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

Steven Spencer Terry

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A COMPARATIVE STUDY OF 8TH AND 9TH GRADE ALGEBRA
STUDENTS AT CLAYTON JUNIOR HIGH SCHOOL
                        by
                Steven Spencer Terry
A seminar report submitted in partial fulfillment
        of the requirements for the degree
                        of
        MASTER OF EDUCATION
            in
            Secondary School Teaching
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INTRODUCTION ..... 1
Origin and Nature of Problem ..... 1
Objectives ..... 2
REVIEW OF LITERATURE ..... 3
Pupil Readiness ..... 3
Differences in Achievement ..... 5
Studies done ..... 5
Results and conclusions of studies ..... 8
Predictors of Success ..... 10
PROCEDURE ..... 13
RESULTS ..... 14
Differences in Means ..... 14
Pitner test scores ..... 14
Lee test scores ..... 17
Arithemetic grades ..... 20
Cooperative achievement test scores ..... 20
Correlations ..... 25
Pitner and Cooperative scores ..... 25
Lee and Cooperative scores ..... 29
Arithemetic grades and Cooperative scores ..... 29
Lee and Pitner test scores ..... 34
Lee scores and Arithemetic grades ..... 35
Pitner scores and arithemetic grades ..... 38
Cooperative Mathematics Test and final algebra grades ..... 40
Multiple Correlations ..... 42
Cooperative scores with arithemetic grades and Pitner scores ..... 42
Cooperative scores with arithemetic grades and Lee scores ..... 43
Cooperative scores with Pitner and Lee scores ..... 44

## TABLE OF CONTENTS (Continued)

Page
SUMMARY ..... 45
CONCLUSIONS ..... 47
LITERATURE CITED ..... 50
APPENDIX ..... 52
VITA ..... 55

## LIST OF TABLES

Table
Page

1. Mean, median, and mode of Pitner Test Scores, ninth grade . ..... 15
2. Mean, median, and mode of Pitner Test Scores, eighth grade ..... 15
3. Standard deviation of Pitner Scores, ninth grade ..... 16
4. Standard deviation of Pitner Scores, eighth grade ..... 16
5. Mean, median, and mode of Lee Ability Scores, ninth grade . ..... 18
6. Mean, median, and mode of Lee Ability Scores, eighth grade ..... 18
7. Standard deviation of Lee Ability Scores, ninth grade ..... 19
8. Standard deviation of Lee Ability Scores, eighth grade . ..... 19
9. Mean, median, and mode of arithemetic grades, ninth grade . ..... 22
10. Mean, median, and mode of arithemetic grades, eighth grade ..... 22
11. Standard deviation of arithemetic grades, ninth grade ..... 22
12. Standard deviation of arithemetic grades, eighth grade ..... 23
13. Mean, median, and mode for Cooperative Test Scores, ninth grade ..... 23
14. Mean, median, and mode for Cooperative Test Scores, eighth grade ..... 24
15. Standard deviation of Cooperative Scores, ninth grade ..... 24
16. Standard deviation of Cooperative Scores, eighth grade ..... 25
17. $r$ for Pitner and Cooperative Test Scores, ninth grade ..... 26
18. $r$ for Pitner and Cooperative Test Scores, eighth grade ..... 28
19. I for Lee and Cooperative Test Scores, ninth grade ..... 30
20. $r$ for Lee and Cooperative Test Scores, eighth grade ..... 31
21. $r$ for Arithemetic Grades and Cooperative Scores, ninth grade ..... 32
22. $r$ for Arithemetic Grades and Cooperative Scores, eighth grade ..... 33
23. Lee and Pitner Test Scores, ninth grade ..... 36

## LIST OF TABLES (Continued)

Table Page
24. Lee and Pitner Test Scores, eighth grade ..... 36
25. Lee Scores and Arithemetic Grades, ninth grade ..... 37
26. r for Lee Scores and Arithemetic Grades, eighth grade ..... 39
27. $r$ for Pitner Scores and Arithemetic Grades, ninth grade ..... 39
28. $r$ for Pitner Scores and Arithemetic Grades, eighth grade ..... 41
29. I for Cooperative Mathematics Test and Algebra Grades, ninth grade ..... 41
30. $r$ for Cooperative Test Scores and Algebra Grades, eighth grade ..... 43
31. Raw scores, ninth grade ..... 53
32. Raw scores, eighth grade ..... 54

## 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 "nonintellectual" 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, l961). 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 seventhyear 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 pretest 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 camparisons 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 Arher (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 8 th 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 9 th grade mean and $S_{x_{8}}$ is the standard error of the 8th grade mean, the following was obtained:

$$
\begin{aligned}
& s_{x_{9}}=\frac{s_{9}}{\sqrt{N_{9}}} \\
& s_{x_{8}}=\frac{S_{8}}{\sqrt{N_{8}}} \\
& =\frac{11.6}{\sqrt{98}} \\
& =\frac{11.6}{9.90} \\
& =\frac{8.7}{\sqrt{33}} \\
& =\frac{8.7}{5.74} \\
& =1.17 \\
& =1.51
\end{aligned}
$$

