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A Comparative Study of 8th and 9th Grade Algebra Students at Clayton Junior High School

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A COMPARATIVE STUDY OF 8TH AND 9TH GRADE ALGEBRA STUDENTS AT CLAYTON JUNIOR HIGH SCHOOL

by

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INTRODUCTION

Origin and Nature of Problem

With the inclusion of algebra in the eighth grade in the curricula of Clayton Junior High School there has been created a need for some means of identifying students who are likely to be successful in algebra at this level. For the most part, it has only involved, in the past, advising students with very low grades in arithemetic not to take algebra.

Also, the problem of achievement has arisen. Do eighth graders score as well on achievement tests after one year of instruction as do ninth graders? This question is in the minds of many teachers and parents who are aware that the standard eighth grade mathematics course offers little challenge to the talented child.

A number of people, including Dr. James P. Conant, believe that the pupil who is above average should take algebra in the eighth grade while others do not believe that eighth graders have the readiness or the maturity to understand algebraic concepts as well as a ninth grader does.

Several studies have been done, and many different results have been found. In some studies, it was concluded that one year's difference in age apparently makes little difference in achievement in beginning algebra. While others found a significant difference in achievement for the eighth and ninth grades.

These were the problems this writer chose to study: How can we best predict success in first year algebra? And, is there a significant difference between the achievement of eighth and ninth grade algebra students?

Objectives

This paper will consider the following questions:

1. Is there a significant difference between the achievement of eighth and ninth grade algebra students at Clayton Junior High School?

2. How significant are the Pitner Mental Ability Test, the Lee Test of Algebraic Ability and previous arithemetic grades in predicting success in first year algebra?

REVIEW OF LITERATURE

Pupil Readiness

It is generally agreed by teachers that there is great variability in the capacity of students to understand mathematical concepts. Many reasons are given for this. Cristantiello (1961) suggests that "non-intellectual" factors such as attitude and emotional make-up have an important bearing upon a student's success with mathematics or any course. Barakat (1951) through his factorial analysis of mathematical ability suggests that such factors as "emotional irritability" and lack of industry interfere with success in mathematical tasks. Investigating achievement in an introductory statistics class, Bendig and Hughes (1954) attributed about four percent of the variability in achievement to difference in students' attitudes.

But our main concern at this point of investigation is not so much with the factors which influence success, but only with age at which a child is first able to master the elementary concepts of algebra. Davydov (1962) experimenting in a Soviet school reported that his observations of the training process showed that children of seven and eight years of age are quite ready to master the material of elementary algebra. At this age, he claims, their level of intellectual development (such things as, capacity for abstract reasoning, for consecutively performing mental operations, etc.) was high enough and so they did not find it difficult to learn generalized patterns of quantitative relationships and the letter form of expressing them. His conclusion is quite clear, i.e. it is altogether possible to teach mathematics to children in elementary school.

An American, Corley (1958) also reports similarly that the ability of pupils to learn algebraic terms and concepts is quite well developed at the sixth grade level and this ability improves at a slow, approximately uniform rate as the pupil progresses into the tenth grade.

Research done by Piaget, Bruner, and others, also throws considerable light on the matter of learning concepts and a child's readiness to learn them. According to Schaaf (1965), who is summarizing their works, the learning of concepts involves two major factors: (1) discovery and intuition, and (2) communication. Bruner (1960) breaks this down into four factors, but it is more convenient to think of discovery and intuition together, while as Schaaf (1965) states, "translation" and "readiness" are so inextricably associated with language and semantics that probably the translating of intuitive ideas into generalizations and abstractions is part and parcel of communication between teacher and learner.

Along this same theme it has been said,

> Readiness, I would agree, is a function not so much of maturation, but rather of our intentions and our skill at translation of ideas into the language and concepts of the age we are teaching. But let it be clear to us that our intentions must be plain before we can start deciding what can be taught to children of what age, for life is short and art is long and there is much art yet to be created in the transmission of knowledge. (Bruner, 1960, p. 617)

As a concluding remark regarding pupil readiness, the following statement seems to bring together the various findings:

> I urge that we use the unfolding of readiness to our advantage: to give the child a sense of his own growth and his own capacity to leap ahead in mastery. The problem of translating concepts to this or that age level can be solved, the evidence shows, once we decide what it is we want to translate. (Bruner, 1960, p. 619)

Differences in Achievement

Studies done

How to best make the selection of first year algebra classes, in order to compare eighth and ninth grade achievement, has been the major concern of those involved in this field of study. There are many variables to be considered, of which, the most commonly used by today's school systems are: previous grades, achievement tests, I. Q. test results, and algebra prognostic test results. Some studies have used as many as eleven variables (Barnes and Asher, 1962) and others as few as two (Friesen, 1960; Fowler, 1961; and Callicut, 1961). These variables of selection can be classified into the following general types:

1. I. Q. test results
2. Teacher and counselor recommendation
3. Past arithmetic grades
4. Expression of interest by student
5. Standardized algebra aptitude tests
6. Academic ability in all subjects
7. Emotional stability and personality traits
8. Regularity of attendance
9. Reading scores
10. Basic arithmetic fundamentals test

By whatever variables were chosen to be used, the studies all used the same general form to evaluate the student's initial standing in algebra fundamentals and final achievement.

Duncan (1960) used two classes of eighth grade students in algebra and gave them a battery of standardized tests at the end of their seventh-year in school and along with other tests given later were compared with the norms of ninth grade students.

Friesen (1960) involved 211 eighth graders and 774 ninth graders. He administered an intelligence test and an algebra aptitude or pre-test at the beginning of the school year. An algebra achievement or post-test was administered at the end of the school year to measure achievement.

Brown and Abell (1966) tested fifth, seventh, eighth, and ninth grade students who were taught the same mathematical concepts and were tested in the same manner.

Ropp, (1963) at the beginning of the eighth grade administered an algebra prognosis test and only those who ranked about 70 percent or higher were considered for algebra. He also considered past performance, for he believed a student may have the ability but not the ambition. Also he used the teacher's and counselor's recommendations to eliminate those students felt to be too immature to achieve in the program.

Messler (1961) used one group of 34 eighth grade students and the other group of 34 ninth grade students (21 boys and 13 girls in each group). He selected them on the basis of I. Q., arithemetic achievement, academic ability in all subjects, and teacher-counselor opinions based on emotional stability, interests, work habits, and regularity of attendance.

Two tests were given, one a mental ability test and the other an arithemetic achievement test. The pupils were then matched pupil to pupil, so that the I. Q. differed by not more than five points.

The same material was presented by the same teacher during the same school year.

Two more tests were then administered, one during the second week of the school year, (the Cooperative Algebra Test) and a different form of the Cooperative Test at the end of the school year.

The analysis of covariance technique was used (automatically adjusts the first test means for any difference between the two groups being compared, as measured by a pre-test, at the same time that it determines whether or not there is statistically significant difference between the final adjusted test means).

Fowler (1961) also used the Cooperative Algebra Test and administered it to five classes of eighth grade algebra and five classes of ninth grade algebra students. Six different teachers were involved and he tried to match students of equal ability.

Callicutt (1961) used only two variables in the selection of students' previous arithemetic grades and I. Q. scores.

Hegstrom and Riffle (1963) proposed candidates by the following criteria:

1. Teacher recommendation
2. Past grades and interest in mathematics
3. A series of standardized tests to consist of the following as a minimum:

(a) All seventh grade students would take an arithemetic fundamentals test and students placing at the ninetieth percentile or above would be eligible for further testing; a student placing below the ninetieth percentile would be eligible only if recommended by his teacher.

(b) Superior ratings on the mathematics phase of the California Achievement test.

(c) Superior rating on a valid algebra aptitude test.

(d) Written parental approval.

Their evaluation was conducted by test results and correlation of the test results to the system of selection.

Barnes and Asher (1962) had the largest number of variables the author found, eleven in all. Also, this was the only study cited which used a high-speed computer to determine correlations.

Pauley (1961) adopted the following criteria as the basis for placement of pupils in the program:

1. The pupil and his parents desire such placement.

2. The pupil has demonstrated a high level of academic achievement.

3. The pupil has demonstrated a keen interest in mathematics.

4. The pupil has received scores on group tests of scholastic ability which place him or her within the upper twenty-five percent of the school population at his grade level or has I. Q. scores of 115 or better.

Results and conclusions of studies

Duncan (1960) reported that 89 percent of the eighth grade students scored above the mean of the norms for ninth graders. This seemed to indicate to him that comparable groups of bright eighth graders generally could be expected to achieve in algebra as well as or better than unselected groups of ninth grade pupils.

Friesen (1960) found in four of his comparisons there were significant differences at the one percent level. However, in one of these four comparisons, it was concluded that the eighth grade advantage could have been due to greater initial knowledge. In the other nine comparisons there were no significant differences.

He concluded that mathematically talented eighth grade pupils comprising the upper ten to fifteen percent of their classes achieved as well as or better in algebra than selected ninth grade pupils. Also he concluded that acceleration is one means of developing the abilities of mathematically talented pupils.

Brown and Abell (1966) reported that the highest ten percent of the fifth grade scored higher than the bottom ten percent of the ninth grade; the highest thirty percent of the fifth grade scored higher than the lowest thirty percent of the seventh grade; and likewise the top thirty percent of the seventh grade scored higher than the bottom thirty percent of the ninth grade.

In one of their studies, eighth grade students achieved significantly greater scores than did ninth grade students. Therefore, they concluded that one year's difference in age apparently makes little difference in achievement in beginning algebra.

Robb (1963) states that "when the better student knows that he can get ahead by extra effort, he usually will produce more." (Ropp, 1963, p. 297)

Messler (1961) concluded from his work that test results indicate that age was not detrimental to the achievement in elementary algebra and probably just as important is the extra incentive and zest for the course by the eighth graders.

Fowler (1961) noted that it would appear that eighth grade students can succeed in Algebra I. However, he carefully noted, it should be seen that no so-called low ability groups were included in his study.

