.

TABLE XV

SIGNIFICANCE OF THE MEAN DIFFERENCE IN ACHIEVEMENTS OF PUPILS WHEN UNDER THE SUPERVISION OF TEACHERS WITH HIGH OR LOW BACKGROUNDS IN PROFESSIONAL EDUCATION

<table>
<thead>
<tr>
<th>Teachers</th>
<th>Pupils</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anglo-American</td>
<td>Latin-American</td>
<td>Composite</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>M</td>
<td>N</td>
<td>M</td>
<td>N</td>
</tr>
<tr>
<td>High background</td>
<td>129</td>
<td>7.30</td>
<td>110</td>
<td>5.48</td>
<td>239</td>
</tr>
<tr>
<td>Low background</td>
<td>128</td>
<td>10.34</td>
<td>86</td>
<td>7.75</td>
<td>214</td>
</tr>
<tr>
<td>Md</td>
<td>..</td>
<td>3.04</td>
<td>..</td>
<td>2.27</td>
<td>..</td>
</tr>
<tr>
<td>P</td>
<td>..</td>
<td>&gt;.01</td>
<td>..</td>
<td>&gt;.01</td>
<td>..</td>
</tr>
</tbody>
</table>
From the data in Table XV, it can be seen that the mean achievement score of the 129 Anglo-American pupils under the supervision of teachers possessing high backgrounds in professional education was 7.30. The mean achievement score of the 128 pupils under the supervision of teachers with low backgrounds in professional education was 10.34. The mean difference was 3.04 points in favor of the pupils under the supervision of teachers with low backgrounds in professional education. The significance of this difference was greater than the 1 per cent level. On the basis of this analysis, it seems justified to reject the null hypothesis of no relationship.

A further glance at the results in Table XV shows that the mean achievement score of the 110 Latin-American pupils was 5.48 when under the supervision of teachers with high backgrounds in professional education. The mean achievement score of the 86 pupils under the supervision of teachers whose backgrounds in professional education were low was 7.75. The mean difference was 2.27 points in favor of the pupils under the supervision of teachers with low backgrounds in professional education. The significance of this difference was greater than the 1 per cent level. Therefore, it seems justified to reject the null hypothesis of no relationship.
It can be noted in Table XV that when the Anglo- and Latin-American pupils were combined to form composite groups under high or low background teachers, the mean achievement score of the 239 pupils under high background teachers was 6.46. The mean achievement score of the 214 pupils under low background teachers was 9.29. The mean difference was 2.83 points in favor of the pupils under the supervision of teachers possessing low backgrounds in professional education. The significance of this difference was greater than the .1 per cent level. Therefore, the null hypothesis of no relationship was rejected.

However, it should be noted from Appendix F that 30 per cent of the teachers with low backgrounds in professional education possessed high backgrounds in mathematics. Of the teachers who possessed high backgrounds in professional education, 40 per cent possessed low backgrounds in mathematics. When the results of Table XV are considered, it seems plausible to assume that the teachers who prepare themselves adequately in mathematics do not take many courses in professional education. Similarly, teachers that are preparing themselves adequately in professional education do not take many courses in mathematics. This inverse relationship of mathematical preparation and professional education that was obtained in Table XV may also
indicate that many teachers may not be teaching in their major fields of study.

An additional aspect of testing the third sub-hypothesis should be noted. In the establishment of methods to test the hypotheses of the study, only the upper one-third portion and lower one-third portion of teachers were used in the comparisons. This method of treating the data eliminated four teachers who were adequately prepared in both fields but who did not fall within the upper or lower one-third portion of teachers.

The results of the analysis of the fourth sub-hypothesis, that there was no significant relationship between judgments of teachers concerning the practical value of algebra and the pupils' achievements in algebra, are presented in Table XVI.

The achievements of pupils when under the supervision of teachers expressing favorable or unfavorable judgments concerning the practical value of algebra were used in the analysis of Table XVI. The pupils' achievements when under the supervision of the upper one-third portion of teachers were compared to the achievements of the pupils under the supervision of the lower one-third level of teachers.
TABLE XVI

SIGNIFICANCE OF THE ACHIEVEMENTS OF PUPILS WHEN UNDER THE SUPERVISION OF TEACHERS WITH FAVORABLE OR UNFAVORABLE JUDGMENTS CONCERNING THE PRACTICAL VALUE OF ALGEBRA

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>$\chi^2$</th>
<th>D.F.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anglo-American</td>
<td>378</td>
<td>44.18</td>
<td>1</td>
<td>&gt;.001</td>
</tr>
<tr>
<td>Latin-American</td>
<td>184</td>
<td>.726</td>
<td>1</td>
<td>NS</td>
</tr>
<tr>
<td>Composite groups</td>
<td>562</td>
<td>27.91</td>
<td>1</td>
<td>&gt;.001</td>
</tr>
</tbody>
</table>

The method of analysis in Table XVI was by chi-square. In order to establish division points for the cells on a two by two chi-square table, the pupils' mean achievement scores were selected as the points of division. The mean achievement was 10.09 points for the Anglo-American pupils and 6.57 points for the Latin-American pupils. When the Anglo- and Latin-American pupils were combined to form composite groups under teachers whose judgments were favorable or unfavorable, the mean achievement score was 9.21 points. Pupils whose achievements were higher than the mean achievement score were defined as high achievers. All other pupils were defined as low achievers.
It can be noted that when the chi-square statistic was applied to the data found in Table XVI, the data produced a chi-square value of 44.18 for the scores of the 378 Anglo-American pupils. The pupils under the supervision of teachers expressing favorable judgments concerning the practical value of algebra made greater achievements than the pupils under the supervision of teachers expressing unfavorable judgments. This chi-square value was significant at greater than the .1 percent level. Therefore, the null hypothesis of no relationship was rejected.

The chi-square value was .726 for the scores of the 184 Latin-American pupils. The pupils under the supervision of teachers expressing favorable judgments concerning the practical value of algebra made greater achievements than the pupils under the supervision of teachers expressing unfavorable judgments. Since the chi-square value did not approach the 5 percent level of significance, the null hypothesis of no relationship was accepted.

When the Anglo- and Latin-American pupils were combined to form composite groups under favorable or unfavorable attitude teachers, chi-square was 27.91. The pupils under the supervision of teachers expressing favorable judgments concerning the practical value of
algebra made greater achievements than the pupils under the supervision of teachers expressing unfavorable judgments. This chi-square value was significant at greater than the .1 per cent level. Therefore, the null hypothesis of no relationship was rejected for the combined scores of the Anglo- and Latin-American pupils.

The analysis of the fifth subhypothesis, that there was no significant relationship between the judgments of teachers concerning the practical value of algebra and the end-of-course judgments of pupils regarding the practical value of algebra, is summarized in Table XVII.

**TABLE XVII**

**SIGNIFICANCE OF THE MEAN DIFFERENCE IN END-OF-COURSE JUDGMENTS OF PUPILS WHEN UNDER THE SUPERVISION OF TEACHERS WITH FAVORABLE OR UNFAVORABLE JUDGMENTS CONCERNING THE PRACTICAL VALUE OF ALGEBRA**

<table>
<thead>
<tr>
<th>Teachers</th>
<th>Pupils</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Anglo-American</td>
<td>Latin-American</td>
<td>Composite</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>M</td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>Favorable judgment</td>
<td></td>
<td>184</td>
<td>21.68</td>
<td>96</td>
<td>22.13</td>
</tr>
<tr>
<td>Unfavorable</td>
<td></td>
<td>194</td>
<td>21.82</td>
<td>88</td>
<td>21.34</td>
</tr>
<tr>
<td>judgment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M_D</td>
<td></td>
<td>.14</td>
<td>.79</td>
<td>.32</td>
<td>.32</td>
</tr>
<tr>
<td>F</td>
<td></td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>
As shown in Table XVII, the mean end-of-course judgment concerning the practical value of algebra for the 184 Anglo-American pupils when under the supervision of favorable judgment teachers was 21.68 scale points. The mean end-of-course judgment of the 194 pupils under the supervision of unfavorable judgment teachers was 21.82 scale points. The mean difference was .14 points in favor of the pupils under the supervision of teachers possessing unfavorable judgments concerning the practical value of algebra. Although there was a slightly higher gain in the scores of the pupils under the supervision of unfavorable judgment teachers, the difference obtained did not approach the 5 per cent level of significance. Therefore, the null hypothesis of no relationship was accepted for the Anglo-American pupil group.

A closer analysis of the data presented in Table XVII revealed that the mean end-of-course judgment concerning the practical value of algebra for the 90 Latin-American pupils when under the supervision of favorable judgment teachers was 22.13 scale points. The mean end-of-course judgment for the 88 pupils under the supervision of unfavorable judgment teachers was 21.34 scale points. The mean difference was .79 points in favor of the pupils under the supervision of favorable judgment teachers.
although there was a slightly greater gain in the scores of the pupils under the supervision of teachers whose judgments were favorable, the difference obtained did not approach the 5 per cent level of significance. Therefore, the null hypothesis was accepted for the Latin-American pupil group.

It was also noted from Table XVII that the mean end-of-course judgment concerning the practical value of algebra for the composite group of 280 Anglo- and Latin-American pupils under the supervision of favorable judgment teachers was 21.90 scale points. The mean end-of-course judgment for the 282 combined pupils under the supervision of unfavorable judgment teachers was 21.53 scale points. The mean difference was .32 points in favor of the group of pupils under the supervision of teachers expressing favorable judgments concerning the practical value of algebra. However, the difference obtained was not great enough to be considered significant. Therefore, the null hypothesis of no relationship was accepted for the composite Anglo- and Latin-American pupil groups.

A summary of the scores used to test the sixth sub-hypothesis, that there was no significant relationship between teachers' attitudes toward algebra and the end-of-course attitudes of pupils toward algebra, is presented in
Table XVIII. The method of treating the data was by the t technique.

**TABLE XVIII**

**SIGNIFICANCE OF THE MEAN DIFFERENCE IN END-OF-COURSE ATTITUDES OF PUPILS WHEN UNDER THE SUPERVISION OF TEACHERS WITH FAVORABLE OR UNFAVORABLE ATTITUDES**

<table>
<thead>
<tr>
<th>Teachers</th>
<th>Pupils</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anglo-American</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td>Favorable attitude</td>
<td>255</td>
</tr>
<tr>
<td>Unfavorable attitude</td>
<td>216</td>
</tr>
<tr>
<td>$M_D$</td>
<td>.</td>
</tr>
<tr>
<td>$p$</td>
<td>.</td>
</tr>
</tbody>
</table>

It was shown from Table XVIII that the mean score which represented the 255 Anglo-American pupils' end-of-course attitudes toward algebra was 60.59 scale points. The mean score for the 216 pupils under the supervision of teachers expressing unfavorable attitudes toward algebra was 57.28 points. The mean difference was 3.31 points in favor of the pupils under the supervision of teachers possessing favorable attitudes. The difference obtained was significant at greater than the 1 per cent level.
Therefore, the null hypothesis was rejected for the Anglo-American pupil group.