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

| Scores | £ | $x^{\prime}$ | fx' |  |
| :---: | :---: | :---: | :---: | :---: |
| 148-151 | 2 | 7 | 14 | $\overline{\mathrm{X}}=\mathrm{M}^{\prime}+\underline{\underline{\prime}} \mathrm{X}^{\prime}$ |
| 144-147 | 1 | 6 | 6 | N |
| 140-143 | 2 | 5 | 10 |  |
| 136-139 | 1 | 4 | 4 | $=121.5+\underline{-82}$ |
| 132-135 | 4 | 3 | 12 | 98 |
| 128-131 | 11 | 2 | 22 |  |
| 124-127 | 6 | 1 | 6 | $=121.5-.84$ |
| 120-123 | 20 | 0 | 0 |  |
| 116-119 | 8 | -1 | -8 | $=120.7$ |
| 112-115 | 16 | -2 | -32 |  |
| 108-111 | 14 | -3 | -42 | Median $=115.5+2.5$ |
| 104-107 | 3 | -4 | -12 |  |
| 100-103 | 4 | -5 | -20 | $=118$ |
| 96-99 | 7 | -6 | -42 |  |
| $\mathrm{N}=98$ |  | $\Sigma=$ |  |  |
| Mean - 120.7 |  | Med | - 118 | - 121.5 |

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

| Scores | £ | $\mathrm{x}^{\prime}$ | fx' |  |
| :---: | :---: | :---: | :---: | :---: |
| 148-151 | 0 | 7 |  | $\bar{X}=M^{\prime}+\underline{\Sigma f X^{\prime}}$ |
| 144-147 | 0 | 6 | 0 | N |
| 140-143 | 1 | 5 | 5 |  |
| 136-139 | 4 | 4 | 16 | $=121.5+34$ |
| 132-135 | 4 | 3 | 12 | 33 |
| 128-131 | 6 | 2 | 12 |  |
| 124-127 | 4 | 1 | 4 | $=121.5+1.03$ |
| 120-123 | 6 | 0 | 0 |  |
| 116-119 | 3 | -1 | -3 | $=122.5$ |
| 112-115 | 3 | -2 | -6 |  |
| 108-111 | 2 | -3 | -6 | Median $=123.5+2.5$ |
| 104-107 | 0 | -4 | 0 |  |
| 100-103 | 0 | -5 | 0 | $=126$ |
| 96-99 | 0 | -6 | 0 |  |
| $\mathrm{N}=33$ |  | $\Sigma=$ |  |  |
| Mean - 122.5 |  | Med | - 126 | 121.5 and 129.5 |

Table 3. Standard deviation of Pitner Scores, ninth grade


Table 4. Standard deviation of Pitner Scores, eighth grade

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: $Z=D_{X}$ where $D_{x}$ is the difference between the means. So $Z$ is found by:

$$
\mathrm{z}=\frac{\mathrm{x}_{8}-\mathrm{x}_{9}}{S_{D_{\mathrm{x}}}}=\underline{122.5-120.7}=\frac{1.8}{1.91}=0.94
$$

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 8 th 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:

$$
\begin{aligned}
S_{x_{9}} & =\frac{S_{9}}{\sqrt{N_{9}}} & S_{x_{8}} & =\frac{S_{8}}{\sqrt{N_{8}}} \\
& =\frac{16.4}{\sqrt{98}} & & =\frac{12.5}{\sqrt{33}} \\
& =\frac{16.4}{9.9} & & =\frac{12.5}{5.74} \\
& =1.65 & & =2.17
\end{aligned}
$$

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 | $\mathrm{x}^{\prime \prime}$ | fx' |  |
| :---: | :---: | :---: | :---: | :---: |
| 151-156 | 0 | 9 | 0 | $\bar{X}=M^{\prime \prime}+\Sigma \mathrm{EX}^{\prime \prime}$ |
| 145-150 | 1 | 8 | 8 | N |
| 139-144 | 1 | 7 | 7 |  |
| 139-144 | 1 | 7 | 7 | $=99.5+173$ |
| 133-138 | 6 | 6 | 36 | 98 |
| 127-132 | 11 | 5 | 55 |  |
| 121-126 | 11 | 4 | 44 | $=101.3$ |
| 115-120 | 10 | 3 | 30 |  |
| 109-114 | 9 | 2 | 18 | Median $=108.5$ |
| 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 |  |