He suggested that eighth graders who elect algebra or, better still, are recommended by their guidance counselors and arithemetic teachers, probably will succeed as well in Algebra I as ninth graders of similar mental ability.

Also, he suggests that future studies, in order to draw more definite conclusions, should try to match students of the same ability with the same teacher working under similar conditions.

Hegstrom and Riffle (1963) indicated that their findings lead them to believe that at least fifteen percent of both of their eighth grade classes had sufficient ability to accelerate.

Pauley (1961) concluded from his results and the opinions of his cooperating teachers that elementary algebra can be taught to eighth grade pupils successfully if the pupils are selected according to the criteria suggested by him.

Furthermore, he states, that the teachers unanimously reported that they had found the program to be satisfactory and were almost unanimous in saying that they felt that students had made more progress in these special classes than they would have made in the regular mathematics program.

This same response was found by Baker (1962) who sent opinionaires to principals, teachers, and students in Michigan. They indicated a favorable reaction to eighth grade algebra and almost all stated that the superior eighth graders in their programs could successfully take algebra in the eighth grade.

Predictors of Success

With the inclusion of algebra in the eighth grade in the curricula of many schools there has been created a need for some means of identifying students who are likely to be successful in algebra at this level. For the most part it only involves advising students with very low grades in arithemetic not to take algebra. But, perhaps this is all that is needed. Callicut (1961) found a correlation of .58 between seventh grade arithmetic grades and achievement in algebra. These grades were found to be a better basis for prognosis than intelligence quotients, achievement test scores, or composite averages.

Sommerfield and Tracy (1963) place only secondary importance on the student's past scholastic record, Barnes and A^her (1962) agree with Callicut that the best single predictor of success in algebra, at least in their school system, is the student's previous grades with a correlation of .5881. Further they state that there should not be emphasis placed on the I. Q. in the selection of students to take algebra.

Callicutt (1961) also reports the correlation between I. Q.'s and achievement in algebra, and I. Q.'s and previous mathematics grades to be .51 and .48, respectively.

Osburn and Melton (1963) after administering a battery of aptitude tests found that for the most part these aptitude tests were equally valid in predicting proficiency in algebra. He used the Iowa Algebra Aptitude Test, the Orleans Algebra Prognosis test, and the Primary Mental Abilities tests, which showed lower validities as compared with the Iowa and the Orleans tests. Surprisingly, to them, verbal meaning and reasoning were generally the best predictors, and number was the least effective.

Guilford (1965) investigating this area stated that it is fairly obvious that algebra capitalizes upon symbolic information and prominent among the abilities for learning it and for operating it must surely be symbolic factors.

He also concluded that batteries of factor scores were better predictors of achievement than two of the standard-test combinations, especially in the prediction of algebra.

With only predictors that gave statistically significant contributions to prediction of achievement, some 12 different factors were found relevent. Most of these factors were from the symbolic category of the structure of intellect; very few are cognition factors and quite a number are evolution factors; most of them deal with the products of relations and implications.

Coleman (1956) found many other interesting facts about predictors of success in algebra, among which are the following: (1) computational ability is an ability distinct from the only remotely related to mathematical ability, (2) mathematical ability is closely akin to ability in deductive reasoning, (3) ability to see spatial relationships is helpful in a limited area in mathematics only, (4) a good memory is not a necessary ingredient of mathematical ability, (5) grades in mathematics courses are affected by students goals not necessarily commensurate with their abilities, (6) individuals lacking in mathematical ability can be completely baffled by concepts elementary to the "mathematically gifted," (7) while the mathematical ability possessed by an individual remaining rather constant, varying efforts and different backgrounds of individuals for various topics in mathematics lead to differential successes, and (8) degrees of mathematical ability are differentiated both by the accuracy with which inferences are made and by the depth of understanding of mathematical concepts.

PROCEDURE

The subject groups were composed of 98 ninth grade algebra students and 33 eighth grade students. The students were chosen for algebra mainly on the basis of their previous years arithemetic semester grades and upon the recommendation of their previous years arithemetic teacher.

Both groups were taught by the same instructor and basically the same material in the same way.

During the first month of school, the Pitner Mental Ability Test was administered to both groups by the school counselor in charge of testing. In the second month of the school year, the Lee Test of Algebraic Ability was administered by this writer to both groups and the results recorded. Finally, during the last week of the school year, the Cooperative Mathematics Test, form B, algebra one test was given to all students engaged in this study.

The following section contains all the data compiled and computed by this writer from the following statistical measures.

RESULTS

Differences in Means

Pitner test scores

The Raw Scores, as found in Table 31, represents all of the data found and determined for the subjects engaged in this study. Using these raw scores, this writer evaluated the Pitner scores first.

Table 1 yielded the mean of the 9th grade students' Pitner scores to be 120.7, the median as 118 and mode as 121.5. Table 2 gave the same information, but for the 8th grade; mean, 122.5; median, 126; and two modes of 121.5 and 129.5.

The standard deviations for the pitner scores were determined from the data in Table 3 for the 9th grade, and from Table 4 for the 8th grade. These were 11.6 and 8.7, respectively. Using S_{D_x} (standard error of the difference between the means) and formula 1:

$$S_{D_x} = \sqrt{S_{x_9}^2 + S_{x_8}^2}$$

where S_{x_9} is the standard error of the 9th grade mean and S_{x_8} is the standard error of the 8th grade mean, the following was obtained:

$$S_{x_9} = \frac{S_9}{\sqrt{N_9}} = \frac{11.6}{\sqrt{98}} = \frac{11.6}{9.90} = 1.17$$

$$S_{x_8} = \frac{S_8}{\sqrt{N_8}} = \frac{8.7}{\sqrt{33}} = \frac{8.7}{5.74} = 1.51$$

Table 1. Mean, median, and mode of Pitner Test Scores, ninth grade

Scores	f	x'	fx'
148-151	2	7	14
144-147	1	6	6
140-143	2	5	10
136-139	1	4	4
132-135	4	3	12
128-131	11	2	22
124-127	6	1	6
120-123	20	0	0
116-119	8	-1	-8
112-115	16	-2	-32
108-111	14	-3	-42
104-107	3	-4	-12
100-103	4	-5	-20
96- 99	7	-6	-42

$$\bar{X} = M' + \frac{\Sigma fx'}{N}$$

$$= 121.5 + \frac{-82}{98}$$

$$= 121.5 - .84$$

$$= 120.7$$

Median = 115.5 + 2.5

= 118

N = 98 Σ = -82

Mean - 120.7 Median - 118 Mode - 121.5

Table 2. Mean, median, and mode of Pitner Test Scores, eighth grade

Scores	f	x'	fx'
148-151	0	7	0
144-147	0	6	0
140-143	1	5	5
136-139	4	4	16
132-135	4	3	12
128-131	6	2	12
124-127	4	1	4
120-123	6	0	0
116-119	3	-1	-3
112-115	3	-2	-6
108-111	2	-3	-6
104-107	0	-4	0
100-103	0	-5	0
96- 99	0	-6	0

$$\bar{X} = M' + \frac{\Sigma fx'}{N}$$

$$= 121.5 + \frac{34}{33}$$

$$= 121.5 + 1.03$$

$$= 122.5$$

Median = 123.5 + 2.5

= 126

N = 33 Σ = 34

Mean - 122.5 Median - 126 Mode - 121.5 and 129.5

Table 3. Standard deviation of Pitner Scores, ninth grade

Scores	f	x'	fx'	fx'^{2}
148-151	2	7	14	98
144-147	1	6	6	36
140-143	2	5	10	50
136-139	1	4	4	16
132-135	4	3	12	36
128-131	11	2	22	44
124-127	6	1	6	6
120-123	19	0	0	0
116-119	8	-1	-8	8
112-115	16	-2	-32	64
108-111	14	-3	-42	126
104-107	3	-4	-12	48
100-103	4	-5	-20	100
96- 99	7	-6	-41	252

$$x^2 = i^2 \left[\Sigma fx'^2 - \frac{(\Sigma fx')^2}{N} \right]$$

$$= 16 \left(884 - \frac{(-82)^2}{98} \right)$$

$$= 16 \left(884 - 66.4 \right)$$

$$= 16(817.6) = 13081.6$$

$$S = \sqrt{\frac{x^2}{N - 1}}$$

$$= \sqrt{\frac{13081.6}{97}} = \sqrt{134.9} = 11.6$$

N = 98 Σ = -82 Σ = 884
S = 11.6

Table 4. Standard deviation of Pitner Scores, eighth grade

Scores	f	x'	fx'	fx'^{2}
148-151	0	7	0	0
144-147	0	6	0	0
140-143	1	5	5	25
136-139	4	4	16	64
132-135	4	3	12	36
128-131	6	2	12	24
124-127	4	1	4	4
120-123	6	0	0	0
116-119	3	-1	-3	3
112-115	3	-2	-6	12
108-111	2	-3	-6	18
104-107	0	-4	0	0
100-103	0	-5	0	0
96- 99	0	-6	0	0

$$x^2 = i^2 \left[\Sigma fx'^2 - \frac{(\Sigma fx')^2}{N} \right]$$

$$= 16 \left(186 - \frac{1156}{33} \right)$$

$$16 \left(186 - 35 \right)$$

$$16(151) = 2416$$

$$S = \sqrt{\frac{x^2}{N - 1}}$$

$$= \sqrt{\frac{2416}{32}} = \sqrt{75.5} = 8.7$$

N = 33 Σ = 34 Σ = 186
S = 8.7

so $S_{D_x} = \sqrt{S_{x_9}^2 + S_{x_8}^2} = \sqrt{(1.17)^2 + (1.51)^2} = \sqrt{1.3689 + 2.2801}$

$= \sqrt{3.6490} = 1.91$

Next, changing the deviation into standard score units: $Z = \frac{D_x}{S_{D_x}}$

where D_x is the difference between the means. So Z is found by:

$$Z = \frac{X_8 - X_9}{S_{D_x}} = \underline{122.5 - 120.7} = \frac{1.8}{1.91} = 0.94$$

Because of the Z we have no reason to believe that there is any difference between the two groups and therefore we cannot reject the null hypothesis that the difference between these two means is 0.