Further analysis of the data in Table XVIII indicates that the mean score for the 146 Latin-American pupils under the supervision of teachers with favorable attitudes was 57.31 scale points. The mean score for the 81 pupils under the supervision of teachers with unfavorable attitudes toward algebra was 52.27 points. The mean difference was 5.04 points in favor of the pupils under the supervision of teachers with favorable attitudes toward algebra. The difference obtained was significant at greater than the 1 per cent level. Therefore, the null hypothesis was rejected for the Latin-American pupil group.

When the Anglo- and Latin-American pupils were combined to form composite groups under favorable or unfavorable attitude teachers, the mean end-of-course attitude for the 401 pupils under the supervision of teachers with favorable attitudes toward algebra was 59.40 scale points. The mean score for the 297 pupils under the supervision of teachers with unfavorable attitudes was 55.91 points. The mean difference was 3.49 points in favor of the pupils under the supervision of favorable attitude teachers. The difference obtained was significant at greater than the .1 per cent level. Therefore,
the null hypothesis was rejected for the composite groups of pupils.

A summary of the outcomes of testing the seventh sub-
hypothesis, that there was no significant relationship
between teachers' attitudes toward algebra and the changes
in pupils' attitudes toward algebra, is presented in
Table AIX.

<table>
<thead>
<tr>
<th>TABLE AIX</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGNIFICANCE OF THE CHANGE IN ATTITUDES OF PUPILS WHEN UNDER THE SUPERVISION OF TEACHERS WITH FAVORABLE OR UNFAVORABLE ATTITUDES TOWARD ALGEBRA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>$X^2$</th>
<th>D.F.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anglo-American</td>
<td>401</td>
<td>1.53</td>
<td>1</td>
<td>NS</td>
</tr>
<tr>
<td>Latin-American</td>
<td>227</td>
<td>7.62</td>
<td>1</td>
<td>&gt;.01</td>
</tr>
<tr>
<td>Composite groups</td>
<td>628</td>
<td>.49</td>
<td>1</td>
<td>NS</td>
</tr>
</tbody>
</table>

To obtain the pupils' change in attitudes toward algebra, the "Attitude Inventory for Pupils of First-Year Algebra" was administered to each participating pupil at the beginning and at the end of the academic school year 1961-1962. The scores of each pupil were then paired, and the difference for each pair was obtained. These differences were then defined as the pupils' change in attitudes
toward algebra. The changes in the Anglo-American pupils' attitudes toward algebra ranged from a gain of +36.00 points through a loss of -44.00 points. The mean change of the Anglo-American pupils' attitudes was -4.72 points. The changes in the Latin-American pupils' attitudes toward algebra ranged from a gain of +34.00 points through a loss of -30.00 points. The mean change of the Latin-American pupils' attitudes toward algebra was -7.72 points.

The change-in-attitude scores of the pupils under the supervision of teachers exhibiting favorable or unfavorable attitudes toward algebra were used in the analysis of Table XIX. The pupils' change in attitudes, when under the supervision of the upper one-third level of teachers, were compared to the change in attitudes of the pupils under the supervision of the lower one-third portion of teachers.

The method of analysis in Table XIX was by chi-square. In order to establish division points for the cells on a two-by-two chi-square table, the mean change-in-attitude scores were selected as the points of division. The mean change-in-attitude score of the Anglo-American pupils was -4.72 points. The mean change-in-attitude score of the Latin-American pupils was -7.72 points. When the Anglo- and Latin-American pupils were combined to form composite groups under favorable or unfavorable attitude
teachers, the mean change-in-attitude score was $-5.69$ points. The pupils whose changes in attitudes were higher than the mean change in attitude were defined as belonging to the "upper change-in-attitude" group. All other pupils were defined as belonging to the "lower change-in-attitude" group.

It can be noted that when the chi-square statistic was applied to the data summarized in Table XIX, chi-square was 1.53 for the scores of the Anglo-American pupil group. The pupils under the supervision of teachers expressing favorable attitudes toward algebra had a loss in their attitudes that was less than the loss of pupils under the supervision of teachers expressing unfavorable attitudes toward algebra. However, chi-square did not approach the 5 per cent level of significance. Therefore, the null hypothesis of no relationship was accepted for the Anglo-American pupil group.

The chi-square value was 7.62 for the scores of the Latin-American pupil group. The pupils under the supervision of teachers expressing favorable attitudes toward algebra had a loss in their attitudes that was less than the loss of the pupils under the supervision of teachers exhibiting unfavorable attitudes. This chi-square value was significant at greater than the 1 per cent level.
the supervision of teachers possessing favorable attitudes toward algebra. The pupils under the supervision of teachers possessing favorable attitudes had a loss in their attitudes that was less than the loss of the pupils under the supervision of teachers expressing unfavorable attitudes toward algebra. The difference obtained was significant at greater than the 2 per cent level. Therefore, the null hypothesis of no relationship was rejected for the Anglo-American pupil group.

**TABLE XX**

**SIGNIFICANCE OF THE MEAN DIFFERENCE IN CHANGE IN ATTITUDES OF PUPILS WHEN UNDER THE SUPERVISION OF TEACHERS WITH FAVORABLE OR UNFAVORABLE ATTITUDES TOWARD ALGEBRA**

<table>
<thead>
<tr>
<th>Teachers</th>
<th>Anglo-American</th>
<th>Latin-American</th>
<th>Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M</td>
<td>N</td>
</tr>
<tr>
<td>Favorable attitude</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>255</td>
<td>-5.92</td>
<td>146</td>
</tr>
<tr>
<td>Unfavorable attitude</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>216</td>
<td>-8.51</td>
<td>81</td>
</tr>
<tr>
<td>N_D</td>
<td></td>
<td>2.59</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
<td>&gt;0.02</td>
<td></td>
</tr>
</tbody>
</table>

It was further noted in Table XX that the 146 Latin-American pupils under the supervision of teachers
expressing favorable attitudes toward algebra had a mean loss of -1.06 points. The 81 pupils under the supervision of teachers expressing unfavorable attitudes toward algebra had a mean loss of -6.29 points. The mean difference was 5.23 points in favor of the pupils under the supervision of teachers possessing favorable attitudes toward algebra. The difference obtained was significant at greater than the 1 per cent level of significance. Therefore, the null hypothesis was rejected for the Latin-American pupil group.

When the Anglo- and Latin-American pupils were combined to form composite groups under favorable attitude teachers, the mean score was -4.72 points. The mean score for the group under teachers expressing unfavorable attitudes was -7.72 points. The mean difference was 3.00 points in favor of the pupils under the supervision of teachers expressing favorable attitudes toward algebra. The difference obtained was significant at greater than the 1 per cent level. On the basis of these findings, the null hypothesis was rejected for the combined Anglo- and Latin-American pupil groups.

Summary

1. The mean achievement score of 216 Anglo-American pupils was 10.74 for the pupils under the supervision of teachers expressing unfavorable attitudes toward algebra.
The mean achievement score of 255 Anglo-American pupils was 9.52 for the pupils under the supervision of teachers expressing favorable attitudes toward algebra. The mean difference was 1.22 points in favor of those pupils under the supervision of teachers possessing unfavorable attitudes toward algebra.

The mean achievement score of 146 Latin-American pupils under the supervision of favorable attitude teachers was 5.94. The mean achievement score of 81 pupils under the supervision of unfavorable attitude teachers was 5.96. The mean difference was .02 points in favor of the pupils under the supervision of teachers with unfavorable attitudes toward algebra.

When the Anglo- and Latin-American pupils were combined to form composite groups under favorable or unfavorable attitude teachers, the mean achievement score was 8.22 for the 401 pupils under the supervision of teachers expressing favorable attitudes. The mean achievement score was 9.43 for the 297 pupils under the supervision of teachers expressing unfavorable attitudes toward algebra. The mean difference was 1.21 points in favor of the pupils under the supervision of teachers expressing unfavorable attitudes toward algebra.

None of the differences obtained above were great enough to be considered significant.
2. The mean achievement score of the 253 Anglo-American pupils under the supervision of teachers with high mathematical backgrounds was 11.37 points. The mean achievement score of the 138 pupils under the supervision of teachers with low mathematical backgrounds was 9.24 points. The mean difference was 2.13 points in favor of the pupils under the supervision of teachers with high mathematical backgrounds. The difference obtained was significant at greater than the 1 per cent level.

The mean achievement score of the 43 Latin-American pupils under the supervision of teachers with high mathematical backgrounds was 7.67 points. The mean achievement score of the 128 pupils under the supervision of teachers with low mathematical backgrounds was 6.37 points. The mean difference was 1.30 points in favor of the pupils under the supervision of teachers with high mathematical backgrounds. However, the difference obtained was not great enough to be considered significant.

When the Anglo- and Latin-American pupils were combined to form composite groups under high or low mathematical background teachers, the 296 pupils under the supervision of high mathematical background teachers provided a mean achievement score of 10.06 points. The 266 pupils under the supervision of low mathematical background teachers was 7.04 points. The mean difference was
Therefore, the null hypothesis of no relationship was rejected.

When the Anglo- and Latin-American pupils were combined to form composite groups under favorable or unfavorable attitude teachers, chi-square was .49. The pupils under the supervision of teachers expressing favorable attitudes toward algebra had a loss in their attitudes that was less than the loss of pupils under the supervision of teachers possessing unfavorable attitudes. However, chi-square did not approach the 5 per cent level of significance and the null hypothesis of no relationship was accepted.

The outcomes of testing the eighth subhypothesis, that there was no significant relationship between the change in the attitude scores of pupils when taught by teachers with favorable attitudes toward algebra and teachers with unfavorable attitudes toward algebra, are presented in Table XX.

A glance at the results of Table XX shows that the 255 Anglo-American pupils under the supervision of teachers expressing favorable attitudes toward algebra had a mean loss of -5.92 points. The 216 pupils under the supervision of teachers expressing unfavorable attitudes toward algebra had a mean loss of -8.51 points. The mean difference was 2.59 points in favor of the pupils under
3.02 points in favor of the pupils under the supervision of teachers with high mathematical backgrounds. The difference obtained was significant at greater than the .1 per cent level.

3. The mean achievement score of the 129 Anglo-American pupils under the supervision of teachers with high educational backgrounds was 7.30. The mean achievement score of the 128 pupils under the supervision of teachers with low backgrounds was 10.34. The mean difference was 3.04 points in favor of the pupils under the supervision of teachers with low educational backgrounds. The difference obtained was significant at greater than the 1 per cent level.