$N=98 \quad \Sigma=173$
Mean - 101.3 Median - 108.5 Mode - 99.5

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

| Scores | f | $x^{\prime \prime}$ | fx' |  |
| :---: | :---: | :---: | :---: | :---: |
| 151-156 | 1 | 5 | 5 | $\bar{X}=M^{\prime}+\Sigma f x^{\prime}$ |
| 145-150 | 0 | 4 | 0 | N |
| 139-144 | 3 | 3 | 9 |  |
| 133-138 | 4 | 2 | 8 | $=123.5+11$ |
| 127-132 | 10 | 1 | 10 | 33 |
| 121-126 | 6 | 0 | 0 |  |
| 115-120 | 3 | -1 | -3 | $=123.5+.3$ |
| 109-114 | 3 | -2 | -6 |  |
| 103-108 | 1 | -3 | -3 | $=123.8$ |
| 97-102 | 1 | -4 | -4 |  |
| 91-96 | 1 | -5 | -5 | Median $=126.5+.9$ |
| 85-90 | 0 | -6 | 0 |  |
| 79-84 | 0 | -7 | 0 | $=127.4$ |
| 73-78 | - | -8 | 0 |  |
| $\mathrm{N}=33$ |  |  | $\Sigma=11$ |  |
| Mean - 123.8 |  | Med | - 127.4 | - 129.5 |

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

| Scores | f | $\mathrm{x}^{\prime}$ | fx' | $\mathrm{fx}^{2}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 151-156 | 0 | 9 | 0 | 0 | $x^{2}=i^{2}\left(\Sigma f x^{\prime} 2-{\left.\left.\underline{\left(\Sigma f x^{\prime}\right.}\right)^{2}\right)}^{\prime}\right.$ |
| 145-150 | 1 | 8 | 8 | 64 | N |
| 139-144 | 1 | 7 | 7 | 49 |  |
| 133-138 | 6 | 6 | 36 | 216 | $=36(1029-\underline{29929)}$ |
| 127-132 | 11 | 5 | 55 | 275 | 98 |
| 121-126 | 11 | 4 | 44 | 176 |  |
| 115-120 | 10 | 3 | 30 | 90 | $=36(1029-305.4)$ |
| 109-114 | 9 | 2 | 18 | 36 |  |
| 103-108 | 15 | 1 | 15 | 15 | $=36(723.6)=26049.6$ |
| 97-102 | 15 | 0 | 0 | 0 |  |
| 91-96 | 8 | -1 | -8 | 8 | $S=\sqrt{x^{2}}=\sqrt{26049.6}$ |
| 85-90 | 4 | -2 | -8 | 16 | N-1 97 |
| 79-84 | 4 | -3 | -12 | 36 |  |
| 73-78 | 3 | -4 | -12 | 48 | $=\sqrt{268.55} \neq \sqrt{16.4}$ |
| $\begin{aligned} & \mathrm{N}=98 \\ & \mathrm{~S}=16.4 \end{aligned}$ |  |  | 173 | $=1029$ |  |

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

| Scores | f | $\mathrm{X}^{\prime}$ | $f x^{\prime}$ | fx' ${ }^{2}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 151-156 | 1 | 5 | 5 | 25 | $\mathrm{X}^{2}=i^{2}\left(\Sigma \mathrm{fx}^{\prime 2}=\left(\Sigma \mathrm{f} \mathrm{x}^{\prime}\right)^{2}\right)$ |
| 145-150 | 0 | 4 | 0 | 0 | N |
| 139-144 | 3 | 3 | 9 | 27 |  |
| 133-138 | 4 | 2 | 8 | 16 | $=36(143-121)$ |
| 127-132 | 10 | 1 | 10 | 10 | 33 |
| 121-126 | 6 | 0 | 0 | 0 |  |
| 115-120 | 3 | -1 | -3 | 3 | $=36(143-3.7)$ |
| 109-114 | 3 | -2 | -6 | 12 |  |
| 103-108 | 1 | -3 | -3 | 9 | $=36(139.3)=5014.8$ |
| 97-102 | 1 | -4 | -4 | 16 |  |
| 91-96 | 1 | -5 | -5 | 25 | $S=\sqrt{x^{2}}=\sqrt{5014.8}$ |
| 85-90 | 0 | -6 | 0 | 0 | N-1 32 |
| 79-84 | 0 | -7 | 0 | 0 |  |
| 73-78 | 0 | -8 | 0 | 0 | $=\sqrt{156.71}=12.5$ |
| $\begin{aligned} & \mathrm{N}=33 \\ & \mathrm{~S}=12.5 \end{aligned}$ |  |  | 1 | $=143$ |  |

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 9 th grade Lee scores and the 8 th 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:

$$
\begin{aligned}
S_{x_{9}} & =\frac{S_{9}}{\sqrt{N_{9}}} & S_{x_{8}} & =\frac{S_{8}}{\sqrt{N_{8}}} \\
& =\frac{.68}{\sqrt{98}} & & =\frac{.47}{\sqrt{33}} \\
& =\frac{.68}{9.9} & & =\frac{.47}{5.74} \\
& =.07 & & =.08
\end{aligned}
$$

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:

$$
\mathrm{z}=\frac{\mathrm{x}_{8}-\mathrm{x}_{9}}{\mathrm{~S}_{\mathrm{D}_{\mathrm{x}}}}=\frac{3.3-2.8}{.11}=\frac{.5}{.11}=4.54
$$