Lee test scores

From Table 5 the following information concerning the Lee Test of Algebraic Ability was found and computed for the 9th grade: Mean, 101.3; median, 108.5; and the mode, 105.5 and 99.5. Table 6 yielded the following for the 8th grade: Mean, 123.8; median, 127.4; and mode of 129.5.

Stating a null hypothesis that there is again no difference between these means, the following measures were employed to test this hypothesis:

$S_{x_9} = \frac{S_9}{\sqrt{N_9}}$ (from Table 7)

$= \frac{16.4}{\sqrt{98}}$

$= \frac{16.4}{9.9}$

$= 1.65$

$S_{x_8} = \frac{S_8}{\sqrt{N_8}}$ (from Table 8)

$= \frac{12.5}{\sqrt{33}}$

$= \frac{12.5}{5.74}$

$= 2.17$

And now using formula 1 again:

$$S_{D_x} = \sqrt{(1.65)^2 + (2.17)^2} = \sqrt{2.7225 + 4.7089} = \sqrt{7.1314} = 2.67$$

Using this deviation and changing it into standard score units:

$$Z = \frac{127.4 - 101.3}{2.67} = \frac{26.1}{2.67} = 9.77$$

Table 5. Mean, median, and mode of Lee Ability Scores, ninth grade

Scores	f	x'	fx'
151-156	0	9	0
145-150	1	8	8
139-144	1	7	7
139-144	1	7	7
133-138	6	6	36
127-132	11	5	55
121-126	11	4	44
115-120	10	3	30
109-114	9	2	18
103-108	15	1	15
97-102	16	0	0
91- 96	8	-1	-8
85- 90	4	-2	-8
79- 84	4	-3	-12
73- 78	3	-4	-12

$$\bar{X} = M' + \frac{\Sigma fx'}{N}$$

$$= 99.5 + \frac{173}{98}$$

$$= 101.3$$

Median = 108.5

N = 98 $\Sigma = 173$

Mean - 101.3 Median - 108.5 Mode - 99.5

Table 6. Mean, median, and mode of Lee Ability Scores, eighth grade

Scores	f	x'	fx'
151-156	1	5	5
145-150	0	4	0
139-144	3	3	9
133-138	4	2	8
127-132	10	1	10
121-126	6	0	0
115-120	3	-1	-3
109-114	3	-2	-6
103-108	1	-3	-3
97-102	1	-4	-4
91- 96	1	-5	-5
85- 90	0	-6	0
79- 84	0	-7	0
73- 78	-	-8	0

$$\bar{X} = M' + \frac{\Sigma fx'}{N}$$

$$= 123.5 + \frac{11}{33}$$

$$= 123.5 + .3$$

$$= 123.8$$

Median = 126.5 + .9

= 127.4

N = 33 $\Sigma = 11$

Mean - 123.8 Median - 127.4 Mode - 129.5

Table 7. Standard deviation of Lee Ability Scores, ninth grade

Scores	f	x'	fx'	fx'^{2}
151-156	0	9	0	0
145-150	1	8	8	64
139-144	1	7	7	49
133-138	6	6	36	216
127-132	11	5	55	275
121-126	11	4	44	176
115-120	10	3	30	90
109-114	9	2	18	36
103-108	15	1	15	15
97-102	15	0	0	0
91- 96	8	-1	-8	8
85- 90	4	-2	-8	16
79- 84	4	-3	-12	36
73- 78	3	-4	-12	48

$$X^2 = i^2\left(\Sigma fx'^2 - \frac{(\Sigma fx')^2}{N}\right)$$

$$= 36\left(1029 - \frac{29929}{98}\right)$$

$$= 36(1029 - 305.4)$$

$$= 36(723.6) = 26049.6$$

$$S = \sqrt{\frac{X^2}{N-1}} = \sqrt{\frac{26049.6}{97}}$$

$$= \sqrt{268.55} = \sqrt{16.4}$$

N = 98 Σ = 173 Σ = 1029

S = 16.4

Table 8. Standard deviation of Lee Ability Scores, eighth grade

Scores	f	x'	fx'	fx'^{2}
151-156	1	5	5	25
145-150	0	4	0	0
139-144	3	3	9	27
133-138	4	2	8	16
127-132	10	1	10	10
121-126	6	0	0	0
115-120	3	-1	-3	3
109-114	3	-2	-6	12
103-108	1	-3	-3	9
97-102	1	-4	-4	16
91- 96	1	-5	-5	25
85- 90	0	-6	0	0
79- 84	0	-7	0	0
73- 78	0	-8	0	0

$$X^2 = i^2\left(\Sigma fx'^2 = \frac{(\Sigma fx')^2}{N}\right)$$

$$= 36\left(143 - \frac{121}{33}\right)$$

$$= 36(143 - 3.7)$$

$$= 36(139.3) = 5014.8$$

$$S = \sqrt{\frac{X^2}{N-1}} = \sqrt{\frac{5014.8}{32}}$$

$$= \sqrt{156.71} = 12.5$$

N = 33 Σ = 11 Σ = 143

S = 12.5

This Z of 9.77 permits this writer to reject the null hypothesis at the 1 percent level of significance. Therefore, we can conclude that this is a meaningful difference between the means of the 9th grade Lee scores and the 8th grade Lee scores.

Arithemetic grades

From the data in Table 9, the mean of the 9th graders arithemetic grades was found to be 2.8; the median, 3.0; and the mode, 3.0. The 8th graders mean was determined from Table 10 to be 3.3; their median, 3.0; and the mode, 3.0.

Starting from a null hypothesis that there is no difference between these means and using the data from Tables 11 and 12, the following was calculated:

$$S_{x_9} = \frac{S_9}{\sqrt{N_9}} = \frac{.68}{\sqrt{98}} = \frac{.68}{9.9} = .07 \qquad S_{x_8} = \frac{S_8}{\sqrt{N_8}} = \frac{.47}{\sqrt{33}} = \frac{.47}{5.74} = .08$$

Again by the use of formula 1 the standard error of the difference between the means is found to be:

$$S_{D_x} = \sqrt{(.07)^2 + (.08)^2} = \sqrt{.0049 + .0064} = \sqrt{.0113} = .11$$

And converting this standard error in standard score units:

$$Z = \frac{X_8 - X_9}{S_{D_x}} = \frac{3.3 - 2.8}{.11} = \frac{.5}{.11} = 4.54$$

Now we can reject the null hypothesis at the 1 percent level of significance.

Cooperative achievement test scores

The evaluations and computations which follow were made for the achievement test from Tables 13 and 14. The mean of the 9th grade was found to be 56.7; the median, 56.8; and the mode, 56.5. For the 8th grade, the mean was 68.5; median, 70.8; and the two modes were found to be 72.5 and 76.5. Tables 15 and 16 gave the following standard deviations for the 9th and 8th grades, respectively: 10.8 and 10.3.

To determine the difference between the means, a null hypothesis was assumed that there was no difference between the two means and then this hypothesis was tested as follows:

$$S_{x_9} = \frac{S_9}{\sqrt{N_9}} = \frac{10.8}{\sqrt{98}} = \frac{10.8}{9.9} = 1.09$$

$$S_{x_8} = \frac{S_8}{\sqrt{N_8}} = \frac{10.3}{\sqrt{33}} = \frac{10.3}{5.74} = 1.79$$

Next finding the standard error of the difference between the means, the following was computed:

$$S_{D_x} = \sqrt{S_{x_9}^2 + S_{x_8}^2} = \sqrt{1.09^2 + 1.79^2} = \sqrt{1.1881 + 3.2041} = \sqrt{4.3922} = 2.10$$

Now again changing this standard error into standard scores:

$$Z = \frac{68.5 - 56.7}{2.10} = \frac{11.8}{2.10} = 5.62$$

Therefore the null hypothesis can be rejected at the 1 percent level of significance.

Table 9. Mean, median, and mode of arithemetic grades, ninth grade

Scores	f	x'	fx'	
4.0	9	3	27	$\overline{X} = M' + \frac{\Sigma fx'}{N}$
3.5	15	2	30	
3.0	33	1	33	
2.5	18	0	0	$= 2.5 + .3$
2.0	19	-1	-19	
1.5	4	-2	-8	$= 2.8$
1.0	1	-3	-3	

N = 98 $\Sigma = 60$
Mean - 2.8 Median - 3.0 Mode - 3.0

Table 10. Mean, median, and mode of arithemetic grades, eighth grade

Scores	f	x'	fx'	
4.0	7	2	14	$X = M' + \frac{\Sigma fx'}{N}$
3.5	6	1	6	
3.0	17	0	0	
2.5	3	-1	-3	$= 3.0 + .3 = 3.3$

N = 33 $\Sigma = 17$
Mean - 3.3 Median - 3.0 Mode 3.0

Table 11. Standard deviation of arithemetic grades, ninth grade

Scores	f	x	x^2	fx^2	
4.0	9	1.2	1.44	12.96	$S = \sqrt{\frac{\Sigma fx^2}{N - 1}}$
3.5	15	.7	.49	7.35	
3.0	33	.2	.04	1.32	
2.5	17	-.3	.09	1.53	$= \sqrt{\frac{45.32}{97}}$
2.0	19	-.8	.64	12.16	
1.5	4	-1.3	1.69	6.76	
1.0	1	-1.8	3.24	3.24	$= \sqrt{.46} = .68$

N = 98 $\Sigma = 45.32$
X = 2.8

Table 12. Standard deviation of arithemetic grades, eighth grade

Scores	f	x	x^2	fx^2	
4.0	7	.7	.49	3.43	$S = \sqrt{\frac{7.12}{32}}$
3.5	6	.2	.04	.24	
3.0	17	-.3	.09	1.53	
2.5	3	-.8	.64	1.92	$= \sqrt{.22} = .45$