The mean achievement score of the 110 Latin-American pupils under the supervision of teachers with high educational backgrounds was 5.48. The mean achievement score of the 86 pupils under the supervision of teachers with low backgrounds was 7.75 points. The mean difference was 2.27 points in favor of the pupils under the supervision of teachers with low educational backgrounds. The difference obtained was significant at greater than the 1 per cent level.

When the Anglo- and Latin-American pupils were combined to form composite groups under high educational background teachers, the mean score of the 239 pupils was
6.46 points. The mean achievement score of the 214 pupils under the supervision of low educational background teachers was 9.29 points. The difference obtained was 2.83 points in favor of the pupils under the supervision of teachers with low educational backgrounds. This difference was significant at greater than the 1 per cent level.

It should be noted that 30 per cent of the teachers with low educational backgrounds possessed a high background in mathematics. Of those teachers who possessed high mathematical backgrounds, 40 per cent possessed low educational backgrounds. It seems plausible to assume, from the inverse relationship found above, and when considering the percentage of teachers possessing low backgrounds in mathematics or professional education, that teachers preparing themselves adequately in mathematics are not taking many courses in professional education. Similarly, the teachers that are preparing themselves in professional education are not taking many courses in mathematics. This inverse relationship may also indicate that teachers are not teaching in their major fields.

4. When tested by methods of chi-square to determine if a significant relationship existed between the pupils' achievements in algebra and the teachers' judgments concerning the practical value of algebra, the scores of the
Anglo-American pupils produced a chi-square value of 44.18. The pupils under the supervision of teachers expressing favorable judgments achieved more than the pupils under the supervision of teachers expressing unfavorable judgments. This chi-square value was significant at greater than the .1 per cent level.

Chi-square was .726 for the scores of the 184 Latin-American pupils. The pupils under the supervision of teachers expressing favorable judgments achieved more than the pupils under the supervision of teachers expressing unfavorable judgments. This chi-square value did not approach the 5 per cent level of significance.

When the Anglo- and Latin-American pupils were combined to form composite groups under favorable or unfavorable judgment teachers, chi-square was 27.91 for the 562 pupils involved in the analysis. The pupils under the supervision of teachers expressing favorable judgments achieved more than the pupils under the supervision of teachers expressing unfavorable judgments. This chi-square value was significant at greater than the .1 per cent level.

5. The mean end-of-course judgment concerning the practical value of algebra of the 184 Anglo-American pupils under the supervision of teachers expressing favorable judgments was 21.68 points. The mean end-of-course
judgment of the 194 pupils under the supervision of teachers expressing unfavorable judgments was 21.82. The mean difference was .14 points in favor of the pupils under the supervision of teachers possessing unfavorable judgments concerning the practical value of algebra. However, the difference obtained was not great enough to be considered significant.

The mean end-of-course judgment concerning the practical value of algebra of the 194 Latin-American pupils under the supervision of teachers expressing favorable judgments was 22.13 points. The mean end-of-course judgment of the 88 pupils under the supervision of teachers expressing unfavorable judgments was 21.34. The mean difference was .79 points in favor of the pupils under the supervision of teachers expressing favorable judgments. However, the difference obtained was not great enough to be considered significant.

The mean end-of-course judgment concerning the practical value of algebra of the composite group of 280 Anglo- and Latin-American pupils under the supervision of teachers expressing favorable judgments was 21.90 points. The mean end-of-course judgment of the 262 pupils under the supervision of teachers expressing unfavorable judgments was 21.58 points. The mean difference was .32 points in favor of the pupils under the supervision of teachers expressing
favorable judgments. However, the difference obtained was
not great enough to be considered significant.

6. The mean end-of-course attitude toward algebra of
the 255 Anglo-American pupils under the supervision of
teachers expressing favorable attitudes toward algebra was
60.59 points. The mean end-of-course attitude of the 216
pupils under the supervision of teachers expressing
unfavorable attitudes was 57.28 points. The mean differ-
ence was 3.31 points in favor of the pupils under the
supervision of teachers expressing favorable attitudes.
The difference obtained was significant at greater than
the 1 per cent level.

The mean end-of-course attitude toward algebra of the
146 Latin-American pupils under the supervision of
teachers expressing favorable attitudes toward algebra
was 57.31 points. The mean end-of-course attitude of the
61 pupils under the supervision of teachers expressing
unfavorable attitudes was 52.27 points. The mean differ-
ence was 5.04 points in favor of the pupils under the
supervision of teachers expressing favorable attitudes
toward algebra. The difference provided was significant
at greater than the 1 per cent level.

The mean end-of-course attitude toward algebra of the
composite group of Anglo- and Latin-American pupils under
the supervision of teachers exhibiting favorable attitudes
was 59.40 for the 401 pupils used in the analysis. The mean end-of-course attitude of the 297 combined pupils under the supervision of teachers expressing unfavorable attitudes was 55.91 points. The mean difference was 3.49 points in favor of the pupils under the supervision of teachers expressing favorable attitudes toward algebra. The difference obtained was significant at greater than the .1 per cent level.

7. When tested by methods of chi-square to determine if a significant relationship existed between the pupils' change in attitudes toward algebra and the teachers' attitudes toward algebra, the scores of the 401 Anglo-American pupils produced a chi-square value of 1.53. The pupils under the supervision of teachers expressing favorable attitudes had a loss in their attitudes that was less than the loss of the pupils under the supervision of teachers expressing unfavorable attitudes. However, chi-square was not great enough to be considered significant.

Chi-square was 7.62 for the scores of the 227 Latin-American pupils. The pupils under the supervision of teachers expressing favorable attitudes had a loss in their attitudes that was less than the loss of the pupils under the supervision of teachers expressing unfavorable attitudes toward algebra. Chi-square was considered significant at greater than the .1 per cent level.
When the Anglo- and Latin-American pupils were combined to form composite groups under favorable or unfavorable attitude teachers, chi-square was .49 for the 628 pupils used in the analysis. The pupils under the supervision of teachers expressing favorable attitudes toward algebra had a loss in their attitudes that was less than the loss of the pupils under the supervision of teachers possessing unfavorable attitudes toward algebra. However, chi-square was not great enough to be considered significant.

8. The changes in the Anglo-American pupils' attitudes toward algebra ranged from a gain of +36.00 points through a loss of -44.00 points. The mean change-in-attitude score of the 255 Anglo-American pupils under the supervision of teachers expressing favorable attitudes toward algebra was -5.92 points. The mean change in attitude of the 216 pupils under the supervision of teachers expressing unfavorable attitudes toward algebra was -8.51 points. The mean difference was 2.59 points in favor of the pupils under the supervision of teachers expressing favorable attitudes toward algebra. The difference obtained was significant at greater than the 2 per cent level.

The changes in the Latin-American pupils' attitudes toward algebra ranged from a gain of +34.00 points through
a loss of -30.00 points. The mean change-in-attitude score of the 146 pupils under the supervision of teachers expressing favorable attitudes toward algebra was -1.06 points. The mean change in attitude of the 81 pupils under the supervision of teachers expressing unfavorable attitudes was -6.29 points. The mean difference was 5.23 points in favor of the pupils under the supervision of teachers expressing favorable attitudes toward algebra. The difference obtained was significant at greater than the 1 per cent level.

The mean change-in-attitude score of the composite group of 401 Anglo- and Latin-American pupils under the supervision of teachers expressing favorable attitudes toward algebra was a loss of -4.72 points. The mean change-in-attitude score of the 297 pupils under the supervision of teachers expressing unfavorable attitudes toward algebra was -7.72 points. The mean difference was 3.00 points in favor of the pupils under the supervision of teachers possessing favorable attitudes toward algebra. The difference obtained was significant at greater than the 1 per cent level.
CHAPTER BIBLIOGRAPHY

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

This chapter is divided into four major parts. The first section consists of an over-all summary of the problem and procedures. The results are summarized in the second section. A presentation of the conclusions drawn from the study is given in the third section, and the recommendations are presented in the final section.

Summary

The primary purpose of the study was to determine the extent to which certain characteristics of teachers of first-year algebra were related to (a) their pupils' attitudes toward algebra and (b) their pupils' achievements in algebra. An additional aspect of the study was to ascertain and study the differences between Anglo- and Latin-American pupils' attitudes and achievements in algebra.

The study was designed to investigate the outcomes of the pupils' attitudes toward algebra, their judgments concerning the practical value of algebra, and their achievements in algebra when influenced by the educational backgrounds, attitudes toward algebra, and judgments
concerning the practical value of algebra of their teachers. Two secondary aims were to determine the relationship that existed between (a) the pupils' attitudes toward algebra and their achievements in algebra, and (b) the pupils' judgments concerning the practical value of algebra and their achievements in algebra.

The study was conducted during the academic school year 1961-1962 in sixty-seven selected first-year algebra classes involving forty-five teachers located within the West Texas geographical area. The sixty-seven classes contained 873 Anglo- and 290 Latin-American pupils. The two groups were treated collectively and, to prevent bias of the data from these two ethnic groups, the data of each group were treated separately.

In order to gather the data for the study, two testing periods were established: the first testing period occurred between the tenth and fifteenth class day of school, September, 1961. The second testing period occurred between the 165th and the 170th class day of school, May, 1962. The approximate time for each testing session was fifty-five minutes. Each participating pupil was administered the "Attitude Inventory for Pupils of First-Year Algebra," which was especially designed for use in the study, and the Cooperative Algebra Test during each testing period. Also, during each testing period, the
participating teachers were administered the "Attitude Inventory for Teachers of First-Year Algebra," an instrument designed especially for use in the study.

At the beginning of the academic school year 1961, the total number of semester hours in the fields of college mathematics and professional education of each teacher was obtained from his immediate supervisor.

A teacher who had accumulated thirty-nine or more semester hours in professional education was defined as belonging to the "high" educational group. A teacher whose background in professional education did not exceed twenty-four semester hours was defined as belonging to the "low" educational group. These division points were selected so that the scores of the pupils, when under the supervision of the upper one-third portion of teachers, could be compared to the scores of the pupils when under the supervision of the lower one-third portion of teachers.

A teacher who had accumulated thirty or more semester hours in college mathematics was defined as belonging to the "high" mathematical group. A teacher whose background in mathematics was less than twenty-four semester hours was defined as belonging to the "low" mathematical group. These division points were selected so that the scores of the pupils when under the supervision of the upper
one-third portion of teachers could be compared to the scores of the pupils when under the supervision of the lower one-third portion of teachers.

Divisional points were established so that the teachers whose attitude scores comprised the upper one-third level of scores were defined as possessing favorable attitudes toward algebra or as possessing favorable judgments concerning the practical value of algebra. Similarly, the teachers whose attitude scores comprised the lower one-third portion of scores were defined as possessing unfavorable attitudes toward algebra or as possessing unfavorable judgments concerning the practical value of algebra.