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 9 th 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 $9 t h$ and $8 t h$ 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:

$$
\begin{aligned}
S_{x_{9}} & =\frac{S_{9}}{\overline{N_{9}}} & S_{x_{8}} & =\frac{S_{8}}{\sqrt{N_{8}}} \\
& =\frac{10.8}{\sqrt{98}} & & =\frac{10.3}{\overline{33}} \\
& =\frac{10.8}{9.9} & & =\frac{10.3}{5.74} \\
& =1.09 & & 1.79
\end{aligned}
$$

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

$$
\begin{aligned}
S_{D_{x}} & =\sqrt{S_{X}^{2}+S_{x}^{2}}=\sqrt{1.09^{2}+1.79^{2}}=\sqrt{1.1881+3.2041} \\
& =\sqrt{4.3922}=2.10
\end{aligned}
$$

Now again changing this standard error into standard scores:

$$
\begin{aligned}
z & =\frac{68.5-56.7}{2.10} \\
& =\frac{11.8}{2.10} \\
& =5.62
\end{aligned}
$$

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 | $x^{\prime}$ | fx' |  |
| :---: | :---: | :---: | :---: | :---: |
| 4.0 | 9 | 3 | 27 | $\bar{X}=M^{\prime}+\underline{\underline{E} X^{\prime}}$ |
| 3.5 | 15 | 2 | 30 | N |
| 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 |  |
| $\begin{aligned} & N=98 \\ & \text { Mean }-2.8 \end{aligned}$ |  | $\Sigma=60$ |  |  |
|  |  | Med | $-3.0$ | 3.0 |

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

| Scores | f | $\mathrm{x}^{\prime}$ | fx' |  |
| :---: | :---: | :---: | :---: | :---: |
| 4.0 | 7 | 2 | 14 | $X=M^{\prime}+\Sigma \underline{I X}^{\prime}$ |
| 3.5 | 6 | 1 | 6 | N |
| 3.0 | 17 | 0 | 0 |  |
| 2.5 | 3 | -1 | -3 | $=3.0+.3=3.3$ |
| $\begin{aligned} & N=33 \\ & \text { Mean }-3.3 \end{aligned}$ |  | $\Sigma=17$ |  |  |
|  |  |  | - 3.0 | 3.0 |

Table 11. Standard deviation of arithemetic grades, ninth grade
Scores $f \quad x \quad x^{2} \quad \mathrm{fx}^{2}$

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

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

Table 12. Standard deviation of arithemetic grades, eighth grade


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


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

| Scores | f | $\mathrm{x}^{\prime}$ | fx' |  |
| :---: | :---: | :---: | :---: | :---: |
| 79-82 | 5 | 3 | 15 | $X=M^{\prime}+\underline{\underline{f} x^{\prime}}$ |
| 75-78 | 6 | 2 | 12 | N |
| 71-74 | 6 | 1 | 6 |  |
| 67-70 | 5 | 0 | 0 | $=68.5+\frac{1}{33}$ |
| 63-66 | 4 | -1 | -4 | 33 |
| 59-62 | 2 | -2 | -4 |  |
| 55-58 | 1 | -3 | -3 | $=68.5+.03$ |
| 51-54 | 1 | -4 | -4 |  |
| 47-50 | 2 | -5 | -10 | $=68.5$ |
| 43-46 | 0 | -6 | 0 |  |
| 39-42 | 1 | -7 | -7 | Median $=70.5+.33$ |
|  |  |  |  | $=70.8$ |
| $\mathrm{N}=33$ |  |  |  |  |
| Mean - 68.5 |  | Median - 70.8 |  | Mode - 72.5 and 76.5 |

Table 15. Standard deviation of Cooperative Scores, ninth grade

| Scores | f | $\mathrm{x}^{\prime}$ | fx' | $\mathrm{fx}^{\prime}{ }^{2}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 79-82 | 3 | 6 | 18 | 108 | $x^{2}=16(704-400)$ |
| 75-78 | 3 | 5 | 15 | 75 | 98 |
| 71-74 | 4 | 4 | 16 | 64 |  |
| 67-70 | 11 | 3 | 33 | 99 | $=16(704-4.1)$ |
| 63-66 | 10 | 2 | 20 | 40 |  |
| 59-62 | 7 | 1 | 7 | 7 | $=16(699.9)$ |
| 55-58 | 21 | 0 | 0 | 0 |  |
| 51-54 | 14 | -1 | -14 | 14 | $=11198.4$ |
| 47-50 | 10 | -2 | -20 | 40 |  |
| 43-46 | 5 | -3 | -15 | 45 | $S=\sqrt{11198.4} / 97$ |
| 39-42 | 4 | -4 | -16 | 64 |  |
| 35-38 | 2 | -5 | -10 | 50 | $=\sqrt{115.44}$ |
| 31-34 | 0 | -6 | 0 | 0 |  |
| 27-30 | 2 | -7 | -14 | 98 | $=10.8$ |
| $\begin{aligned} & N:=98 \\ & S=10 . \end{aligned}$ |  |  | $=20$ | $\Sigma=704$ |  |