N = 33 $\Sigma = 7.12$
X = 3.3
S - .47

Table 13. Mean, median, and mode for Cooperative Test Scores, ninth grade

Scores	f	x'	fx'	
79-82	3	6	18	$X = M' + \frac{\Sigma fx'}{N}$
75-78	3	5	15	
71-74	4	4	16	
67-70	11	3	33	$= 56.5 + \frac{20}{98}$
63-66	10	2	20	
59-62	7	1	7	
55-58	21	0	0	= 56.5 + .20
51-54	14	-1	-14	
47-50	10	-2	-20	= 56.7
43-46	5	-3	-15	
39-42	4	-4	-16	Median = 54.5 + 2.3
35-38	2	-5	-10	
31-34	0	-6	0	= 56.8
27-30	2	-7	-14	

N = 98 $\Sigma = 20$
Mean - 56.7 Median - 56.8 Mode - 56.5

Table 14. Mean, median, and mode for Cooperative Test Scores, eighth grade

Scores	f	x'	fx'
79-82	5	3	15
75-78	6	2	12
71-74	6	1	6
67-70	5	0	0
63-66	4	-1	-4
59-62	2	-2	-4
55-58	1	-3	-3
51-54	1	-4	-4
47-50	2	-5	-10
43-46	0	-6	0
39-42	1	-7	-7

$$X = M' + \frac{\Sigma fx'}{N}$$

$$= 68.5 + \frac{1}{33}$$

$$= 68.5 + .03$$

$$= 68.5$$

Median = 70.5 + .33

= 70.8

N = 33 $\Sigma = 1$
Mean - 68.5 Median - 70.8 Mode - 72.5 and 76.5

Table 15. Standard deviation of Cooperative Scores, ninth grade

Scores	f	x'	fx'	fx'^2
79-82	3	6	18	108
75-78	3	5	15	75
71-74	4	4	16	64
67-70	11	3	33	99
63-66	10	2	20	40
59-62	7	1	7	7
55-58	21	0	0	0
51-54	14	-1	-14	14
47-50	10	-2	-20	40
43-46	5	-3	-15	45
39-42	4	-4	-16	64
35-38	2	-5	-10	50
31-34	0	-6	0	0
27-30	2	-7	-14	98

$$x^2 = 16(704 - \frac{400}{98})$$

$$= 16(704 - 4.1)$$

$$= 16(699.9)$$

$$= 11198.4$$

$$S = \sqrt{11198.4/97}$$

$$= \sqrt{115.44}$$

$$= 10.8$$

N = 98 $\Sigma = 20$ $\Sigma = 704$
S = 10.8

Table 16. Standard deviation of Cooperative Scores, eighth grade

Scores	f	x'	fx'	fx'
79-82	5	3	15	45
75-78	6	2	12	24
71-74	6	1	6	6
67-70	5	0	0	0
63-66	4	-1	-4	4
59-62	2	-2	-4	8
55-58	1	-3	-3	9
51-54	1	-4	-4	16
47-50	2	-5	-10	50
43-46	0	-6	0	0
39-42	1	-7	-7	49

$$X^2 = 16\left(211 - \frac{1}{33}\right)$$

$$= 16(211 - .03)$$

$$= 16(211) = 3376$$

$$S = \sqrt{\frac{3376}{32}}$$

$$= \sqrt{105.50}$$

$$= 10.3$$

N = 33 $\Sigma = 1$ $\Sigma = 211$

S = 10.3

Correlations

Pitner and Cooperative scores

The Pearson Product-Moment correlation coefficient, r, for the Pitner Mental Ability Test and the Cooperative Mathematics Test was computed next from the scattergram found in Table 17 and by the following formula 2:

$$r = \frac{x'y' - \frac{(\Sigma fx')(\Sigma fy')}{N}}{\sqrt{\left(fx'^2 - \frac{(\Sigma fx')^2}{N}\right)\left(fy'^2 - \frac{(\Sigma fy')^2}{N}\right)}}$$

Using this formula and Table 17 for the 9th grade the correlation coefficient was determined to be: .22

Table 17. r for Pitner and Cooperative Test Scores, ninth grade

x-axis, Pitner Scores				y-axis, Cooperative Test Scores				
f	x'	fx'	fx'^{2}	f	y'	fy'	fy'^{2}	x'y'
6	0	0	0	0	14	0	0	0
4	1	4	4	3	13	507	507	182
3	2	6	12	3	12	36	432	192
14	3	42	128	4	11	44	484	255
16	4	64	256	11	10	110	1100	780
8	5	40	200	10	9	90	810	540
18	6	108	648	7	8	56	448	360
6	7	42	294	21	7	147	1029	777
11	8	88	704	14	6	84	504	390
4	9	36	324	10	5	50	250	190
1	10	10	100	5	4	20	80	100
2	11	22	242	4	3	12	36	39
1	12	12	144	2	2	4	8	6
2	13	26	338	0	1	0	0	0
0	14	0	0	2	0	0	0	0
N=98		Σ=500	Σ=3398	N=98		Σ=692	Σ=5688	Σ=3711

Using formula 2:

$$r = \frac{3711 - \frac{(500)(692)}{98}}{\sqrt{\left(3398 - \frac{(500)^2}{98}\right)\left(5688 - \frac{(692)^2}{98}\right)}}$$

$$= \frac{3711 - 3530.6}{\sqrt{(3398 - 2550.1)(5688 - 4886.3)}}$$

$$= \frac{180.4}{\sqrt{(847.9)(801.7)}}$$

$$= \frac{180.4}{\sqrt{679761.43}}$$

$$= \frac{180.4}{824}$$

$$= .22$$

The problem arose after determining this correlation coefficient as to whether or not it is a measure of real relationship or merely a chance deviation from a population in which the r is 0.

It seemed advantageous to make a Z-test which is again, the ratio of a deviation to a standard deviation. The deviation in this case is the r; the standard deviation is the standard error of this r. The standard error of the r was obtained by the following formula 3:

$$S_{r_o} = \frac{1}{\sqrt{N - 1}}$$

$$= \frac{1}{\sqrt{98 - 1}}$$

$$= \frac{1}{\sqrt{97}}$$

$$= \frac{1}{9.85}$$

$$= .10$$

So $Z = \frac{.22}{.10}$ which is significant at the 5 percent level.

Therefore we can reject the null hypothesis that it is not a real relationship.

The 8th grade was done in a similar manner using Table 18 and the work which is reproduced below:

$$S_{r_o} = \frac{1}{\sqrt{33 - 1}}$$

$$= \frac{1}{\sqrt{32}}$$

$$= \frac{1}{5.66}$$

$$= .18$$

Testing for significance with a null hypothesis of no real relationship between the two, the r from Table 18 of .63 was used with the standard error of the r as computed above to find:

Table 18. r for Pitner and Cooperative Test Scores, eighth grade

x-axis, Pitner Scores				y-axis, Cooperative Test Scores				
f	x'	fx'	fx'^{2}	f	y'	fy'	fy'^{2}	x'y'
0	0	0	0	0	14	0	0	0
0	1	0	0	6	13	78	1014	663
0	2	0	0	5	12	60	720	492
2	3	6	18	6	11	66	726	506
3	4	12	48	5	10	50	500	330
3	5	15	75	4	9	36	324	198
6	6	36	216	2	8	16	128	112
4	7	28	196	1	7	7	49	49
6	8	48	384	1	6	6	36	30
4	9	36	324	2	5	10	20	50
4	10	40	400	0	4	0	0	0
1	11	11	121	1	3	3	9	9
0	12	0	0	0	2	0	0	0
0	13	0	0	0	1	0	0	0
0	14	0	0	0	0	0	0	0
N=33		Σ=232	Σ=1781	N=33		Σ=332	Σ=3526	Σ=2439

Using formula 2:

$$r = \frac{2439 - \frac{(232)(332)}{33}}{\sqrt{\left(1781 - \frac{(232)^2}{33}\right)\left(3526 - \frac{(332)^2}{33}\right)}}$$

$$= \frac{2439 - 2334.1}{\sqrt{(1781 - 1631)(3526 - 3340.1)}}$$

$$= \frac{104.9}{\sqrt{(150)(185.9)}}$$

$$= \frac{104.9}{\sqrt{27885}}$$

$$= \frac{104.9}{167}$$

$$= .63$$

$$Z = \frac{.63}{.18} = 3.50$$ which is significant at the 1 percent level.

Lee and Cooperative scores

The correlation r between the Lee Test of Algebraic Ability and the Cooperative Mathematics Test for the 9th grade was determined from Table 19, formula 2 and the following computations.

Table 19 gave a coefficient of .46 and after stating a null hypothesis that this is not a real relationship and is only a chance correlation, the following test of significance was made:

$S_{r_o} = .10$ (see page 23) so $Z = \frac{.46}{.10} = 4.60$ which is significant at the 1 percent level.

This same procedure was followed to find the correlation coefficient of the Lee Test and Cooperative Test for the 8th grade using Table 20. From this table an r coefficient of .73 was found. Stating the same null hypothesis as before and using formula 3 and the value of the standard error as found on page 23, the following was determined:

$$S_{r_o} = .18 \text{ and } Z = \frac{.73}{.18} = 4.05$$

Again this value of 4.05 is significant at the 1 percent level therefore the null hypothesis can be rejected.

Arithemetic grades and Cooperative scores

By the scattergram method which is found on Table 21, the r coefficient for the 9th grade was determined to be .52.

As has been done before, a null hypothesis was made and then tested as demonstrated below:

$$S_{r_o} = .10 \text{ so } Z = \frac{.52}{.10} = 5.20$$

This Z-test score is significant at the 1 percent level so again the null hypothesis may be rejected with confidence.