Comparisons were made between the pupils under the supervision of teachers expressing favorable attitudes toward algebra and the pupils under the supervision of teachers expressing unfavorable attitudes toward algebra. Pupils under the supervision of teachers expressing favorable judgments concerning the practical value of algebra were compared to the pupils under the supervision of teachers expressing unfavorable judgments. Similarly, pupils under the supervision of teachers possessing high backgrounds in college mathematics or professional education were compared to the pupils under the supervision of teachers possessing low backgrounds.
Findings

The actual differences found in various phases of the study are summarized below:

1. An analysis of the mean differences was made between the 873 Anglo- and 290 Latin-American pupils' attitudes toward algebra. Of a possible maximum total score of 80.00 and a minimum total score of 16.00 points, the Anglo-American pupils provided a mean attitude toward algebra of 61.03 points. The Latin-American pupils provided a mean attitude score of 61.11 points. The mean difference was 0.92 points in favor of the Anglo-American pupils. The difference obtained was significant at greater than the .1 per cent level.

2. An analysis of the mean differences was made between the 873 Anglo- and 290 Latin-American pupils' beginning judgments concerning the practical value of algebra. Of a possible minimum of 6.00 and a maximum total of 30.00 points, the Anglo-American pupils provided a mean judgment of 24.62 points. The mean judgment of the Latin-American pupils was 23.47 points. The analysis showed a difference of 1.15 points in favor of the Anglo-American pupils. The difference obtained was significant at greater than the 5 per cent level.

3. The analysis of the 873 Anglo- and 290 Latin-American pupils' competencies in mathematics at the
beginning of the academic school year showed the Anglo-American pupils worked an average of 3.57 problems more than the Latin-American pupils. The mean number of problems worked by the anglo-american pupils was 14.82. The mean number of problems worked correctly by the Latin-American pupils was 11.25. The difference, 3.57 points, was significant at greater than the .1 per cent level in favor of the Anglo-American pupils.

4. An analysis of the pupils' end-of-course attitudes toward algebra and their achievements in algebra was made to determine if a significant relationship existed between the two factors. Only those attitude scores toward algebra that fell in the upper one fourth or the lower one-fourth portion of scores were used in the analysis.

The scores of the 435 Anglo-American pupils produced a chi-square value of 49.57. The pupils that exhibited favorable end-of-course attitudes toward algebra achieved more than the pupils that exhibited unfavorable attitudes. Chi-square was considered significant at greater than the .1 per cent level.

The chi-square value for the scores of the 151 Latin-American pupils was 6.68. The pupils that exhibited favorable end-of-course attitudes toward algebra achieved more than the pupils that expressed unfavorable attitudes
toward algebra. Chi-square was considered significant at greater than the 1 per cent level.

When the Anglo- and Latin-American pupils were combined to form composite groups expressing favorable or unfavorable attitudes toward algebra, chi-square was 43.92 for the 586 pupils used in the analysis. The pupils that expressed favorable end-of-course attitudes toward algebra achieved more than the pupils that expressed unfavorable attitudes toward algebra. Chi-square was considered significant at greater than the .1 per cent level.

5. The chi-square statistic was applied to determine if a significant relationship existed between the Anglo- and Latin-American pupils' end-of-course judgments concerning the practical value of algebra and their achievements in algebra. Only the judgment scores that fell in the upper one fourth or the lower one-fourth portion of scores were used in the analysis. The scores of the 500 Anglo-American pupils produced a chi-square value of 43.87. The pupils that expressed favorable end-of-course judgments achieved more than the pupils that expressed unfavorable judgments concerning the practical value of algebra. Chi-square was significant at greater than the .1 per cent level.

The chi-square value for the scores of the 135 Latin-American pupils was .614. The pupils that exhibited
favorable end-of-course judgments achieved more than the pupils that exhibited unfavorable judgments concerning the practical value of algebra. Chi-square was not large enough to be considered significant.

When the Anglo- and Latin-American pupils were combined to form composite groups expressing favorable or unfavorable judgments concerning the practical value of algebra, chi-square was 31.01 for the 633 pupils used in the analysis. The pupils that expressed favorable end-of-course judgments achieved more than the pupils that expressed unfavorable judgments. Chi-square was considered significant at greater than the .1 per cent level.

6. An analysis was made of the mean differences between the 873 Anglo- and 290 Latin-American pupils' beginning- and end-of-course attitudes toward algebra. Of a possible total score of 80.00, the mean score of the Anglo-American pupils' attitudes toward algebra was 63.03 points at the beginning of the academic school year. The mean score of this same group of pupils was 57.70 at the end of the academic school year 1962. This change produced a loss of -5.33 scale points between the beginning and the end of the academic school year. The difference obtained was considered significant at greater than the 1 per cent level. Although a significant loss occurred,
the mean end-of-course attitude toward algebra still represented a favorable attitude.

The mean score of the 290 Latin-American pupils' attitudes toward algebra was 61.11 scale points at the beginning of the academic school year. The mean score of this same group of pupils was 57.62 at the end of the academic school year 1962. This change produced a loss of -3.49 scale points between the beginning and the end of the academic school year. The difference obtained was significant at greater than the 2 per cent level. Although a significant loss occurred, the mean end-of-course attitude toward algebra still represented a favorable attitude.

When the Anglo- and Latin-American pupils were combined to form a composite group of 1,163 pupils, the mean score of the pupils' attitudes toward algebra was 62.05 points at the beginning of the academic school year and was 57.67 points at the end of the academic school year. The loss provided, -4.38 scale points, was significant at greater than the 1 per cent level. However, the mean end-of-course attitude toward algebra of the 1,163 pupils still represented a favorable attitude.

7. An analysis was made of the mean differences between the 873 Anglo- and 290 Latin-American pupils' beginning- and end-of-course judgments concerning the
practical value of algebra. Of a possible total score of 30.00 scale points, the mean score of the Anglo-American pupils' judgments was 24.62 points at the beginning of the academic school year. The mean score of this same group of pupils was 21.79 points at the end of the academic school year. The loss provided, -2.83 scale points, was significant at greater than the 5 per cent level. Although a significant loss occurred, the mean end-of-course judgment still represented a favorable judgment concerning the practical value of algebra.

The mean score of the Latin-American pupils' judgments concerning the practical value of algebra was 23.47 scale points at the beginning of the academic school year. The mean score of this same group of pupils was 21.79 at the end of the academic year. The loss provided, -2.68 scale points, was not great enough to be considered significant.

When the Anglo- and Latin-American pupils were combined to form a composite group of 1,163 pupils, the mean score of the pupils' judgments concerning the practical value of algebra was 24.24 points at the beginning of the academic school year and was 21.79 at the end of the academic school year. The loss provided, -2.45 scale points, was not great enough to be considered significant. However, the mean end-of-course judgment of the 1,163 pupils
still represented a favorable judgment concerning the practical value of algebra.

8. An analysis was made between the mean differences of the 873 Anglo- and 290 Latin-American pupils' achievements in algebra. The mean achievement score of the Anglo-American pupils was 10.09 points. The mean achievement score of the Latin-American pupils was 6.57 points. The analysis showed a difference of 4.52 points in favor of the Anglo-American pupils. The difference obtained was significant at greater than the .1 per cent level.

9. The mean achievement score of the 216 Anglo-American pupils was 10.74 points when under the supervision of teachers expressing unfavorable attitudes toward algebra. The mean achievement score of 255 Anglo-American pupils was 9.52 points when under the supervision of teachers expressing favorable attitudes toward algebra. The mean difference was 1.22 points in favor of the pupils under the supervision of teachers expressing unfavorable attitudes toward algebra.

The mean achievement score of 146 Latin-American pupils under the supervision of favorable attitude teachers was 5.94 points. The mean achievement score of 81 pupils under the supervision of unfavorable attitude teachers was 5.96 points. The mean difference was .02
points in favor of the pupils under the supervision of teachers expressing unfavorable attitudes toward algebra.

When the Anglo- and Latin-American pupils were combined to form composite groups under favorable or unfavorable attitude teachers, the mean achievement score was 8.22 points for the 401 pupils under the supervision of teachers expressing favorable attitudes toward algebra. The mean achievement score was 9.43 points for the 297 pupils under the supervision of teachers expressing unfavorable attitudes toward algebra. The mean difference was 1.21 points in favor of the pupils under the supervision of teachers expressing unfavorable attitudes toward algebra.

None of the differences obtained above was great enough to be considered significant.

10. The mean achievement score of the 253 Anglo-American pupils under the supervision of teachers with high mathematical backgrounds was 11.37 points. The mean achievement score of the 138 pupils under the supervision of teachers with low mathematical backgrounds was 9.24 points. The mean difference was 2.13 points in favor of the pupils under the supervision of teachers with high mathematical backgrounds. The difference obtained was significant at greater than the 1 per cent level.
The mean achievement score of the 43 Latin-American pupils under the supervision of teachers with high mathematical backgrounds was 7.67 points. The mean achievement score of the 128 pupils under the supervision of teachers with low mathematical backgrounds was 6.37 points. The mean difference was 1.30 points in favor of the pupils under the supervision of teachers with high mathematical backgrounds. However, the difference obtained was not great enough to be considered significant.

When the Anglo- and Latin-American pupils were combined to form composite groups under high or low mathematical background teachers, the 296 pupils under the supervision of high mathematical background teachers provided a mean achievement score of 10.06 points. The 266 pupils under the supervision of low mathematical background teachers was 7.04 points. The mean difference was 3.02 points in favor of the pupils under the supervision of teachers with high mathematical backgrounds. The difference obtained was significant at greater than the .1 per cent level.

11. The mean achievement score of the 129 Anglo-American pupils under the supervision of teachers with high backgrounds in professional education was 7.30 points. The mean achievement score of the 128 pupils under the supervision of teachers with low backgrounds
was 10.34. The mean difference was 3.04 points in favor of the pupils under the supervision of teachers with low backgrounds in professional education. The difference obtained was significant at greater than the 1 per cent level.

The mean achievement score of the 110 Latin-American pupils under the supervision of teachers with high backgrounds in professional education was 5.48 points. The mean achievement score of the 86 pupils under the supervision of teachers with low backgrounds was 7.75 points. The mean difference was 2.27 points in favor of the pupils under the supervision of teachers with low backgrounds in professional education. The difference obtained was significant at greater than the 1 per cent level.