Table 16. Standard deviation of Cooperative Scores, eighth grade

| Scores | f | $\mathrm{x}^{\prime}$ | fx' | fx' |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 79-82 | 5 | 3 | 15 | 45 | $x^{2}=16(211-1)$ |
| 75-78 | 6 | 2 | 12 | 24 | - $\overline{33}$ |
| 71-74 | 6 | 1 | 6 | 6 |  |
| 67-70 | 5 | 0 | 0 | 0 | $=16(211-.03)$ |
| 63-66 | 4 | -1 | -4 | 4 |  |
| 59-62 | 2 | -2 | -4 | 8 | $=16(211)=3376$ |
| 55-58 | 1 | -3 | -3 | 9 |  |
| 51-54 | 1 | -4 | -4 | 16 | $S=\sqrt{3376}$ |
| 47-50 | 2 | -5 | -10 | 50 | $\frac{332}{32}$ |
| 43-46 | 0 | -6 | 0 | 0 |  |
| 39-42 | 1 | -7 | -7 | 49 | $=\sqrt{105.50}$ |
|  |  |  |  |  | $=10.3$ |

$\mathrm{N}=33$
$\Sigma=1 \quad \Sigma=211$
$S=10.3$

## 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:

$$
r=\frac{x^{\prime} y^{\prime}-\frac{\left(\Sigma f x^{\prime}\right)\left(\Sigma f y^{\prime}\right)}{N}}{\sqrt{\left(f x^{\prime 2}-\frac{\left(\Sigma f x^{\prime}\right)^{2}}{N}\right)\left(f y^{\prime 2}-\frac{\left(\Sigma f y^{\prime}\right)^{2}}{N}\right)}}
$$

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


$$
\begin{aligned}
& \text { Using formula } 2: \\
& \qquad \begin{aligned}
r & =\frac{3711-\frac{(500)(692)}{98}}{\left(3398-\frac{\left.\left.(500)^{2}\right)\left(5688-\frac{(692}{98}\right)^{2}\right)}{98}\right.} \\
& =\frac{3711-3530.6}{(3398-2550.1)(5688-4886.3)} \\
& =\frac{180.4}{\overline{(847.9)(801.7)}} \\
& =\frac{180.4}{\overline{679761.43}} \\
& =\frac{180.4}{824} \\
& =.22
\end{aligned} \\
& \\
&
\end{aligned}
$$

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:

$$
\begin{aligned}
S_{r_{0}} & =\frac{1}{\sqrt{N-1}} \\
& =\frac{1}{\sqrt{98-1}} \\
& =\frac{1}{\sqrt{97}} \\
& =\frac{1}{9.85} \\
& =.10
\end{aligned}
$$

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:

$$
\begin{aligned}
S_{r_{0}} & =\frac{1}{\sqrt{33-1}} \\
& =\frac{1}{\sqrt{32}} \\
& =\frac{1}{5.66} \\
& =.18
\end{aligned}
$$

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 comnuted above to find:

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


Using formula 2:

$$
\begin{aligned}
r & =\frac{2439-\frac{(232)(332)}{33}}{\sqrt{\left(1781-\frac{\left.(232)^{2}\right)\left(3526-\frac{(332)^{2}}{33}\right)}{33}\right.}} \\
& =\frac{2439-2334.1}{\sqrt{(1781-1631)(3526-3340.1)}} \\
& =\frac{104.9}{\sqrt{(150)(185.9)}} \\
& =\frac{104.9}{\sqrt{27885}} \\
& =\frac{104.9}{167} \\
& =.63
\end{aligned}
$$

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

## 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:

$$
S_{r_{O}}=.10 \text { (see page 23) so } Z=\frac{.46}{.10}=4.60 \text { which is significant }
$$ 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:

$$
S_{r_{0}}=.18 \text { and } Z=\frac{.73}{.18}=4.05
$$

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 9 th grade was determined to be .52.

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

$$
S_{r_{0}}=.10 \text { so } Z=\frac{.52}{.10}=5.20
$$

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


Using formula 2:

$$
\begin{aligned}
r & =\frac{4361-\frac{(564)(698)}{98}}{\sqrt{\left(3978-\frac{\left.(564)^{2}\right)\left(5724-\frac{\left.(698)^{2}\right)}{98}\right.}{98}\right.}} \\
& =\frac{4361-4017.1}{\sqrt{(3978-3245.9)(5724-4971.5)}}=\frac{343.9}{\sqrt{(732.1)(752.5)}} \\
& =\frac{343.9}{\sqrt{550905.25}=\frac{343.9}{742}}=.46
\end{aligned}
$$