Table 19. r for Lee and Cooperative Test Scores, ninth grade

x-axis, Lee Scores				y-axis, Cooperative Test Scores				
f	x'	fx'	fx'^{2}	f	y'	fy'	fy'^{2}	x'y'
4	0	0	0	0	14	0	0	0
3	1	3	3	3	13	39	507	299
4	2	8	16	3	12	36	432	324
8	3	24	72	4	11	44	484	253
14	4	56	224	11	10	110	1100	800
17	5	85	425	10	9	90	810	702
8	6	48	288	7	8	56	448	416
10	7	70	490	21	7	147	1029	728
11	8	88	704	15	6	90	540	438
11	9	99	891	10	5	50	250	235
6	10	60	600	5	4	20	80	112
1	11	11	121	4	3	12	36	42
1	12	12	144	2	2	4	8	12
0	13	0	0	0	1	0	0	0
0	14	0	0	2	0	0	0	0
N= 98		Σ=564	Σ=3978	N=98		Σ=698	Σ=5724	Σ=4361

Using formula 2:

$$r = \frac{4361 - \frac{(564)(698)}{98}}{\sqrt{\left(3978 - \frac{(564)^2}{98}\right)\left(5724 - \frac{(698)^2}{98}\right)}}$$

$$= \frac{4361 - 4017.1}{\sqrt{(3978 - 3245.9)(5724 - 4971.5)}} \qquad = \frac{343.9}{\sqrt{(732.1)(752.5)}}$$

$$= \frac{343.9}{\sqrt{550905.25}} \qquad = \frac{343.9}{742} \qquad = .46$$

Table 20. r for Lee and Cooperative Test Scores, eighth grade

x-axis, Lee Scores				y-axis, Cooperative Test Scores				
f	x'	fx'	fx'^{2}	f	y'	fy'	fy'^{2}	x'y'
0	0	0	0	0	14	0	0	0
0	1	0	0	5	13	65	845	663
0	2	0	0	6	12	72	864	684
1	3	3	9	6	11	66	726	550
1	4	4	16	5	10	50	500	450
1	5	5	25	4	9	36	324	279
3	6	18	108	2	8	16	128	112
3	7	21	147	1	7	7	49	56
6	8	48	384	1	6	6	36	18
10	9	90	810	2	5	10	50	60
4	10	40	400	0	4	0	0	0
3	11	33	363	1	3	3	9	12
0	12	0	0	0	2	0	0	0
1	13	13	169	0	1	0	0	0
0	14	0	0	0	0	0	0	0
N= 33		Σ=275	Σ=2431	N=33		Σ= 331	Σ=3531	Σ=2884

Using formula 2:

$$r = \frac{2884 - \frac{(275)(331)}{33}}{\sqrt{\left(2431 - \frac{(275)^2}{33}\right)\left(3531 - \frac{(331)^2}{33}\right)}}$$

$$= \frac{2884 - 2758.3}{\sqrt{(2431 - 2291.7)(3531 - 3320)}} \qquad = \frac{125.7}{\sqrt{(139.3)(211)}}$$

$$= \frac{125.7}{\sqrt{29392.30}} \qquad = \frac{125.7}{172} \qquad = .73$$

Table 21. r for Arithemetic Grades and Cooperative Scores, ninth grade

x-axis, Arithemetic Grades				y-axis, Cooperative Test Scores				
f	x'	fx'	fx'^{2}	f	y'	fY'	fy'^{2}	x'y'
0	0	0	0	0	14	0	0	0
1	1	1	1	3	13	39	507	351
0	2	0	0	3	12	36	432	372
3	3	9	27	4	11	44	484	440
0	4	0	0	11	10	110	1100	1150
19	5	95	475	10	9	90	810	828
0	6	0	0	7	8	56	448	568
17	7	119	833	21	7	147	1029	1113
0	8	0	0	15	6	90	540	714
33	9	297	2673	10	5	50	250	370
0	10	0	0	5	4	20	80	100
15	11	165	1815	4	3	12	36	90
0	12	0	0	2	2	4	8	20
9	13	117	1521	0	1	0	0	0
0	14	0	0	2	0	0	0	0
N= 98		Σ=803	Σ=7345	N=98		Σ=698	Σ=5724	Σ=6116

Using formula 2:

$$r = \frac{6116 - \frac{(803)(698)}{98}}{\sqrt{\left(7345 - \frac{(803)^2}{98}\right)\left(5724 - \frac{(698)^2}{98}\right)}}$$

$$= \frac{6116 - 5719.3}{\sqrt{(7345 - 6579.5)(5724 - 4971.4)}} = \frac{396.7}{\sqrt{(765.5)(752.6)}}$$

$$= \frac{396.7}{\sqrt{576798}} = \frac{396.7}{759} = .52$$

Table 22. r for Arithemetic Grades and Cooperative Scores, eighth grade

x-axis, Arithemetic Grades				y-axis, Cooperative Test Scores				
f	x'	fx'	fx'^2	f	y'	fy'	fy'^2	x'y'
0	0	0	0	0	14	0	0	0
0	1	0	0	5	13	65	845	767
0	2	0	0	6	12	72	864	792
0	3	0	0	6	11	66	726	638
0	4	0	0	5	10	50	500	490
0	5	0	0	4	9	36	324	324
0	6	0	0	2	8	16	128	176
3	7	21	147	1	7	7	49	63
0	8	0	0	1	6	6	36	54
17	9	153	1377	2	5	10	50	80
0	10	0	0	0	4	0	0	0
6	11	66	726	1	3	3	9	21
0	12	0	0	0	2	0	0	0
7	13	91	1183	0	1	0	0	0
0	14	0	0	0	0	0	0	0
N=33		Σ=331	Σ=3433	N=33		Σ=331	Σ=3531	Σ=3405

Using formula 2:

$$r = \frac{3405 - \frac{(331)(331)}{33}}{\sqrt{\left(3433 - \frac{(331)^2}{33}\right)\left(3531 - \frac{(331)^2}{33}\right)}}$$

$$= \frac{3405 - 3320}{\sqrt{(3433 - 3320)(3531 - 3320)}}$$

$$= \frac{85}{\sqrt{(113)(211)}}$$

$$= \frac{85}{\sqrt{23843}}$$

$$= \frac{85}{154}$$

$$= .55$$

Table 22 was used to find the r for the 8th grade for Arithemetic grades and the Cooperative Test scores which was .55.

Using the null hypothesis of no real relationship, the following was then computed:

$$S_{r_o} = .18 \text{ and so } Z = \frac{.55}{.18} = 3.06$$

Which is significant at the 1 percent level of confidence.

Lee and Pitner test scores

Table 23 yielded the correlation coefficient of .37 for the 9th grade between the Lee Test of Algebraic Ability and the Pitner Mental Ability Test.

The computation of this r value from this table is shown below:

Using formula 2:

$$r = \frac{3246 - \frac{(566)(506)}{98}}{\sqrt{(4208 - \frac{(566)^2}{98})(3428 - \frac{(506)^2}{98})}}$$

$$= \frac{3246 - 2922.4}{\sqrt{(4208 - 3268.9)(3428 - 2612.6)}}$$

$$= \frac{323.6}{\sqrt{(939.1)(815.4)}}$$

$$= \frac{323.6}{\sqrt{765742.14}}$$

$$= \frac{323.6}{875} \qquad = .37$$

The 8th grade was determined the same way, but using Table 24 instead. Some of the computation involved is found below:

Using formula 2:

$$r = \frac{2014 - \frac{(275)(232)}{33}}{\sqrt{\left(2431 - \frac{(275)^2}{33}\right)\left(1782 - \frac{(232)^2}{33}\right)}}$$

$$= \frac{2014 - 1933.3}{\sqrt{(2431 - 2291.7)(1782 - 1631)}}$$

$$= \frac{8017}{\sqrt{(139.3)(151)}}$$

$$= \frac{80.7}{\sqrt{21034.3}}$$

$$= \frac{80.7}{145}$$

$$= .56$$

Lee scores and Arithemetic grades

The correlation r, for the 9th grade was determined from Table 25 and that which follows:

Using formula 2:

$$r = \frac{4913 - \frac{(565)(803)}{98}}{\sqrt{\left(3989 - \frac{(565)^2}{98}\right)\left(7335 - \frac{(803)^2}{98}\right.}}$$

$$= \frac{4913 - 4629.5}{\sqrt{(3989 - 3257.3)(7335 - 6579.6)}}$$

$$= \frac{283.5}{\sqrt{(731.7)(755.4)}}$$

$$= \frac{283.5}{\sqrt{552726.18}}$$

$$= \frac{283.5}{743}$$

$$= .38$$

Table 23. Lee and Pitner Test Scores, ninth grade

x-axis, Lee Test Scores				y-axis, Pitner Test Scores				
f	x'	fx'	fx'^2	f	y'	fy'	fy'^2	x'y'
3	0	0	0	0	14	0	0	0
3	1	3	3	2	13	26	338	234
4	2	8	16	1	12	12	144	48
8	3	24	72	2	11	22	242	198
14	4	56	224	1	10	10	100	90
16	5	80	400	4	0	36	324	243
9	6	54	324	11	8	88	704	544
10	7	70	490	6	7	42	294	343
11	8	88	704	19	6	114	684	658
11	9	99	1089	8	5	40	200	240
5	10	50	500	16	4	64	256	364
2	11	22	242	14	3	42	126	258
1	12	12	144	3	2	6	12	16
0	13	0	0	4	1	4	4	10
0	14	0	0	6	0	0	0	0
N=98		Σ=566	Σ=4208	N=98	Σ=232	Σ=1782		Σ=2014