When the Anglo- and Latin-American pupils were combined to form composite groups under high educational background teachers, the mean score of the 239 pupils was 6.46 points. The mean achievement score of the combined 214 pupils under the supervision of low educational background teachers was 9.29 points. The difference obtained was 2.83 points in favor of the pupils under the supervision of teachers with low educational backgrounds. The difference obtained was significant at greater than the .1 per cent level.
It should be noted that 30 per cent of the teachers with low backgrounds in professional education possessed high mathematical backgrounds. Of the teachers who possessed high educational backgrounds, 40 per cent possessed low backgrounds in mathematics. It seems plausible to assume, from the inverse relationship found above, and when considering the percentage of teachers possessing low backgrounds in mathematics or professional education, that teachers preparing themselves adequately in mathematics do not take many courses in professional education. Similarly, the teachers that are preparing themselves in professional education do not take many courses in mathematics. This inverse relationship may also indicate that teachers are not teaching in their major fields.

12. When tested by methods of chi-square to determine if a significant relationship existed between the pupils' achievements in algebra and the teachers' judgments concerning the practical value of algebra, the scores of the 378 Anglo-American pupils produced a chi-square value of 44.18. The pupils under the supervision of teachers expressing favorable judgments made greater achievements than the pupils under the supervision of teachers expressing unfavorable judgments. This chi-square value was significant at greater than the .1 per cent level.
Chi-square was .726 for the scores of the 184 Latin-American pupils. The pupils under the supervision of teachers expressing favorable judgments made greater achievements than the pupils under the supervision of teachers expressing unfavorable judgments. This chi-square value did not approach the 5 per cent level of significance.

When the Anglo- and Latin-American pupils were combined to form composite groups under favorable or unfavorable judgment teachers, chi-square was 27.91 for the 562 pupils involved in the analysis. The pupils under the supervision of teachers expressing favorable judgments made greater achievements than the pupils under the supervision of teachers expressing unfavorable judgments. This chi-square value was significant at greater than the .1 per cent level.

13. The mean end-of-course judgment concerning the practical value of algebra of the 184 Anglo-American pupils under the supervision of teachers expressing favorable judgments was 21.68 points. The mean end-of-course judgment of the 194 pupils under the supervision of teachers expressing unfavorable judgments was 21.82 points. The mean difference was .14 points in favor of the pupils under the supervision of teachers expressing unfavorable judgments concerning the practical value of
algebra. However, the difference obtained was not great enough to be considered significant.

The mean end-of-course judgment concerning the practical value of algebra of the 194 Latin-American pupils under the supervision of teachers expressing favorable judgments was 22.13 points. The mean end-of-course judgment of the 88 pupils under the supervision of teachers expressing unfavorable judgments was 21.34 points. The mean difference was .79 points in favor of the pupils under the supervision of teachers expressing favorable judgments. However, the difference obtained was not great enough to be considered significant.

The mean end-of-course judgment concerning the practical value of algebra of the composite group of 280 Anglo- and Latin-American pupils under the supervision of teachers expressing favorable judgments was 21.90 points. The mean end-of-course judgment of the 282 pupils under the supervision of teachers expressing unfavorable judgments was 21.58 points. The mean difference was .32 points in favor of the pupils under the supervision of teachers expressing favorable judgments. However, the difference obtained was not great enough to be considered significant.

14. The mean end-of-course attitude toward algebra of the 255 Anglo-American pupils under the supervision of teachers expressing favorable attitudes was 60.59 points.
The mean end-of-course attitude of the 216 pupils under the supervision of teachers expressing unfavorable attitudes was 57.28 points. The mean difference was 3.31 points in favor of the pupils under the supervision of teachers expressing favorable attitudes. The difference obtained was significant at greater than the 1 per cent level.

The mean end-of-course attitude toward algebra of the 146 Latin-American pupils under the supervision of teachers expressing favorable attitudes toward algebra was 57.31 points. The mean end-of-course attitude of the 81 pupils under the supervision of teachers expressing unfavorable attitudes was 52.27 points. The mean difference was 5.04 points in favor of the pupils under the supervision of teachers expressing favorable attitudes toward algebra. The difference provided was significant at greater than the 1 per cent level.

The mean end-of-course attitude toward algebra of the composite group of Anglo- and Latin-American pupils under the supervision of teachers exhibiting favorable attitudes was 59.40 for the 401 pupils used in the analysis. The mean end-of-course attitude of the 297 combined pupils under the supervision of teachers expressing unfavorable attitudes was 55.91 points. The mean difference was 3.49 points in favor of the pupils under the supervision of
teachers expressing favorable attitudes toward algebra. The difference obtained was significant at greater than the .1 per cent level.

15. When tested by methods of chi-square to determine if a significant relationship existed between the pupils' change in attitudes toward algebra and the teachers' attitudes toward algebra, the scores of the 401 Anglo-American pupils produced a chi-square value of 1.53. The pupils under the supervision of teachers expressing favorable attitudes had a loss in their attitudes that was less than the loss of the pupils under the supervision of teachers expressing unfavorable attitudes. However, chi-square was not great enough to be considered significant.

Chi-square was 7.62 for the scores of the 227 Latin-American pupils. The pupils under the supervision of teachers expressing favorable attitudes had a loss in their attitudes that was less than the loss of the pupils under the supervision of teachers expressing unfavorable attitudes toward algebra. Chi-square was considered significant at greater than the 1 per cent level.

When the Anglo- and Latin-American pupils were combined to form composite groups under favorable or unfavorable attitude teachers, chi-square was .49 for the 628 pupils involved in the analysis. The pupils under the supervision of teachers expressing favorable attitudes
toward algebra had a loss in their attitudes that was less than the loss of the pupils under the supervision of teachers possessing unfavorable attitudes toward algebra. However, chi-square was not great enough to be considered significant.

16. The changes in the Anglo-American pupils' attitudes toward algebra ranged from a gain of +36.00 points through a loss of -44.00 points. The mean change-in-attitude score of the 255 Anglo-American pupils under the supervision of teachers expressing favorable attitudes toward algebra was -5.92 points. The mean change in attitude of the 216 pupils under the supervision of teachers expressing unfavorable attitudes toward algebra was -8.51 points. The mean difference was 2.59 points in favor of the pupils under the supervision of teachers expressing favorable attitudes toward algebra. The difference obtained was significant at greater than the 2 per cent level.

The changes in the Latin-American pupils' attitudes toward algebra ranged from a gain of +34.00 points through a loss of -30.00 points. The mean change-in-attitude score of the 146 pupils under the supervision of teachers expressing favorable attitudes toward algebra was -1.06 points. The mean change in attitude of the 81 pupils under the supervision of teachers expressing unfavorable
attitudes was -6.23 points. The mean difference was 5.23 points in favor of the pupils under the supervision of teachers expressing favorable attitudes toward algebra. The difference obtained was greater than the 1 per cent level.

The mean change-in-attitude score of the composite group of Anglo- and Latin-American pupils under the supervision of teachers expressing favorable attitudes toward algebra was a loss of -4.72 points. The mean change-in-attitude score of the 297 pupils under the supervision of teachers expressing unfavorable attitudes toward algebra was -7.72 points. The mean difference was 3.00 points in favor of the pupils under the supervision of teachers possessing favorable attitudes toward algebra. The difference obtained was significant at greater than the 1 per cent level.

It should be noted that, in the above analyses, although a significant loss occurred in the pupils' attitudes toward algebra, the end-of-course attitudes were still favorable attitudes.

Conclusions

Subject to the limitations of the study, the findings appear to justify the following conclusions:
1. There was found to be no significant relationship between teachers' attitudes toward algebra and the pupils' achievements in algebra.

2. In testing the relationship between subject matter preparation in mathematics of algebra teachers and the pupils' achievements in algebra, it was found that pupils achieved more when under the supervision of adequately prepared teachers. The following conclusions were drawn:
   
   (a) A significant relationship existed between the two factors for the Anglo-American pupils.

   (b) No significant relationship existed between the two factors for the Latin-American pupils.

   (c) When the Anglo- and Latin-American pupils were combined to form a composite group, a significant relationship was found between the two factors.

3. There was found to be a significant inverse relationship between the backgrounds in professional education of algebra teachers and the pupils' achievements in algebra. This fact appeared, however, to have resulted because teachers belonging to the lower educational group exhibited higher mathematical backgrounds. Similarly, teachers belonging to the higher educational group possessed lower mathematical backgrounds.

4. In testing the relationship between the judgments of teachers concerning the practical value of algebra and
the pupils' achievements in algebra, it was found that the pupils under the supervision of teachers expressing favorable judgments achieved more than the pupils under the supervision of teachers expressing unfavorable judgments. The following conclusions were drawn:

(a) A significant relationship existed between the two factors for the Anglo-American pupils.

(b) No significant relationship existed between the two factors for the Latin-American pupils.

(c) A significant relationship was found between the two factors for the composite Anglo- and Latin-American pupil groups.

5. There was found to be no significant relationship between the judgments of teachers concerning the practical value of algebra and the end-of-course judgment of pupils concerning the practical value of algebra. This finding was true for the Anglo-, Latin-, and the composite Anglo- and Latin-American pupil groups.

6. There was found to be a significant relationship between the teachers' attitudes toward algebra and the end-of-course attitudes of pupils toward algebra. The pupils under the supervision of teachers expressing favorable attitudes toward algebra exhibited higher attitudes than the pupils under the supervision of teachers expressing unfavorable attitudes.
7. In testing the relationship between teachers' attitudes toward algebra and the changes in the pupils' attitudes toward algebra, the following conclusions were drawn:

(a) No significant relationship existed between the two factors for the Anglo-American pupils.

(b) A significant relationship existed between the two factors for the Latin-American pupils.

(c) No significant relationship was found between the two factors for the composite Anglo- and Latin-American pupil groups.

8. There was found to be a significant relationship between the changes in the attitude scores of pupils when taught by teachers with favorable attitude scores and teachers with unfavorable attitude scores. The pupils under the supervision of teachers expressing favorable attitudes toward algebra had a loss in their attitudes that was less than the loss of the pupils under the supervision of teachers expressing unfavorable attitudes toward algebra.

Recommendations

The results of the study provide stimulation for further research in testing the validity of interpretations in the following areas:
1. Further study seems justified to determine procedures for making algebra appear more practical to pupils. This study should also include methods to influence positively pupils' attitudes toward algebra.

2. It would be helpful to discover the reasons why Latin-American pupils exhibit attitudes and mathematical backgrounds which are significantly lower than the attitudes and mathematical backgrounds of the Anglo-American pupils.

3. The education process would be improved if research could provide a description of the type of qualities possessed by teachers who have positive influences upon the attitudes of the Anglo- and Latin-American pupils.