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

| $x$-axis, Lee Scores |  |  |  | $y$-axis, Cooperative Test Scores |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| f | $x^{\prime}$ | fx' | $\mathrm{fx}^{\prime}{ }^{2}$ | f | $y^{\prime}$ | fy' | fy ${ }^{\prime 2}$ | $x^{\prime} y^{\prime}$ |
| 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 |

Using formula 2:

$$
\begin{aligned}
r & =\frac{2884-\frac{(275)(331)}{33}}{\sqrt{\left(2431-\frac{(275)^{2}}{33}\right)\left(3531-\frac{(331)^{2}}{33}\right)}} \\
& =\frac{2884-2758.3}{\sqrt{(2431-2291.7)(3531-3320)}}=\frac{125.7}{\sqrt{(139.3)(211)}} \\
& =\frac{125.7}{\sqrt{29392.30} \quad=\frac{125.7}{172} \quad=.73}
\end{aligned}
$$

Table 2l. $r$ for Arithemetic Grades and Cooperative Scores, ninth grade

| x-axis, Arithemetic Grades |  |  |  | $y$-axis, Cooperative Test Scores |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| f | $\mathrm{x}^{\prime \prime}$ | fx' | fx'2 | f | $y^{\prime}$ | $\mathrm{f}^{\prime}$ | fy' ${ }^{2}$ | $x^{\prime} y^{\prime}$ |
| 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 |

Using formula 2:

$$
\begin{aligned}
r & =\frac{6116-\frac{(803)(698)}{98}}{\sqrt{\left(7345-\frac{\left.(803)^{2}\right)\left(5724-\frac{(698)^{2}}{98}\right)}{98}\right.}} \\
& =\frac{6116-5719.3}{\frac{1}{(7345-6579.5)(5724-4971.4)} \sqrt{(765.5)(752.6)}} \\
& =\frac{396.7}{\sqrt{\frac{396.7}{}}=\frac{396.7}{759}}=.52
\end{aligned}
$$

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


Using formula 2:

$$
\begin{aligned}
r & =\frac{3405-\frac{(331)(331)}{33}}{\sqrt{\left(3433-\frac{\left.(331)^{2}\right)\left(3531-\frac{(331)^{2}}{33}\right)}{33}\right.}} \\
& =\frac{3405-3320}{\sqrt{(3433-3320)(3531-3320)}} \\
& =\frac{85}{\sqrt{(113)(211)}} \\
& =\frac{85}{\sqrt{23843}} \\
& =\frac{85}{154} \\
& =.55
\end{aligned}
$$

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:

$$
s_{r_{0}}=.18 \text { and so } z=\frac{.55}{.18}=3.06
$$

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 9 th 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:

$$
\begin{aligned}
r & =\frac{3246-\frac{(566)(506)}{98}}{\sqrt{\left(4208-\frac{\left.(566)^{2}\right)\left(3428-\frac{(506)^{2}}{98}\right)}{98}\right.}} \\
& =\frac{3246-2922.4}{\sqrt{(4208-3268.9)(3428-2612.6)}} \\
& =\frac{323.6}{\sqrt{(939.1)(815.4)}} \\
& =\frac{323.6}{\sqrt{765742.14}} \\
& =\frac{323.6}{875}
\end{aligned}
$$