Table 24. Lee and Pitner Test Scores, eighth grade

x-axis, Lee Test Scores				y-axis, Pitner Test Scores				
f	x'	fx'	fx'^2	f	y'	fy'	fy'^2	x'y'
0	0	0	0	0	14	0	0	0
0	1	0	0	0	13	0	0	0
0	2	0	0	0	12	0	0	0
1	3	3	9	1	11	11	121	88
1	4	4	16	4	10	40	400	390
1	5	5	25	4	9	36	324	315
3	6	18	108	6	8	48	384	488
3	7	21	147	4	7	28	196	238
6	8	48	384	6	6	36	216	288
10	9	90	810	3	5	15	75	95
4	10	40	400	3	4	12	48	76
3	11	33	363	2	3	6	18	36
0	12	0	0	0	2	0	0	0
1	13	13	169	0	1	0	0	0
0	14	0	0	0	0	0	0	0
N= 33		Σ= 275	Σ=2431	N=33		Σ=232	Σ=1782	Σ=2014

Table 25. Lee Scores and Arithemetic Grades, ninth grade

x-axis, Lee Test Scores				y-axis, Arithemetic Grades				
f	x'	fx'	fx'^2	f	y'	fy'	fy'^2	x'y'
3	0	0	0	0	14	0	0	0
3	1	3	3	9	13	117	1521	1027
4	2	8	16	0	12	0	0	0
8	3	24	72	15	11	165	1805	957
14	4	56	224	0	10	0	0	0
16	5	80	400	33	9	297	2673	1899
9	6	54	324	0	8	0	0	0
10	7	70	490	17	7	119	833	493
11	8	88	704	0	6	0	0	0
11	9	99	891	19	5	95	475	490
6	10	60	600	0	4	0	0	0
1	11	121	121	3	3	9	27	39
1	12	12	144	0	2	0	0	0
0	13	0	0	1	1	1	1	8
0	14	0	0	0	0	0	0	0
N=98		Σ= 565	Σ=3989	N=98		Σ=803	Σ=7335	Σ=4913

The 8th grade correlation between the Lee Test and Arithemetic grades was found from Table 26 and from:

Using formula 2:

$$r = \frac{2792 - \frac{(274)(331)}{33}}{\sqrt{(2414 - \frac{(274)^2}{33})(3433 - \frac{(331)^2}{33})}}$$

$$= \frac{2792 - 2748.3}{\sqrt{(2414 - 2275)(3433 - 3320)}}$$

$$= \frac{43.7}{\sqrt{(139)(113)}}$$

$$= \frac{43.7}{\sqrt{15707}}$$

$$= \frac{43.7}{125}$$

$$= .35$$

Pitner scores and arithemetic grades

Computing the 9th grade first, Table 27 and the following work determined the correlation coefficient as:

Using formula 2:

$$r = \frac{4861 - \frac{(506)(803)}{98}}{\sqrt{\left(3428 - \frac{(506)^2}{98}\right)\left(7345 - \frac{(803)^2}{98}\right)}}$$

$$= \frac{4861 - 4146.1}{\sqrt{\left(3428 - \frac{(506)^2}{98}\right)\left(7345 - \frac{(803)^2}{98}\right)}}$$

$$= \frac{4861 - 4146.1}{\sqrt{(3428 - 2612.6)(7345 - 6579.6)}}$$

$$= \frac{714.9}{\sqrt{(815.4)(765.4)}}$$

$$= \frac{714.9}{\sqrt{624107.16}}$$

$$= \frac{714.9}{790}$$

$$= .90$$

And again, determining the correlation coefficient for the 8th grade by using Table 28 and the work below, r was found to be:

Using formula 2:

$$r = \frac{2428 - \frac{(232)(335)}{33}}{\sqrt{\left(1782 - \frac{(232)^2}{33}\right)\left(3521 - \frac{(335)^2}{33}\right)}}$$

$$= \frac{2428 - 2355.1}{\sqrt{(1782 - 1631)(3521 - 3400.7)}}$$

$$= \frac{72.9}{\sqrt{(151)(120.3)}}$$

$$= \frac{72.9}{\sqrt{18165.3}} = \frac{72.9}{135} = .54$$

Table 26. r for Lee Scores and Arithemetic Grades, eighth grade

x-axis, Lee Test Scores				y-axis, Arithemetic Grades				
f	x'	fx'	fx'^2	f	y'	fy'	fy'^2	x'y'
0	0	0	0	0	14	0	0	0
0	1	0	0	7	13	91	1183	910
0	2	0	0	0	12	0	0	0
1	3	3	9	6	11	66	726	594
1	4	4	16	0	10	0	0	0
1	5	5	25	17	9	153	1377	1169
3	6	18	108	0	8	0	0	0
3	7	21	147	3	7	21	147	119
7	8	56	448	0	6	0	0	0
9	9	81	729	0	5	0	0	0
4	10	40	400	0	4	0	0	0
3	11	33	363	0	3	0	0	0
0	12	0	0	0	2	0	0	0
1	13	13	169	0	1	0	0	0
0	14	0	0	0	0	0	0	0
N=33		Σ=274	Σ=2414	N=33		Σ=331	Σ=3433	Σ=2792

Table 27. r for Pitner Scores and Arithemetic Grades, ninth grade

x-axis, Pitner Scores				y-axis, Arithemetic Grades				
f	x'	fx'	fx'^2	f	y'	fy'	fy'^2	x'y'
6	0	0	0	0	14	0	0	0
4	1	4	4	9	13	117	1521	754
3	2	6	12	0	12	0	0	0
14	3	42	126	15	11	165	1815	880
16	4	64	256	0	10	0	0	0
8	5	40	200	33	9	297	2673	1611
19	6	114	684	0	8	0	0	0
6	7	42	294	17	7	119	833	533
11	8	88	704	0	6	0	0	0
4	9	36	324	19	5	95	475	565
1	10	10	100	0	4	0	0	0
2	11	22	242	3	3	9	27	42
1	12	12	144	0	2	0	0	0
2	13	26	338	1	1	1	1	3
0	14	0	0	0	0	0	0	0
N= 98		Σ = 506	Σ=3428	N=98		Σ=803	Σ=7345	Σ=4861

Cooperative Mathematics Test and final algebra grades

It was felt that since the Cooperative Mathematics Test was used as the measure of achievement in first year algebra that a correlation coefficient be determined between it and the final grades given to the students.

This was done for the 9th grade with Table 29 and r was computed as:

Using Table 29 and formula 2:

$$r = \frac{5695 - \frac{(695)(726)}{98}}{\sqrt{\left(5655 - \frac{(695)^2}{98}\right)\left(6265 - \frac{(726)^2}{98}\right)}}$$

$$= \frac{5695 - 5148.6}{\sqrt{(5655 - 4928.8)(6265 - 5378.3)}}$$

$$= \frac{546.4}{\sqrt{(726.2)(886.7)}}$$

$$= \frac{546.4}{\sqrt{643921.82}}$$

$$= \frac{546.4}{802}$$

$$= .68$$

And from Table 30, the 8th grade correlation was computed as:

Using formula 2:

$$r = \frac{3047 - \frac{(331)(283)}{33}}{\sqrt{\left(3531 - \frac{(331)^2}{33}\right)\left(2771 - \frac{(283)^2}{33}\right)}}$$

$$= \frac{(3047 - 2838.5}{\sqrt{(3531 - 3320)(2771 - 2426.4)}}$$

$$= \frac{208.5}{\sqrt{(211)(344.1)}}$$

$$= \frac{208.5}{\sqrt{72605.1}}$$

$$= \frac{208.5}{270}$$

$$= .77$$

Table 28. r for Pitner Scores and Arithemetic Grades, eighth grade

x-axis, Pitner Test Scores				y-axis, Arithemetic Grades				
f	x'	fx'	fx'^2	f	y'	fy'	fy'^2	x'y'
0	0	0	0	0	14	0	0	0
0	1	0	0	8	13	104	1352	845
0	2	0	0	0	12	0	0	0
2	3	6	18	6	11	66	726	561
3	4	12	48	0	10	0	0	0
3	5	15	75	16	9	144	1296	945
6	6	36	216	0	8	0	0	0
4	7	28	196	3	7	21	147	77
6	8	48	384	0	6	0	0	0
4	9	36	324	0	5	0	0	0
4	10	40	400	0	4	0	0	0
1	11	11	121	0	3	0	0	0
0	12	0	0	0	2	0	0	0
0	13	0	0	0	1	0	0	0
0	14	0	0	0	0	0	0	0
N=33		Σ = 232	Σ = 1782	N=33		Σ = 335	Σ = 3521	Σ = 2428

Table 29. r for Cooperative Mathematics Test and Algebra Grades, ninth grade

x-axis, Cooperative Mathematics Test				y-axis, Algebra Grades				
f	x'	fx'	fx'^2	f	y'	fy'	fy'^2	x'y'
2	0	0	0	0	14	0	0	0
0	1	0	0	6	13	78	1014	741
2	2	4	8	0	12	0	0	0
4	3	12	36	7	11	77	847	660
5	4	20	80	0	10	0	0	0
10	5	50	250	37	9	330	2997	2844
15	6	90	540	0	8	0	0	0
21	7	147	1029	19	7	133	931	924
7	8	56	448	0	6	0	0	0
10	9	90	810	16	5	80	400	410
12	10	120	1200	0	4	0	0	0
4	11	44	484	8	3	24	72	102
3	12	36	432	0	2	0	0	0
2	13	26	338	4	1	4	4	14
0	14	0	0	0	0	0	0	0
N = 98		Σ = 695	Σ = 5655	N = 98		Σ = 726	Σ = 6265	Σ = 5695

Multiple Correlations

In all computations with multiple correlations, the following code will be used:

1 = arithemetic grades

2 = Pitner Mental Ability Test scores

3 = Lee Test of Algebraic Ability scores

4 = Cooperative Mathematics Test

Cooperative scores with arithemetic grades and Pitner scores

To find the multiple correlation coefficient between the Cooperative Mathematics Test and the combined effects of arithemetic grades and Pitner scores, the following formula was employed for the 9th grade:

$$r_{4.12} = \sqrt{\frac{r_{41}^2 + r_{42}^2 - (2r_{41}r_{42}r_{12})}{1 - r_{12}^2}}$$

$$= \sqrt{\frac{(.52)^2 + (.22)^2 - 2(.52)(.22)(.90)}{1 - (.90)^2}}$$

$$= \sqrt{\frac{.27 + .05 - .21}{1 - .81}}$$

$$= \sqrt{\frac{.11}{.19}} \qquad = \sqrt{.58} \qquad = .76$$

Using the same formula as above, the coefficient for the 8th grade was computed as:

$$r_{4.12} = \sqrt{\frac{(.55)^2 + (.63)^2 - (2)(.55)(.63)(.54)}{1 - (.54)^2}}$$

$$= \sqrt{\frac{.30 + .40 - .37}{1 - .29}}$$

$$= \sqrt{\frac{.33}{.71}} \qquad = \sqrt{.46} \qquad = .68$$

Table 30. r for Cooperative Test Scores and Algebra Grades, eighth grade

x-axis, Cooperative Mathematics Test				y-axis, Algebra Grades				
f	x'	fx'	fx'^{2}	f	y'	fy'	fy'^{2}	x'y'
0	0	0	0	0	14	0	0	0
0	1	0	0	7	13	91	1183	1131
0	2	0	0	0	12	0	0	0
1	3	3	9	4	11	44	484	506
0	4	0	0	0	10	0	0	0
2	5	10	50	8	9	72	648	774
1	6	6	36	0	8	0	0	0
1	7	7	49	5	7	35	245	329
2	8	16	128	0	6	0	0	0
4	9	36	324	7	5	35	175	280
5	10	50	500	0	4	0	0	0
6	11	66	726	2	3	6	36	27
6	12	72	864	0	2	0	0	0
5	13	65	845	0	1	0	0	0
0	14	0	0	0	0	0	0	0
N=33		Σ = 331	Σ=3531	N=33		Σ = 283	Σ = 2771	Σ=3047

Cooperative scores with arithemetic grades and Lee scores

The correlation between the Cooperative Mathematics Test and the combined effects of arithemetic grades and Lee Test scores for the 9th grade was found as follows:

$$r_{4.13} = \sqrt{\frac{r_{41}^2 + r_{43}^2 - (2r_{41}r_{43}r_{13})}{1 - r_{13}^2}}$$

$$= \sqrt{\frac{(.52)^2 + (.46)^2 - 2(.52)(.46)(.38)}{1 - (.38)^2}}$$

$$= \sqrt{\frac{.27 + .21 - .19}{1 - .14}}$$

$$= \sqrt{\frac{.29}{.86}} = \sqrt{.34} = .59$$

And for the 8th grade the same formula was used:

$$r_{4.13} = \sqrt{\frac{(.55)^2 + (.73)^2 - 2(.55)(.73)(.35)}{1 - (.35)^2}}$$

$$= \sqrt{\frac{.30 + .53 - .28}{1 - .12}}$$

$$= \sqrt{\frac{.55}{.88}} \quad = \sqrt{.63} \quad = .79$$

<u>Cooperative scores with Pitner and Lee scores</u>

The multiple correlation coefficient for the 9th grade comparing the Cooperative Mathematics Test and the combined effects of the Pitner Mental Ability Test and the Lee Test of Algebraic Ability was found to be:

$$r_{4.23} = \sqrt{\frac{r_{42}^2 + r_{43}^2 - (2r_{42}r_{43}r_{23})}{1 - r_{23}^2}}$$

$$= \sqrt{\frac{(.22)^2 + (.46)^2 - 2(.22)(.46)(.37)}{1 - (.37)^2}}$$

$$= \sqrt{\frac{.05 + .21 - .07}{1 - .14}}$$

$$= \sqrt{\frac{.19}{.86}} \quad = \sqrt{.22} \quad = .47$$

And for the 8th grade with the same formula:

$$r_{4.23} = \sqrt{\frac{(.63)^2 + (.73)^2 - 2(.63)(.73)(.56)}{1 - (.56)^2}}$$

$$= \sqrt{\frac{.40 + .53 - .52}{1 - .31}}$$

$$= \sqrt{\frac{.41}{.69}} \quad = \sqrt{.59} \quad = .77$$

SUMMARY

From the statistical evidence gathered and the impressions this writer gained as the teacher of the subjects in this study, the following information seems to summarize the results and conclusions of this work.

Taking two groups, one composed of 9th graders and the other of 8th graders with the same mental ability potential, the 8th grade students will tend to demonstrate more success in a first year algebra course than their counterparts in the 9th grade, based on an achievement test.

Also, the best prediction of success, combining both groups together, seems to be found by combining the Pitner scores and arithemetic grades which gives an r of .72 and an r^2 of .52 for predictive purposes. Closely following this combination of predictors is an r of .69 and an r^2 of .48 for the Lee scores and arithemetic grades, then an r of .62 and r^2 of .38 for the combination of Pitner and Lee scores.

The single predictors tested seem to be fairly reliable, by themselves even, as predictors of algebraic success. The Lee Test of Algebraic Ability had a correlation of .60 (r^2 of .36) for the 9th and 8th grades combined. Arithemetic grades followed with a correlation coefficient of .54 (r^2 of .29) and the poorest predictor was the Pitner scores taken alone, which gave an r of .43 and an r^2 of .18.

Certain limitations seemed to be significant to this writer. The most serious of which seemed to be the subjects themselves.

The 9th grade students involved in the study had a mean on the Pitner Mental Ability Test which was statistically the same as the 8th grade mean. Also, this 9th grade group had the same mean, statistically, as did the previous years 9th grade on the Pitner Test.

Unfortunately, the similarity ends here. This 9th grade subject group could probably best be described as "under achievers" as the correlation of their Pitner scores with algebra grades and achievement indicates. Another indicator of this is the significantly lower grade point average of the 9th grade than that of the 8th grade.

In order to form enough 9th grade algebra classes this year, students who normally wouldn't have been allowed to take algebra because of their past arithemetic grades and overall academic achievement, were allowed to register for the class based on their potential alone.

This writer feels that a more accurate comparison of the two groups could be achieved if the same high quality of student that existed in the 8th grade algebra class would be maintained in the 9th grade classes.

CONCLUSIONS

According to the Pitner Mental Ability scores, there was no significant difference, as far as "I. Q." was concerned, between the two groups. The 9th grade's mean was 120.7 and the 8th grade had a mean of 122.5. The Lee Test of Algebraic Ability showed that the 9th grade had a mean of 108.5 on this test, and the 8th grade had a mean of 123.8, a difference significant at the 1 percent level.

The arithemetic grades means for the two groups also showed a significant difference of 2.8 and 3.3 for the 9th and 8th grades, respectively.

This difference indicated to this writer that both groups had the same general ability as measured by the Pitner test, yet the 8th grade students demonstrated more algebraic aptitude and a better foundation as recorded by a higher grade point average than did the 9th grade. This aspect was discussed at greater length in the preceding section.

The conclusion drawn from the significant differences of the means of the 9th and 8th grades of 56.7 and 68.5 for the Cooperative Mathematics Test (the achievement test) seems to indicate that the 8th grade students did experience better success at mastering the concepts of first year algebra at Clayton Junior High School.

With regards to the second objective of this study, i.e., predicting success in first year algebra, the 9th and 8th grades were separated and studied individually. For the 9th grade, the Pitner scores had a correlation coefficient of only .22 (significant at the 5 percent level) with the Cooperative Mathematics Test, which seems to be a poor single predictor of success in the 9th grade. But when the Pitner scores were combined with the arithemetic grades and a multiple correlation was computed, the coefficient was raised to .76, which was the best prediction of success discovered by this writer for the 9th grade.

The best single predictor of success for the 9th graders was the arithemetic grades with an r coefficient of .52, followed by the Lee scores with an r of .46.

As previously stated, the best combination of predictors was the Pitner scores and the arithemetic grades at .76 and followed, not too closely, by the combination of Lee scores and arithemetic grades at .59 and then finally the Pitner and Lee combination at .47.

Since the Cooperative Mathematics Test was used to measure success, a correlation coefficient was determined for this test and the grades given in the algebra classes. For the 9th grade, this correlation coefficient was .68, which indicates that this test does quite well in measuring achievement.

For the 8th grade, the single predictors are listed again, and for convenience, in descending order according to their correlation coefficients. Highest was an r of .73 for the Lee scores and Cooperative Mathematics Test, followed by the Pitner scores at .63 and next by the Lee scores at .55.

The multiple correlations gave better predictors as witnessed by the following review of statistical evidence:

r for Lee and arithemetic grades	- .79
r for Pitner and Lee	- .77
r for Pitner and grades	- .68

The correlation coefficient determined for the 8th grade to test the validity of using the Cooperative Mathematics Test as an indicator of success was computed with the final algebra grades to be .77, which again indicates that it is a good choice for an achievement test.

LITERATURE CITED

Baker, R. R. 1962. Program provisions in Michigan junior high schools for superior students in mathematics. Mathematics Teacher 55:556-559.

Baraket, M. K. 1951. A factorial study of mathematics abilities. British Journal of Psychology (Statistical Section) 4:137-156.

Bending, A. W. and Hughes, J. B. 1954. Student attitude and achievement in a course in introductory statistics. Journal of Educational Psychology 45:268-276.

Brown, K. E. and Abell, T. L. 1966. Research in the teaching of high school mathematics; what factors influence mathematics achievement? Mathematics Teacher 59:55.

Bruner, Jerome S. 1960. On learning mathematics. Mathematics Teacher 53:610-619.

Burnes, W. E. and Asher, J. W. 1962. Predicting students' success in first year algebra. Mathematics Teacher 55:651-654.

Callicutt, W. 1961. Problem of predicting success in algebra. National Association of Secondary School Principals Bulletin 45:107-111.