4. School administrators, teacher educating institutions, and mathematics departments would be benefited if it were known what combination of hours in professional education and mathematics would provide an adequate background in each of the two fields.
# Appendix A

## Attitude Inventory for Pupils of First-Year Algebra

<table>
<thead>
<tr>
<th>Number</th>
<th>Statement</th>
<th>Scale Value</th>
<th>q</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Algebra is okay.</td>
<td>5.17</td>
<td>1.43</td>
</tr>
<tr>
<td>2</td>
<td>Algebra will help us in our daily lives.</td>
<td>3.40</td>
<td>2.00</td>
</tr>
<tr>
<td>3</td>
<td>I feel that algebra is an important part of the school instructional program.</td>
<td>. .</td>
<td>. .</td>
</tr>
<tr>
<td>4</td>
<td>Algebra is one of the most useful subjects I know.</td>
<td>2.87</td>
<td>2.20</td>
</tr>
<tr>
<td>5</td>
<td>I wish we'd miss algebra more often.</td>
<td>9.95</td>
<td>1.78</td>
</tr>
<tr>
<td>6</td>
<td>I really enjoy algebra.</td>
<td>1.72</td>
<td>1.94</td>
</tr>
<tr>
<td>7</td>
<td>Algebra is very practical.</td>
<td>2.21</td>
<td>2.62</td>
</tr>
<tr>
<td>8</td>
<td>Algebra is very uninteresting.</td>
<td>9.06</td>
<td>1.70</td>
</tr>
<tr>
<td>9</td>
<td>I wish we had algebra more often.</td>
<td>2.77</td>
<td>2.21</td>
</tr>
<tr>
<td>10</td>
<td>I can't see how algebra will help me.</td>
<td>8.87</td>
<td>2.81</td>
</tr>
<tr>
<td>11</td>
<td>I wouldn't take algebra if I didn't have to.</td>
<td>10.17</td>
<td>1.62</td>
</tr>
<tr>
<td>12</td>
<td>Algebra is dull and boring.</td>
<td>10.38</td>
<td>1.90</td>
</tr>
<tr>
<td>13</td>
<td>I like to figure and reason out problems in algebra.</td>
<td>2.17</td>
<td>2.17</td>
</tr>
<tr>
<td>14</td>
<td>I don't even try to do my best in algebra.</td>
<td>10.67</td>
<td>1.89</td>
</tr>
<tr>
<td>15</td>
<td>Algebra has its faults, but I still like it.</td>
<td>4.36</td>
<td>2.79</td>
</tr>
<tr>
<td>16</td>
<td>We get too much algebra.</td>
<td>9.20</td>
<td>2.38</td>
</tr>
<tr>
<td>17</td>
<td>I sometimes do extra work in algebra just for fun.</td>
<td>1.58</td>
<td>1.59</td>
</tr>
<tr>
<td>18</td>
<td>I see no practical purpose in emphasizing algebra.</td>
<td>9.08</td>
<td>2.60</td>
</tr>
<tr>
<td>19</td>
<td>Nobody in our room likes algebra.</td>
<td>10.00</td>
<td>1.69</td>
</tr>
<tr>
<td>20</td>
<td>Algebra is a waste of time.</td>
<td>10.67</td>
<td>1.33</td>
</tr>
<tr>
<td>21</td>
<td>I love to study algebra.</td>
<td>2.36</td>
<td>2.67</td>
</tr>
<tr>
<td>22</td>
<td>Algebra is a difficult subject that is not very useful in everyday life.</td>
<td>8.49</td>
<td>2.59</td>
</tr>
</tbody>
</table>
## APPENDIX B

### ATTITUDE INVENTORY FOR TEACHERS OF FIRST-YEAR ALGEBRA

<table>
<thead>
<tr>
<th>Number</th>
<th>Statement</th>
<th>Scale Value</th>
<th>q</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I feel that algebra is an important part of the school curriculum.</td>
<td>. .</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I really enjoy teaching algebra.</td>
<td>1.27</td>
<td>0.98</td>
</tr>
<tr>
<td>3</td>
<td>Algebra serves the needs of a large number of boys and girls.</td>
<td>2.90</td>
<td>2.30</td>
</tr>
<tr>
<td>4</td>
<td>I didn't like algebra in school and I still don't.</td>
<td>10.75</td>
<td>0.65</td>
</tr>
<tr>
<td>5</td>
<td>I feel I make algebra interesting to most of the pupils.</td>
<td>3.00</td>
<td>2.70</td>
</tr>
<tr>
<td>6</td>
<td>Algebra is one of the most useful subjects I know.</td>
<td>3.28</td>
<td>2.64</td>
</tr>
<tr>
<td>7</td>
<td>Algebra is the subject I like least of all to teach.</td>
<td>10.63</td>
<td>1.21</td>
</tr>
<tr>
<td>8</td>
<td>Algebra is of great value.</td>
<td>1.90</td>
<td>1.18</td>
</tr>
<tr>
<td>9</td>
<td>I thoroughly enjoy teaching algebra.</td>
<td>1.09</td>
<td>0.82</td>
</tr>
<tr>
<td>10</td>
<td>Algebra is just a cultural subject.</td>
<td>9.36</td>
<td>2.73</td>
</tr>
<tr>
<td>11</td>
<td>A good teacher needs to keep up with modern methods in teaching algebra.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Algebra is very practical.</td>
<td>1.37</td>
<td>1.34</td>
</tr>
<tr>
<td>13</td>
<td>Algebra develops good reasoning ability.</td>
<td>2.21</td>
<td>2.62</td>
</tr>
<tr>
<td>14</td>
<td>I wish I did not have to teach algebra.</td>
<td>2.36</td>
<td>2.26</td>
</tr>
<tr>
<td>15</td>
<td>Sometimes I give extra assignments in algebra as punishment.</td>
<td>10.64</td>
<td>1.08</td>
</tr>
<tr>
<td>16</td>
<td>I see no practical purpose in emphasizing algebra.</td>
<td>10.49</td>
<td>1.77</td>
</tr>
<tr>
<td>17</td>
<td>A good teacher follows the textbook very closely.</td>
<td>10.33</td>
<td>1.71</td>
</tr>
<tr>
<td>18</td>
<td>Algebra is just a skill with little practical application.</td>
<td>6.60</td>
<td>2.81</td>
</tr>
<tr>
<td>19</td>
<td>I skip over algebra whenever I can.</td>
<td>9.38</td>
<td>2.42</td>
</tr>
<tr>
<td>20</td>
<td>Algebra will benefit only the brighter pupils.</td>
<td>10.62</td>
<td>1.16</td>
</tr>
<tr>
<td>21</td>
<td>I like for the pupils to try several ways of solving problems rather than following a suggested pattern.</td>
<td>9.41</td>
<td>2.00</td>
</tr>
</tbody>
</table>

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# APPENDIX C

## A SCALE FOR MEASURING ATTITUDES TOWARD ANY SUBJECT

<table>
<thead>
<tr>
<th>Number</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No matter what happens, this subject always comes first.</td>
</tr>
<tr>
<td>2</td>
<td>I would rather study this subject than eat.</td>
</tr>
<tr>
<td>3</td>
<td>I love to study this subject.</td>
</tr>
<tr>
<td>4</td>
<td>This subject is of great value.</td>
</tr>
<tr>
<td>5</td>
<td>This subject has an irresistible attraction to me.</td>
</tr>
<tr>
<td>6</td>
<td>I really enjoy this subject.</td>
</tr>
<tr>
<td>7</td>
<td>This subject is profitable to everyone who takes it.</td>
</tr>
<tr>
<td>8</td>
<td>This subject develops good reasoning ability.</td>
</tr>
<tr>
<td>9</td>
<td>This subject is very practical.</td>
</tr>
<tr>
<td>10</td>
<td>Any student who takes this subject is bound to be benefited.</td>
</tr>
<tr>
<td>11</td>
<td>This subject teaches me to be accurate.</td>
</tr>
<tr>
<td>12</td>
<td>This subject is a good subject.</td>
</tr>
<tr>
<td>13</td>
<td>This subject is a universal subject.</td>
</tr>
<tr>
<td>14</td>
<td>All of our great men studied this subject.</td>
</tr>
<tr>
<td>15</td>
<td>This subject is a cultural subject.</td>
</tr>
<tr>
<td>16</td>
<td>All lessons and methods used in this subject are clear and definite.</td>
</tr>
</tbody>
</table>
## APPENDIX D

### REVISED DUTTON ATTITUDE INVENTORY (PUPILS)

<table>
<thead>
<tr>
<th>Number</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I really enjoy algebra.</td>
</tr>
<tr>
<td>2</td>
<td>I wish we'd miss algebra more often.</td>
</tr>
<tr>
<td>3</td>
<td>I like to figure and reason out problems in algebra.</td>
</tr>
<tr>
<td>4</td>
<td>I've found algebra useful at home.</td>
</tr>
<tr>
<td>5</td>
<td>I sometimes do extra work in algebra just for fun.</td>
</tr>
<tr>
<td>6</td>
<td>Algebra is just too hard for me to understand.</td>
</tr>
<tr>
<td>7</td>
<td>We get too much algebra.</td>
</tr>
<tr>
<td>8</td>
<td>I can't see how algebra will be very useful to me out of school.</td>
</tr>
<tr>
<td>9</td>
<td>Algebra teaches me to be accurate.</td>
</tr>
<tr>
<td>10</td>
<td>Algebra is a waste of time.</td>
</tr>
<tr>
<td>11</td>
<td>Algebra is the best subject in school.</td>
</tr>
<tr>
<td>12</td>
<td>Algebra is okay.</td>
</tr>
<tr>
<td>13</td>
<td>I wish we had algebra more often.</td>
</tr>
<tr>
<td>14</td>
<td>If I had my way, everybody would study algebra.</td>
</tr>
<tr>
<td>15</td>
<td>Algebra is one of the most useful subjects I know.</td>
</tr>
<tr>
<td>16</td>
<td>All people should know algebra.</td>
</tr>
<tr>
<td>17</td>
<td>Algebra will help us in our daily lives.</td>
</tr>
<tr>
<td>18</td>
<td>Algebra has its faults, but I still like it.</td>
</tr>
<tr>
<td>19</td>
<td>Algebra is very uninteresting.</td>
</tr>
<tr>
<td>20</td>
<td>Nobody in our room likes algebra.</td>
</tr>
<tr>
<td>21</td>
<td>Algebra might be worthwhile if it were taught right.</td>
</tr>
<tr>
<td>22</td>
<td>Algebra is dull and boring.</td>
</tr>
<tr>
<td>23</td>
<td>I wouldn't take algebra if I didn't have to.</td>
</tr>
<tr>
<td>24</td>
<td>I don't even try to do my best in algebra.</td>
</tr>
<tr>
<td>25</td>
<td>I can't see how algebra will help me.</td>
</tr>
</tbody>
</table>