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=2014-(275)(232)
    \sqrt{}{\frac{33}{(2431-\mp@subsup{\frac{(275)}{33}}{33}{(1)(1782-\frac{(232)}{33}})}}
    = 2014 - 1933.3
    \sqrt{}{(2431-2291.7)(1782-1631)}
= \frac { 8 0 1 7 } { \sqrt { ( 1 3 9 . 3 ) ( 1 5 1 ) } }
    = = \frac { 8 0 . 7 } { \sqrt { 2 1 0 3 4 . 3 } }
    = 80.7
    =. . 56
```

Lee scores and Arithemetic grades
The correlation $r$, for the $9 t h$ grade was determined from Table 25 and that which follows:

Using formula 2:

$$
r=4913-(565)(803)
$$


$=4913-4629.5$

$=283.5$
$\sqrt{(731.7)(755.4)}$
$=283.5$
$\sqrt{552726.18}$
$=\frac{283.5}{743}$
$=.38$

Table 23. Lee and Pitner Test Scores, ninth grade

| f | $x^{\prime}$ | $\mathrm{fx}^{\prime}$ | $\mathrm{fx}^{\prime}$ | f | $y^{\prime}$ | fy' | fy' 2 | $x^{\prime} y^{\prime}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 |

Table 24. Lee and Pitner Test Scores, eighth grade
x-axis, Lee Test Scores
f $x^{\prime}$ fx' $\mathrm{Ex}^{\prime 2}$

|  |  |  |  |  |  |  |  |  |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| 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 |

$N=33$

Table 25. Lee Scores and Arithemetic Grades, ninth grade


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

Using formula 2:

$$
\begin{aligned}
r & =\frac{2792-\frac{(274)(331)}{33}}{\sqrt{\left(2414-\frac{\left.(274)^{2}\right)\left(3433-\frac{(331)^{2}}{33}\right)}{23}\right.}} \\
& =\frac{2792-2748.3}{\sqrt{(2414-2275)(3433-3320)}} \\
& =\frac{43.7}{\sqrt{(139)(113)}} \\
& =\frac{43.7}{\sqrt{15707}} \\
& =\frac{43.7}{125} \\
& =.35
\end{aligned}
$$

## Pitner scores and arithemetic grades

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

Using formula 2:

$$
\begin{aligned}
r & =\frac{4861-\frac{(506)(803)}{98}}{\sqrt{\left(3428-\frac{\left.(506)^{2}\right)\left(7345-\frac{(803)^{2}}{98}\right)}{98}\right.}} \\
& =\frac{4861-4146.1}{\sqrt{\left(3428-\frac{\left.(506)^{2}\right)\left(7345-\frac{\left.(803)^{2}\right)}{98}\right.}{}\right.}} \\
& =\frac{4861-4146.1}{\sqrt{(3428-2612.6)(7345-6579.6)}}
\end{aligned}
$$

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

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

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

$$
=.90
$$

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

Using formula 2:

$$
\begin{aligned}
r & =\frac{2428-\frac{(232)(335)}{33}}{\sqrt{\left(1782-\frac{\left.(232)^{2}\right)\left(3521-\frac{\left.(335)^{2}\right)}{33}\right.}{33}\right.}} \\
& =\frac{2428-2355.1}{\sqrt{(1782-1631)(3521-3400.7)}} \\
& =\frac{72.9}{\sqrt{(151)(120.3)}} \\
& =\frac{72.9}{\sqrt{18165.3}}=\frac{72.9}{135}
\end{aligned}
$$

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


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

## x-axis, Pitner Scores

y-axis, Arithemetic Grades
f $y^{\prime}$ fy' fy'2 $x^{\prime} y^{\prime}$

| 0 | 14 | 0 | 0 | 0 |
| ---: | ---: | ---: | ---: | ---: |
| 9 | 13 | 117 | 1521 | 754 |
| 0 | 12 | 0 | 0 | 0 |
| 15 | 11 | 165 | 1815 | 880 |
| 0 | 10 | 0 | 0 | 0 |
| 33 | 9 | 297 | 2673 | 1611 |
| 0 | 8 | 0 | 0 | 0 |
| 17 | 7 | 119 | 833 | 533 |
| 0 | 6 | 0 | 0 | 0 |
| 19 | 5 | 95 | 475 | 565 |
| 0 | 4 | 0 | 0 | 0 |
| 3 | 3 | 9 | 27 | 42 |
| 0 | 2 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 3 |
| 0 | 0 | 0 | 0 | 0 |

$N=98 \quad \Sigma=506 \quad \Sigma=3428 \quad \Sigma=803 \quad \Sigma=7345 \quad \Sigma=4861$

## 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:

$$
r=5695-\frac{(695)(726)}{98}
$$

$\frac{98}{\sqrt{\left(5655-\frac{(695)^{2}}{98}\right)\left(6265-\frac{(726)^{2}}{98}\right)}}$
$=5695-5148.6$
$\sqrt{(5655-4928.8)(6265-5378.3)}$
$=\frac{546.4}{\sqrt{(726.2)(886.7)}}$
$=546.4$
$\sqrt{643921.82}$
$=\frac{546.4}{802}$
$=.68$
And from Table 30 , the 8 th grade correlation was computed as:
Using formula 2 :

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

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

$=\frac{208.5}{\sqrt{72605.1}}$
$=\frac{208.5}{270}$
$=.77$

Table 28. $r$ for Pitner Scores and Arithemetic Grades, eighth grade x-axis, Pitner Test Scores $\qquad$
$f \quad x^{\prime}$ fx' fx'2

$$
f \quad y^{\prime} \quad \text { fy' } \quad \text { y } y^{\prime 2} \quad x^{\prime} y^{\prime}
$$

| 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 |