Coleman, Ralph H. 1956. An analysis of certain components of mathematical ability, and an attempt to predict mathematical achievement in a specific situation. Unpublished Ph. D. dissertation, Indiana University, Bloomington, Indiana.

Corley, Glyn Jackson. 1958. An experiment in teaching logical thinking and demonstrative geometry in grades six through ten. Unpublished Ph. D. dissertation. George Peabody College for Teachers, Nashville, Tennessee.

Christantiello, P. D. 1961. Attitude toward mathematics and the predictive validity of a measure of quantitative aptitude. Journal of Educational Research 55:184-186.

Davydov, V. V. 1962. Experiment in introducing elements of algebra in elementary school. Soviet Education 5:27-37.

Dessart, D. J. 1964. Mathematics in the secondary school; evolution of curriculum or trends. Review of Educational Research 34:298-300.

Duncan, Roger Lee. 1960. The prediction of success in eighth grade algebra. Unpublished Ph. D. dissertation. University of Oklahoma, Norman, Oklahoma.

Frieson, Edwin J. 1960. A comparative study of the achievement of eighth-grade and ninth-grade algebra pupils in the Wichita Intermediate Schools. Unpublished Ph. D. dissertation. University of Kansas, Lawrence, Kansas.

Fowler, H. S. 1961. Algebra I: eighth grade or ninth grade? School Science and Mathematics 61:699-700.

Guilford, J. R. and others. 1965. Predicting achievement in ninth-grade mathematics from measures of intellectual-aptitude factors. Educational and Psychological Measures 25:659-682.

Hegstrom, I. W. J. and Riffle, D. E. 1963. Two year study of eighth grade algebra. Mathematics Teacher 56:419-423.

Osburn, H. G. and Melton, R. S. 1963. Prediction of proficiency in a modern traditional course in beginning algebra. Educational and Psychological Measures 23:277-287.

Pauley, B. G. 1961. Evaluation of a secondary school mathematics program for able pupils. Mathematics Teacher 54:324-332.

Ropp, D. B. 1963. Accelerated mathematics program in a small school system; Stillman Valley Schools. Illinois Education 51:296-297.

Schaaf, W. L. 1965. Scientific concepts in the junior high school mathematics curriculum. School Science and Mathematics 65:614-625.

Sommerfeld, R. E. and Tracy, N. H. 1963. Study of selected predictors of success in second-year algebra in high school. High School Journal 46:234-240.

APPENDIX

Table 31. Raw scores, ninth grade

Name	Lee	Pitner	Arith.	Alge.	CMT	Name	Lee	Pitner	Arith.	Alge.	CMT
R.B.	72.8	112	2.5	1.0	47	D.C.	88.3	116	2.5	2.0	53
S.C.	96.7	115	1.5	2.5	58	C.C.	86.1	128	2.5	2.5	53
J.D.	113.1	129	2.0	2.5	63	J.F.	97.5	123	2.0	3.0	53
S.G.	105.8	113	3.5	2.5	61	B.H.	133.0	115	4.0	3.0	63
G.H.	129.8	125	3.5	3.5	74	P.J.	142.9	150	3.0	3.0	68
C.M.	128.7	125	4.0	4.0	79	S.M.	116.1	109	4.0	3.0	76
G.M.	125.0	110	1.0	1.5	45	R.R.	91.1	128	2.0	1.5	55
M.S.	101.2	120	3.0	2.0	42	D.S.	133.5	114	3.0	3.0	68
J.T.	101.7	145	2.5	3.0	68	R.W.	106.3	123	3.0	2.5	71
D.W.	129.9	120	4.0	4.0	68	D.B.	99.8	120	3.5	2.0	53
B.B.	101.1	112	2.5	3.0	45	V.C.	94.8	122	3.0	2.0	45
D.D.	133.4	141	4.0	4.0	68	P.F.	116.0	113	3.0	3.0	58
J.H.	87.4	107	2.5	3.0	55	A.H.	118.4	133	2.0	2.5	63
K.L.	94.6	97	3.0	3.0	68	S.S.	129.0	127	3.0	3.0	61
J.S.	120.0	122	3.0	3.0	58	J.S.	108.5	122	3.0	2.0	58
P.T.	78.2	102	2.5	2.0	42	C.W.	98.4	111	3.0	2.0	53
P.B.	106.5	125	1.5	1.5	45	D.D.	88.2	97	2.0	1.0	37
C.G.	115.9	117	2.5	3.0	63	B.H.	95.5	129	2.5	3.0	58
F.H.	114.6	125	3.0	2.0	53	D.H.	122.7	128	3.5	3.5	47
S.H.	127.8	110	3.5	4.0	63	J.L.	120.6	120	3.0	2.5	50
B.L.	104.2	111	2.0	2.0	42	B.M.	110.3	110	3.0	2.5	61
D.M.	83.2	106	2.5	2.5	55	R.N.	95.4	99	2.5	3.0	47
R.O.	122.0	109	2.5	2.0	55	J.P.	121.4	140	4.0	4.0	61
R.Y.	76.1	100	3.0	3.0	58	p.r.	125.0	110	3.0	3.0	63
J.S.	128.1	112	3.0	2.5	47	G.S.	105.1	105	3.0	2.5	55
D.S.	109.4	103	2.0	3.5	82	G.W.	116.9	130	3.0	2.0	53
D.W.	104.2	110	3.0	2.0	42	B.W.	119.4	149	3.0	2.5	58
J.B.	110.9	122	3.0	3.0	68	S.B.	104.0	120	3.5	3.0	71
K.C.	106.7	122	2.0	2.5	55	J.K.	108.2	118	3.5	2.5	58
B.M.	93.6	96	3.0	2.0	50	K.N.	114.0	114	2.0	2.5	50
J.S.	97.5	122	3.5	3.0	55	M.W.	121.2	119	2.0	1.5	45
C.C.	80.1	96	3.0	2.5	47	T.C.	125.1	123	3.0	3.0	79
S.C.	94.8	109	2.0	1.5	53	M.G.	123.5	132	3.0	3.0	76
F.L.	145.5	112	3.0	3.0	76	J.L.	134.5	127	3.0	3.0	61
R.L.	131.1	136	2.0	1.5	55	R.M.	131.6	131	4.0	4.0	68
R.P.	98.5	120	3.0	3.0	71	C.W.	108.7	110	2.0	1.0	29
K.A.	99.4	111	2.0	1.5	37	D.B.	110.0	132	3.0	3.0	66
M.B.	94.3	113	2.0	1.5	27	J.B.	115.7	97	4.0	3.0	53
J.B.	126.5	128	3.0	3.5	61	C.B.	125.4	116	3.0	3.0	63
D.C.	120.9	121	3.5	3.0	68	S.D.	133.9	128	4.0	3.0	63
L.D.	98.6	102	3.5	3.5	53	A.F.	105.8	115	3.5	3.5	68
T.H.	82.6	114	2.0	1.0	58	W.H.	107.2	115	2.5	3.0	53
J.I.	106.1	130	3.5	3.0	68	K.K.	102.5	131	3.0	3.0	55
L.N.	98.5	121	2.5	2.5	53	J.P.	104.8	114	2.0	2.0	53
C.P.	128.1	118	2.5	3.5	58	S.P.	108.9	133	2.0	3.0	47
L.R.	127.6	110	2.0	2.5	58	C.S.	106.0	115	2.5	2.0	53
C.S.	133.3	121	2.5	2.5	53	S.T.	115.1	123	3.5	3.0	66
A.V.	108.2	117	3.5	3.0	61	D.W.	99.0	109	1.5	2.0	47
K.W.	97.7	116	3.5	3.0	55						

Table 32. Raw scores, eighth grade

Name	Lee	Pitner	Arith.	Alge.	CMT	Name	Lee	Pitner	Arith.	Alge.	CMT
D.B.	122.7	128	3.0	2.0	61	W.C.	130.6	136	3.0	2.0	68
D.C.	120.9	125	3.0	2.0	55	R.C.	132.6	137	3.5	3.5	76
D.D.	111.4	112	3.0	2.5	66	R.H.	92.4	119	3.0	1.5	53
S.H.	131.7	128	3.0	3.0	66	J.K.	132.9	125	3.0	3.0	68
J.M.	111.2	112	2.5	3.0	71	S.M.	136.1	128	4.0	4.0	74
J.M.	132.0	121	3.0	3.5	76	D.R.	139.4	121	4.0	3.5	68
B.T.	128.3	137	3.0	2.5	71	K.T.	130.2	124	3.5	4.0	82
B.W.	129.7	117	3.0	3.0	63	H.W.	117.7	112	2.5	2.0	47
D.W.	155.5	129	4.0	4.0	79	A.A.	122.8	132	3.5	2.0	74
C.C.	123.4	109	3.0	2.5	68	K.C.	112.2	123	4.0	2.5	61
J.D.	131.9	132	3.0	3.0	74	B.D.	133.4	131	4.0	3.0	76
P.E.	130.8	134	3.0	3.0	84	G.C.	141.1	130	3.5	3.5	76
J.H.	120.7	140	3.5	4.0	76	M.H.	121.5	120	3.0	3.0	71
L.L.	119.0	118	3.0	2.5	63	m.m.	131.2	132	4.0	4.0	82
S.N.	119.9	125	3.0	2.0	68	S.R.	107.0	120	3.0	2.0	47
C.W.	141.2	139	4.0	4.0	79	A.W.	102.3	110	2.5	1.5	42
A.W.	127.3	120	3.5	4.0	76						

VITA

Steven Spencer Terry

Candidate for the Degree of

Master of Education

Report: A Comparative Study of Eighth and Ninth Grade Algebra Students at Clayton Junior High School

Major Field: Secondary School Teaching

Biographical Information:

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Education: Attended elementary school in Lennox, California; graduated from Big Bear High School in 1960; received Bachelor of Science degree from Utah State University, with a major in mathematics, in 1964; completed requirements for the Master of Education degree, specializing in mathematics, at Utah State University, in 1967.

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