### REVISED DUTTON ATTITUDE INVENTORY (TEACHERS)

<table>
<thead>
<tr>
<th>Number</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No matter what happens, algebra always comes first.</td>
</tr>
<tr>
<td>2</td>
<td>Algebra is of great value.</td>
</tr>
<tr>
<td>Number</td>
<td>Statement</td>
</tr>
<tr>
<td>--------</td>
<td>-----------</td>
</tr>
<tr>
<td>3</td>
<td>Algebra develops good reasoning ability.</td>
</tr>
<tr>
<td>4</td>
<td>I can teach algebra well without reading mathematics magazines and methods books.</td>
</tr>
<tr>
<td>5</td>
<td>Algebra is very practical.</td>
</tr>
<tr>
<td>6</td>
<td>I really enjoy teaching algebra.</td>
</tr>
<tr>
<td>7</td>
<td>Algebra is profitable to everyone who takes it.</td>
</tr>
<tr>
<td>8</td>
<td>I like to have the pupils try several ways of solving problems rather than to follow a suggested pattern.</td>
</tr>
<tr>
<td>9</td>
<td>I look forward to teaching algebra.</td>
</tr>
<tr>
<td>10</td>
<td>Algebra will benefit only the brighter pupils.</td>
</tr>
<tr>
<td>11</td>
<td>Algebra is one of the most useful subjects I know.</td>
</tr>
<tr>
<td>12</td>
<td>I give homework as a way of getting it across.</td>
</tr>
<tr>
<td>13</td>
<td>I use many devices and ways of getting my pupils interested in algebra.</td>
</tr>
<tr>
<td>14</td>
<td>Algebra is very hard for the slow student.</td>
</tr>
<tr>
<td>15</td>
<td>I thoroughly enjoy teaching algebra.</td>
</tr>
<tr>
<td>16</td>
<td>I see no practical purpose in emphasizing algebra.</td>
</tr>
<tr>
<td>17</td>
<td>I wish I did not have to teach algebra.</td>
</tr>
<tr>
<td>18</td>
<td>I have the feeling that my pupils hate algebra.</td>
</tr>
<tr>
<td>19</td>
<td>I feel I make algebra interesting to most of the pupils.</td>
</tr>
<tr>
<td>20</td>
<td>Algebra is not receiving the attention it deserves in school.</td>
</tr>
<tr>
<td>21</td>
<td>Algebra is the subject I like least of all to teach.</td>
</tr>
<tr>
<td>22</td>
<td>Algebra serves the needs of a large number of boys and girls.</td>
</tr>
<tr>
<td>23</td>
<td>A good teacher needs to keep up with modern methods in teaching algebra.</td>
</tr>
<tr>
<td>24</td>
<td>I spend more time on algebra than my schedule calls for.</td>
</tr>
<tr>
<td>25</td>
<td>If the teacher is sure she can solve the problems and exercises in algebra she does not need to plan the algebra lesson.</td>
</tr>
<tr>
<td>26</td>
<td>I skip over algebra whenever I can.</td>
</tr>
<tr>
<td>27</td>
<td>Sometimes I give extra assignments in algebra as punishment.</td>
</tr>
<tr>
<td>28</td>
<td>I didn't like algebra in school and I still don't.</td>
</tr>
<tr>
<td>29</td>
<td>I can't seem to get algebra across to my pupils.</td>
</tr>
<tr>
<td>30</td>
<td>A good teacher follows the textbook very closely.</td>
</tr>
</tbody>
</table>
APPENDIX E

COOPERATIVE ALGEBRA TEST, ELEMENTARY ALGEBRA THROUGH QUADRATICS

By Bernice Orshansky and Others

Educational Testing Service

Princeton, New Jersey
Directions: Each problem below is followed by five choices, one of which is correct. By working each problem, find the correct choice and put its number in the parentheses at the right.

Sample:
0. If \( a = 2 \) and \( b = 5 \), then \( a + b \) equals
0-1 9
0-2 2
0-3 6
0-4 7
0-5 5
Since the answer is 7, which is the fourth choice, the number 4 has been written in the parentheses at the right.

1. The fraction \( \frac{25n^2}{25n^2} \) equals
1-1 1
1-2 0
1-3 5n
1-4 \( n^2 \)
1-5 \( 25n^2 \)
2. The sum of \( -16 \) and \( -8 \) is
2-1 \(-2\)
2-2 \(2\)
2-3 \(-8\)
2-4 \(8\)
2-5 \(-24\)
3. From a temperature of \( 12^\circ C \), a drop of \( 17^\circ C \) would result in a temperature of
3-1 \(-29^\circ C\)
3-2 \(-22^\circ C\)
3-3 \(-5^\circ C\)
3-4 \(29^\circ C\)
3-5 \(5^\circ C\)
4. If \( a^2 + b = a^2 + c \), what does \( b \) equal?
4-1 \( c \)
4-2 \( \frac{a^2}{c} \)
4-3 \( c - 2a^2 \)
4-4 \( \frac{c}{2a^2} \)
4-5 \( ac \)
5. The factors of \( n^2 + 6n - 16 \) are
5-1 \( (n - 4) \) and \( (n + 4) \)
5-2 \( (n - 8) \) and \( (n + 2) \)
5-3 \( (n + 6) \) and \( (n - 16) \)
5-4 \( n \) and \( 2 \)
5-5 not given above.
6. The fraction \( \frac{6x}{7y} \) is equivalent to another fraction with numerator \( 6rx \). What is the denominator of this other fraction?
6-1 \( 6xy \)
6-2 \( 7y \)
6-3 \( 7r \)
6-4 \( 7ry \)
6-5 \( r \)
7. \( a^4 \cdot a^2 \) equals
7-1 \( a^6 \)
7-2 \( a^4 \)
7-3 \( a^6 \)
7-4 \( a^{12} \)
7-5 \( 2a^{12} \)
8. \( 8u \times 5v \times u \) equals
8-1 \( 40 + uv \)
8-2 \( 8u^2 + 5uv \)
8-3 \( 45uv \)
8-4 \( 40uv \)
8-5 none of the above.
9. Which, if any, of the following three expressions are equations?
9-1 Only \( I \)
9-2 Only \( II \)
9-3 Only \( III \)
9-4 \( I, II, \) and \( III \)
9-5 None of them
10. \( 5a - 6b + 8b - a \) equals
10-1 \( 6ab \)
10-2 \( 4a - 2b \)
10-3 \( 5 + 2b \)
10-4 \( 5a - 14b \)
10-5 none of the above.
11. The formula \( p = \frac{2wh}{s + 1} \) is used by engineers. What does \( p \) equal when \( w = 2000 \), \( h = 30 \), and \( s = 1? \)
11-1 \( 12,000 \)
11-2 \( 15,000 \)
11-3 \( 30,000 \)
11-4 \( 60,000 \)
11-5 \( 120,000 \)
12. For which, if any, of the following values of \( x \) and \( y \) will the product \( xy \) be positive?
12-1 \( x = -5, y = -5 \)
12-2 \( x = -10, y = 5 \)
12-3 \( x = -5, y = 5 \)
12-4 \( x = 10, y = -5 \)
12-5 None of the above
13. The equation \( \frac{3}{x} = 5 \) may be written in the form
13-1 \( 3 = \frac{5}{x} \)
13-2 \( 3x = 5x \)
13-3 \( 3 = 5 - x \)
13-4 \( 3 = 5x \)
13-5 \( 3 = \frac{x}{5} \)

Go on to the next page.
14. \( \sqrt{740} \) is a number between
14-1  20 and 30
14-2  30 and 40
14-3  60 and 70
14-4  70 and 80
14-5  80 and 90

15. \((5 + mn)(6 - mn)\) equals
15-1  30 + mn
15-2  30 + mn - mn
15-3  30 - mn
15-4  30 + mn
15-5  30

16. If \(3x - 5 = x + 10\), what does \(2x\) equal?
16-1  \(\frac{7}{2}\)
16-2  \(-5\)
16-3  15
16-4  10
16-5  5

17. What does \(x\) equal in the simultaneous equations \[
\begin{align*}
x + y &= k \\
x - y &= 6
\end{align*}
\]
17-1  \(k = \frac{6}{2}\)
17-2  \(k + \frac{6}{2}\)
17-3  \(k + 6\)
17-4  \(k - 6\)
17-5  \(\frac{6k}{2}\)

18. \(\frac{2\pi rh}{5 - d} + \frac{2\pi r}{d}\) equals
18-1  \(\frac{h}{5 - d^2}\)
18-2  \(\frac{\pi h}{5d}\)
18-3  \(h\)
18-4  \(\frac{hd}{5 - d}\)
18-5  \(\frac{h}{5d - d^2}\)

19. \(\frac{r^2}{s^2}\) equals
19-1  \(\frac{r^2}{s^2}\)
19-2  \(\frac{r^4}{s^3}\)
19-3  \(\frac{r^4}{s^3}\)
19-4  \(\frac{1}{2}\)
19-5  none of the above.

20. In simplest form, \(5\sqrt{75} - 3\sqrt{50}\) equals \(140\)
20-1  10
20-2  2
20-3  \(10\sqrt{3} - 8\sqrt{2}\)
20-4  \(10\sqrt{3} - \sqrt{2}\)
20-5  \(25\sqrt{3} - 15\sqrt{2}\)

21. If \(3\) times \(p\) is equal to \(y\), what does \(3\) times \(y\) equal?
21-1  9 times \(p\)
21-2  6 times \(p\)
21-3  3 times \(p\)
21-4  \(\frac{1}{3}\) times \(p\)
21-5  \(p\)

22. In factored form, \((s^2 - r^2)\) equals
22-1  \((s - r)(s + r)\)
22-2  \(s - r)(s + r)\)
22-3  \((sr)^2\)
22-4  \(sr(s - r)\)
22-5  \(sr(s - 1)\)

23. In the formula \(h = 10b\), when the value of \(b\) changes from 2 to 5, the value of \(h\) changes from
23-1  2 to 5
23-2  5 to 2
23-3  12 to 17
23-4  20 to 30
23-5  20 to 50

24. \(\frac{a + b}{c}\) equals
24-1  \(a + b\)
24-2  \(ac + bc\)
24-3  \(\frac{a + b}{c}\)
24-4  \(\frac{a + b}{2c}\)
24-5  \(\frac{a + b}{c^2}\)

25. If \(k = 2b + 2h\) and \(b = h + 3\), then \(k\) may be expressed in terms of \(h\) alone as
25-1  \(k = 6h\)
25-2  \(k = 4h + 3\)
25-3  \(k = 2h^2 + 3\)
25-4  \(k = 4h + 6\)
25-5  \(k = 4h^2 + 3\)

26. The smaller root of the equation \(x^2 - 3x + 2 = 0\) is
26-1  1
26-2  2
26-3  -3
26-4  -2
26-5  -1

27. If \(x = 7\) satisfies the equation \(x^2 - 4x + b = 0\), what does \(b\) equal?
27-1  -21
27-2  -14
27-3  -3
27-4  14
27-5  21

Go on to the next page.
28. Which one, if any, of the following fractions can **not** be simplified?

28-1 \( \frac{1-n}{n-1} \)
28-2 \( \frac{n}{n+2} \)
28-3 \( \frac{5n}{-2n^2} \)
28-4 \( \frac{3}{6 + 12n} \)

28-5 All of the above fractions can be simplified.

29. In the product of \((s^2 - 4s)\) and \((s - 1)\), with similar terms combined, what is the term which contains \(s^2\)?

29-1 \(-s^2\)
29-2 \(+3s^2\)
29-3 \(-3s^2\)
29-4 \(-4s^2\)
29-5 \(-5s^2\)

30. For what value of \(x\) does \(4x - 16\) equal \(x\)?

30-1 \(x = 12\)
30-2 \(x = 8\)
30-3 \(x = 5\frac{1}{3}\)
30-4 \(x = 4\)
30-5 \(x = 3\frac{1}{5}\)

31. If \(d = \frac{v^2}{2r}\) and \(v\) is positive, what does \(v\) equal in terms of \(d\) and \(r\)?

31-1 \(v = 2rd\)
31-2 \(v = \left(\frac{d}{2r}\right)^\frac{1}{2}\)
31-3 \(v = \sqrt{\frac{d}{2r}}\)
31-4 \(v = 4r^2d^2\)
31-5 \(v = \sqrt{2rd}\)

32. The equation \(x^3 - x - 8 = 0\) may be solved with the aid of the quadratic formula \(x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}\). What value should be substituted for the letter \(b\) in the formula?

32-1 \(+1\)
32-2 \(+2\)
32-3 \(-1\)
32-4 \(-2\)
32-5 \(-8\)

Go on to the next part.

### PART II

(10 minutes)

Directions: Continue as in the preceding part.

1. Which one of the following fractions has a denominator which exceeds its numerator by 5?

1-1 \(\frac{7}{2}\)
1-2 \(\frac{6}{5}\)
1-3 \(\frac{1}{5}\)
1-4 \(\frac{5}{6}\)
1-5 \(\frac{3}{8}\)

1( )

2. If \(n\) is an even integer, the next consecutive even integer is

2-1 \(n + 1\)
2-2 \(n + 2\)
2-3 \(2n\)
2-4 \(2n + 1\)
2-5 \(2n + 2\)

2( )

3. Which one of the following figures suggests the same relation between \(c\) and \(d\) as that which exists in the table above?

3-1 \(\begin{array}{c} c \ \ \ \ d \ \ \ \ \ 2 \\
\end{array}\)
3-2 \(\begin{array}{c} c \ \ \ \ d \ \ \ \ \ 3 \\
\end{array}\)
3-3 \(\begin{array}{c} d \ \ \ \ c \ \ \ \ \ 2 \\
\end{array}\)
3-4 \(\begin{array}{c} d \ \ \ \ 3 \ \ \ \ \ a \\
\end{array}\)
3-5 \(\begin{array}{c} c + 2 \ \ \ \ c + 2 \ \\
5 \ \ \ \ \ \ \ \ \\
\end{array}\)

3( )

Go on to the next page.
4. If each small square in the figure above has the same dimensions, what is the area of the figure?
   4-1 $9h$
   4-2 $12h$
   4-3 $24h$
   4-4 $h^3$
   4-5 $9h^2$ ................. 4( )

5. How many feet are there in m inches?
   5-1 $12m$
   5-2 $m - 12$
   5-3 $12 - m$
   5-4 $\frac{12}{m}$
   5-5 $\frac{m}{12}$ ................. 5( )

6. In the figure above, $L$ equals
   6-1 $3c + 2r$
   6-2 $3c + 4r$
   6-3 $3r$
   6-4 $c^2 + r^2$
   6-5 $c^2 + 2r^2$ ................. 6( )

7. From $y$ yards of wire around a spool, pieces of wire each 3 yards long are cut. A formula for finding the number of yards, $R$, of wire remaining on the spool after $t$ pieces have been cut is
   7-1 $R = \frac{y}{3t}$
   7-2 $R = \frac{y}{t} - 3$
   7-3 $R = \frac{y}{3} - t$
   7-4 $R = y - 3t$
   7-5 $R = y - \frac{t}{3}$ ................. 7( )

8. What part of an hour is 4 seconds? 142
   8-1 $\frac{1}{900}$
   8-2 $\frac{1}{150}$
   8-3 $\frac{1}{90}$
   8-4 $\frac{1}{30}$
   8-5 $\frac{1}{15}$ ................. 8( )

9. If a quantity $g$ varies directly as $p$, and $g$ is 50 when $p$ is 10, what does $g$ equal when $p$ is 12?
   9-1 $40$
   9-2 $48$
   9-3 $52$
   9-4 $60$
   9-5 None of the above ................. 9( )

10. A field of length $p$ is 2 miles longer than it is wide. How many miles wide is the field?
   10-1 $p - 2$
   10-2 $p + 2$
   10-3 $p + p$
   10-4 $2p$
   10-5 $\frac{p}{2}$ ................. 10( )

11. The solution of the pair of simultaneous equations represented by lines $m$ and $n$ on the graph above is
   11-1 (1, 5)
   11-2 (2, 5)
   11-3 (2, 6)
   11-4 (3, 6)
   11-5 (3, 7) ................. 11( )

Go on to the next page.
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15. Which one of the following graphs represents the equation $y = x + 3$?

15-1

15-2

15-3

15-4

15-5

Go on to the next page.
A student took five tests, each having a Part I and a Part II. Graph 1, above, shows the number of questions he answered correctly on each part.

The score on each test is the average of the number of correct answers on Parts I and II of the test. Graph 2, above, is to show these scores.

16. Which point on Graph 2 correctly shows the information for Test 1?

- A
- B
- C
- D
- E

Go on to the next part.

---

**PART III**

(10 minutes)

**Directions:** Continue as in the preceding parts.

1. A recipe calls for 3 times as many cups of flour as of sugar. To find the number of cups of sugar, \( x \), in 10 cups of the sugar-and-flour mixture, which one of the following equations should be solved?

- \( 3x = 10 \)
- \( x + 3x = 10 \)
- \( x(3x) = 10 \)
- \( x + 3 = 10 \)
- \( x + x + 3 = 10 \)  

2. A pipe 42 inches long is to be cut into two pieces such that one is 7 inches longer than the other. How many inches will there be in the longer piece of pipe?

- 24\( \frac{1}{2} \) inches
- 28 inches
- 29 inches
- 31\( \frac{1}{2} \) inches
- 35 inches

3. In the figure above, which is drawn to scale, the line \( CE \) is \( \frac{1}{2} \) inch long. What scale was used in the drawing?

- 1" = 80'
- 1" = 1'
- 1" = 2'
- 1" = 20'
- 1" = \( \frac{1}{4} \)
4. A debt of $1000 is to be paid in four monthly installments, each payment being $50 more than the previous one. What is the amount of the last payment?

4-1 $285
4-2 $300
4-3 $325
4-4 $350
4-5 $375

5. A boy walks toward a village at the rate of 4 miles per hour. After walking for 1 hour, he is picked up by a passing motorist and is driven to the village at the rate of 30 miles per hour. If the motorist gets him to the village in 24 minutes, how far is the village from the boy's starting point?

5-1 7 miles
5-2 12 miles
5-3 17 miles
5-4 22 miles
5-5 The answer is not given.

6. The formula \( \text{effort} \times \text{effort arm} = \text{resistance} \times \text{resistance arm} \) is used in solving lever problems in physics. How much effort is necessary for a resistance of 480 pounds, if the effort arm is 12 inches and the resistance arm is 2 inches?

6-1 40 pounds
6-2 48 pounds
6-3 60 pounds
6-4 120 pounds
6-5 480 pounds

In 1947, it was estimated that the number of needy children in each of the following five European countries was related as follows:

5 times as many in Italy as in Czechoslovakia
4 times as many in Poland as in Czechoslovakia
3 times as many in France as in Czechoslovakia
2 times as many in Rumania as in Czechoslovakia

7. To depict this information on a circle graph, how many degrees of the circle would be marked off to represent France?

7-1 25°
7-2 60°
7-3 72°
7-4 120°
7-5 216°

8. According to these data, for every million needy children in Italy how many are there in Poland?

8-1 1 million
8-2 2 million
8-3 3 million
8-4 4 million
8-5 4 \( \frac{4}{5} \) million

9. At the time that a tower casts a shadow of 400 feet, a man who is 6 feet tall and who is standing near the tower casts a shadow of 11 feet. The height of the tower can be determined by solving the equation

9-1 \( \frac{400}{x} = \frac{6}{11} \)
9-2 \( x = \frac{6}{11} \cdot 400 \)
9-3 \( 400 - x = 11 - 6 \)
9-4 \( 400x = 11(6) \)
9-5 \( x = 400 - 11 - 6 \)

10. After traveling directly north from its starting point for 12 miles, a ship changes its course and travels east for 5 miles. How far from its starting point is the ship?

10-1 7 miles
10-2 12 miles
10-3 17 miles
10-4 \( \sqrt{119} \) miles
10-5 \( \sqrt{119} \) miles

11. An observer 100 feet from the foot of a tree views the top of the tree at an angle of elevation, \( E \), of 25°. How high, to the nearest foot, is the tree?

11-1 23 feet
11-2 42 feet
11-3 47 feet
11-4 91 feet
11-5 110 feet

If you finish before the time is up, you may go back and work on any part.
## APPENDIX F

### LISTING OF TEACHERS, THEIR SCHOOLS, CLASSIFICATIONS, PUPILS, EDUCATIONAL BACKGROUNDS, AND ATTITUDES

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**"1"--the attitude or judgment concerning the practical value of algebra at the beginning of the academic school year; "2"--the attitude or judgment concerning the practical value of algebra at the end of the academic school year.**
APPENDIX G

MAP OF GEOGRAPHICAL WEST TEXAS

EL PASO
YSLETA
CLINT
FABENS
FT. HANCOCK
VAN HORN
VALENTINE
FT. DAVIS
MARFA
ALPINE
MARATHON
SANDERSON
WINK
ODESSA
TOYAH
CRANE
BALMORHEA
FT. STOCKTON
RAAN
SEMINOLE
ANDREWS
MCCAMEY
0 50
MILES
BIBLIOGRAPHY

Books


Articles


Bulletins


Tests

*Cooperative Algebra Test, Elementary Algebra through Quadratics, Form 2*, edited by Bernice Orshansky and others, Princeton, New Jersey, Educational Testing Service, no date given.


Remmers, H. H., "A Scale to Measure Attitude toward Any School Subject," *The Purdue Master Attitude Scales*, Lafayette, Indiana, Purdue Research Foundation, Occupational Research Center, Purdue University, no date given.

Unpublished Materials


University Interscholastic League, Austin, Texas, letter, no date given.