| $\mathbf{N 3}$ |  | $\Sigma=232 \Sigma=1782$ |  | $N=33$ |  | $\Sigma=335 \Sigma=3521$ | $\Sigma=2428$ |  |

Table 29. $r$ for Cooperative Mathematics Test and Algebra Grades, ninth grade x-axis, Cooperative Mathematics Test $\qquad$
f $x^{\prime}$ fx' fx'2 f $x^{\prime}$ fy' fy'2 $x^{\prime} y^{\prime}$

|  |  |  |  |
| ---: | ---: | ---: | ---: |
| 2 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 |
| 2 | 2 | 4 | 8 |
| 4 | 3 | 12 | 36 |
| 5 | 4 | 20 | 80 |
| 10 | 5 | 50 | 250 |
| 15 | 6 | 90 | 540 |
| 21 | 7 | 147 | 1029 |
| 7 | 8 | 56 | 448 |
| 10 | 9 | 90 | 810 |
| 12 | 10 | 120 | 1200 |
| 4 | 11 | 44 | 484 |
| 3 | 12 | 36 | 432 |
| 2 | 13 | 26 | 338 |
| 0 | 14 | 0 | 0 |


| 0 | 14 | 0 | 0 | 0 |
| ---: | ---: | ---: | ---: | ---: |
| 6 | 13 | 78 | 1014 | 741 |
| 0 | 12 | 0 | 0 | 0 |
| 7 | 11 | 77 | 847 | 660 |
| 0 | 10 | 0 | 0 | 0 |
| 37 | 9 | 330 | 2997 | 2844 |
| 0 | 8 | 0 | 0 | 0 |
| 19 | 7 | 133 | 931 | 924 |
| 0 | 6 | 0 | 0 | 0 |
| 16 | 5 | 80 | 400 | 410 |
| 0 | 4 | 0 | 0 | 0 |
| 8 | 3 | 24 | 72 | 102 |
| 0 | 2 | 0 | 0 | 0 |
| 4 | 1 | 4 | 4 | 14 |
| 0 | 0 | 0 | 0 | 0 |

$N=98 \quad \Sigma=695 \quad \Sigma=5655$
$N=98$
$\Sigma=726 \quad \Sigma=6265$
$\Sigma=5695$

## 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:

$$
\begin{aligned}
r_{4.12} & =\sqrt{\frac{r_{41}{ }^{2}+r_{42^{2}-\left(2 r_{41^{r}} 2^{r} 12\right)}^{1-r_{12} 2^{2}}}{1-(.90)^{2}}} \\
& =\sqrt{\frac{(.52)^{2}+(.22)^{2}-2(.52)(.22)(.90)}{1-.81}} \\
& =\sqrt{\frac{.27+.05-.21}{1-.8}} \\
& =\sqrt{\frac{.11}{.19}}=\sqrt{.58}
\end{aligned}
$$

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

$$
\begin{aligned}
r_{4.12} & =\sqrt{\frac{(.55)^{2}+(.63)^{2}-(2)(.55)(.63)(.54)}{1-(.54)^{2}}} \\
& =\sqrt{\frac{.30+.40-.37}{1-.29}} \\
& =\sqrt{\frac{.33}{.71}}=\sqrt{.46}=.68
\end{aligned}
$$

Table 30. $r$ for Cooperative Test Scores and Algebra Grades, eighth grade
x-axis, Cooperative Mathematics Test
y-axis, Algebra Grades


## 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:

$$
\begin{aligned}
r_{4.13} & =\sqrt{\frac{r_{41}{ }^{2}+r_{43^{2}-\left(2 r_{41} r_{43^{r}} 13\right)}^{1-r_{13} 3^{2}}}{1-(.38)^{2}}} \\
& =\sqrt{\frac{(.52)^{2}+(.46)^{2}-2(.52)(.46)(.38)}{1-.21-.19}} \\
& =\sqrt{\frac{.27+.24}{1.86}}=.59
\end{aligned}
$$

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

$$
\begin{aligned}
r_{4.13} & =\sqrt{\frac{(.55)^{2}+(.73)^{2}-2(.55)(.73)(.35)}{1-(.35)^{2}}} \\
& =\sqrt{\frac{.30+.53-.28}{1-.12}} \\
& =\sqrt{\frac{.55}{.88}}=\sqrt{.63}=.79
\end{aligned}
$$

## Cooperative scores with Pitner and Lee scores

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:

$$
\begin{aligned}
r_{4.23} & =\sqrt{\frac{r_{42^{2}+r_{43}-\left(2 r_{42^{r}} 43^{r} 23\right)}^{1-r_{23}{ }^{2}}}{1-(.37)^{2}}} \\
& =\sqrt{\frac{(.22)^{2}+(.46)^{2}-2(.22)(.46)(.37)}{1-.21-.07}} \\
& =\sqrt{\frac{.05+.21}{1}-.14}=.47
\end{aligned}
$$

And for the 8 th grade with the same formula:

$$
\begin{aligned}
r_{4.23} & =\sqrt{\frac{(.63)^{2}+(.73)^{2}-2(.63)(.73)(.56)}{1-(.56)^{2}}} \\
& =\sqrt{\frac{.40+.53-.52}{1-.31}} \\
& =\sqrt{\frac{.41}{.69}}=\sqrt{.59}=.77
\end{aligned}
$$

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 8 th 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 $x^{2}$ 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 $.60\left(r^{2}\right.$ of .36 ) for the 9 th and 8th grades combined. Arithemetic grades followed with a correlation coefficient of $.54\left(r^{2}\right.$ 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 8 th grade algebra class would be maintained in the 9 th grade classes.

## CONCLUSIONS


#### Abstract

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 8 th 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 8 th 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 $9 t h$ and $8 t h$ 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 8 th 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.

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APPENDIX

Table 3l．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 |
| I． $\mathrm{D}_{\text {。 }}$ | 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 |  |  |  |  |  |  |  |  |

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

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[^0]:    Approved:

