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A Study of Selected Data in Predicting Success in Ninth Grade Mathematics at Jefferson Junior High School, Mattoon, Illinois

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A STUDY OF SELECTED DATA
IN PREDICTING SUCCESS IN NINTH GRADE
MATHEMATICS AT JEFFERSON JUNIOR HIGH SCHOOL,
MATTOON, ILLINOIS

(TITLE)

BY

Larry K. Stilgebauer

THESIS

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CHAPTER I

INTRODUCTION

PRELIMINARY STATEMENT

The people of the United States of America have tried to provide equal educational opportunities for all the children of all the people.[1] They have been dedicated to the principle of an education for all in common, as far as abilities permit.[2] In attempting to uphold this principle, a system of education has developed in which both academic and vocational attributes of children's needs are accentuated. While trying to meet the academic needs of children within the district served by Jefferson Junior High School in Mattoon, Illinois, the school administration and the department of mathematics have developed a mathematics curriculum which is divided into three specific parts.

One of the parts, designated as basic mathematics, is, as a rule, a terminal course in mathematics. Because the students who enroll in this course have lacked a sufficient degree of ability in mathematics, the primary purpose is to improve the student's ability in computation. Much time spent

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[1] *Encyclopedia of Modern Education*. ed. Harry N. Rivlin (New York City: The Philosophical Library of New York City, 1943), p. 166.

[2] *Ibid*.

on basic drills usually produces an individual who has better facility in computation and a better understanding of mathematics.[3]

The second of the parts of the mathematics curriculum is functional mathematics. It is not a terminal course but rather is a course designed for those students who are weak in both speed and accuracy. Such students probably would not be able to succeed in college-preparatory algebra at the ninth grade level. These students are capable of succeeding in mathematics, but they would be characterized as being mathematically immature.

The functional mathematics course consists of a rather extensive review, during the first three quarters, of the seventh and eighth grade mathematics with an emphasis on speed and accuracy of computation. The final quarter is devoted to an introductory study of algebra. The design of this course makes it possible for the student, after having completed the course, to decide whether to terminate his study of mathematics or to continue his study with a course in algebra. Seventy to seventy-five per cent of those students who complete the functional mathematics course as ninth graders take algebra in the tenth grade and approximately ninety per cent of these students have success.[4]

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[3]Course Description of Basic Mathematics. Maurice E. Shanholtzer, teacher of basic and functional mathematics, Jefferson Junior High School, Mattoon, Illinois, 1966.

[4]Course Description of Functional Mathematics. Ibid.

The third of the three parts of the mathematics curriculum is a college-preparatory course in algebra. This course, as taught at Jefferson Junior High School, is a modern approach. Much effort is expended to develop the student's ability to discover methods of solution and proof without the aid of the teacher. Materials similar to programmed materials are utilized in this course. Such materials provide the possibility of the last several units being placed on a self-directed basis, thus creating the opportunity for the student to complete units of mathematics beyond that of algebra.[5]

Currently the algebra sections consist of approximately fifty per cent of the total population of ninth grade students at Jefferson Junior High School. Of those remaining, approximately sixty per cent are enrolled in functional mathematics and forty per cent in basic mathematics.[6]

PURPOSE OF THE STUDY

With the continuing stress being placed on higher education and with college entrance depending more and more on academic success in high school, a much greater demand is being placed on course selection at the early stages of an individual's education. This stress creates a need to help

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[5]Course Description of Algebra. Evelyn Shields, teacher of algebra, Jefferson Junior High School, Mattoon, Illinois, 1966.

[6]Interview with Dick James, School Counselor, Jefferson Junior High School, July 11, 1967.

students increase their ability for self-appraisal and decision-making concerning their choices in a mathematics program.[7]

The purpose of this study is to assess the current practices being used to help the student select the mathematics course which he must take as a ninth grade student. This study attempts to determine of what value these practices are in predicting academic success in ninth grade mathematics at Jefferson Junior High School.

An attempt is made herein to determine, from student cumulative records, the existence of any significant data which might be used as predictors of success either in addition to or in the place of the data currently being used for this purpose.

This study is also an attempt to produce material to aid in the counseling of incoming ninth grade students. The results of this study should provide more comprehensive information for the student to enable him to make more realistic decisions concerning his academic future.

This study will involve each of the following items from each student's cumulative record:

1. An arithmetic average of the intelligence test scores
2. A raw score from the Lee Test of Algebraic Ability
3. Eighth grade mathematics mark

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[7] John M. Ivanoff, "Use of Discriminant Analysis for Selecting Students for Ninth Grade Algebra or General Mathematics," <u>The Mathematics Teacher</u>, LVIII (May, 1965), p. 412.

4. Grade equivalence determined from the Metropolitan Achievement Test in
    a. Arithmetic Computation
    b. Problem Solving

5. A percentile rank determined from the Differential Aptitude Test in
    a. Verbal Reasoning
    b. Numerical Ability
    c. Abstract Reasoning
    d. Spatial Relations
    e. Mechanical Reasoning
    f. Verbal Reasoning and Numerical Ability

Each of these items is correlated with the mark obtained from ninth grade mathematics in order to determine the degree to which each item may be used to predict success in ninth grade mathematics.

DELIMITATIONS OF THE STUDY

An entire population was involved in this study since there was no random sampling. The population was chosen from students who had completed their ninth grade education in either 1966 or 1967. Selection of the population was based upon the criterion of attendance at Jefferson Junior High School during both the eighth and ninth grades. The use of this criterion establishes an extremely select collection of data, the results of which are significant only for this particular school.

Only those records which contained all eleven predictors were used in this study. The absence of any one predictor eliminated that record from consideration. Neither the accelerated nor the remedial sections of eighth grade were given the Lee Test of Algebraic Ability. Therefore, these records were eliminated from this study. The absence of these two groups definitely would have an effect on this study.

Each of the items used in this study is designated by a variable.

TABLE 1

A LIST OF VARIABLES AND THEIR CORRESPONDING SYMBOLS

X_1 - intelligence test score

X_2 - Lee Test of Algebraic Ability score

X_3 - mark in eighth grade mathematics

X_4 - grade equivalence in arithmetic computation

X_5 - grade equivalence in problem solving

X_6 - verbal reasoning

X_7 - numerical ability

X_8 - abstract reasoning

X_9 - spatial relations

X_{10} - mechanical reasoning

X_{11} - combination of verbal reasoning and numerical ability

X_{12} - mark in ninth grade algebra

X_{13} - mark in ninth grade functional mathematics

X_{14} - mark in ninth grade basic mathematics

NEED FOR THE STUDY

Pupils of superior aptitude for mathematics should be recognized as early as possible and placed in ability sections in order to receive instruction which is best suited for their ability and capacity. Those students less able and perhaps incapable of profiting from a study such as algebra should likewise be identified in order to save them from wasting their time and effort, to protect them from having to face again the probability of failure, and to enable them to intensify their efforts toward other subjects.[8]

The presence of three different courses in mathematics necessitates that each student make a decision with respect to which mathematics course he will take as a ninth grade student. This decision should be made after much thought and often following a conference with the school counselor. The counselor should be able to furnish information which would aid the student in making his choice. The information currently being used includes three specific areas:

1. results of the Lee Test of Algebraic Ability
2. achievement scores
3. previous mathematics grades

Individual intelligence and achievement tests are given when there is doubt about an individual pupil's ability to achieve.[9]

Having prepared for the teaching of mathematics and having completed two years of teaching mathematics at Jefferson Junior High School, this writer has become quite aware of the lag between prediction of achievement and actual accomplishment. According to those teachers of longer experience, the existence of this discontinuity between predicted success of ninth grade mathematics students and the level attained by

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[8]California Algebra Aptitude Test, American Guidance Service Catalog (1966-67), p. 18.

[9]Teacher's Handbook, Jefferson Junior High School, Mattoon, Illinois.

those students has been evident for several years. Apparently, even with the Lee Test, which according to the test manual has reasonably high predictive validity, the ability to predict a student's success in mathematics at a local level has been quite elusive.

As a result of this lack of predictive validity, the final sectioning of students has been accomplished only after much deliberation on the part of the counselor and administrator. Sectioning of students in this manner requires a large degree of subjectivity. It is not the purpose here to suggest the elimination of the subjective aspect of sectioning because total elimination would surely be an impossible task. An assumption is made, however, of the existence of a more satisfactory and more valid objective approach to this work.

The subjective method has often been no more effective than would be a sampling of students at random. The ineffectiveness of the subjective method can be evidenced by the number of transfers from algebra to one of the other mathematics courses. Incidence of transfer requests, and consequently counselor interviews, has been as high as twenty per cent in previous years.[10]

Aside from the additional administrative work caused by ineffective scheduling, the students are made to suffer. Those students who transfer not only have felt the pain of failure, but they also have missed the opportunity to learn in a course designed more for their ability and capacity.

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[10]Interview with Dick James, School Counselor, Jefferson Junior High School, July 10, 1967.

CHAPTER II

REVIEW OF RELATED LITERATURE

The following statements may be made concerning a survey of the work done in predicting marks in special subjects.

1. The same factors which are used to predict general success in high school may be used to predict success in special subjects.

2. In general any one factor such as an intelligence test or mark in the elementary school correlates less well with a mark in a special subject than with the general average of subjects.

3. To predict success in a special subject one would use data that has something in common with the particular subject being predicted. To predict success in English in high school one would use marks in English in the elementary school rather than marks in arithmetic. Or one would use results from an arithmetic test rather than from a history test to predict success in algebra.[11]

MENTAL ABILITY TESTS

The value of a student's intelligence quotient in this study is determined by an arithmetic average of the I.Q. scores available from the student's record. The number of such scores is dependent upon which elementary school the

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[11]Percival M. Symonds, Measurement in Secondary Education (New York: The MacMillan Company, 1927), p. 405.

student attended. If the student attended elementary school in Mattoon, he took at least three tests from which mental ability or intelligence quotient scores are derived. A student who attended elementary school outside Community Unit School District Number Two may not have as many scores available.

The first two mental ability group tests given in the Mattoon system are the Otis Quick-Scoring Mental Ability tests. The Alpha Test is given in grade two and the Beta in grade four.[12]

The first of these, the Alpha Test, is constructed entirely of pictures, while the Beta is a verbal test. Each of these tests is to measure mental ability, which the test manual describes as being "thinking power or the degree of maturity of the mind". Questions such as those relating to vocabulary and arithmetic reasoning are used to add variety. These questions measure mental ability only in so far as can be assumed that pupils of equal age have had nearly equal opportunity to learn.[13]

When each of the following tests are given during grade eight, correlations of .67 and .73 are found respectively between the Otis Quick-Scoring Mental Ability Test, Beta Test, and the Arithmetic Reasoning and Arithmetic Computation portions of the Stanford Achievement Test, Form J.[14]

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[12]Outline of Community Unit District Number Two Testing Program.

[13]Arthur S. Otis, Manual of Directions for Beta Test, Otis Quick-Scoring Mental Ability Tests (New York: World Book Company, 1954), p.1.

[14]*Ibid*., p. 8.

In certain elementary schools the Peabody Picture Vocabulary Test is given instead of the Otis Beta. The Peabody is a test which measures verbal intelligence. This test is a series of one hundred fifty plates containing four pictures each. The person being tested is asked to identify the picture which corresponds with the word being spoken by the examiner. The identification of the picture may be accomplished either by pointing or by relating the number of the picture. The first of these two methods is used when testing young children while the second method is used primarily with older children and adolescents.

Used as an individual mental ability test, the Peabody Picture Vocabulary Test has an advantage of being easily and quickly administered and scored. According to the test manual, the Peabody Picture Vocabulary Test can be administered in ten to fifteen minutes and scored in one to two minutes. This test covers a wide range and is completely untimed.[15] The weakest point of the test is probably at the superior adult level. Vocabulary has proven to be lacking in discrimination between adults of exceptional mental ability.[16]

The third major mental ability test used at the elementary level in the Mattoon school system is the California Short-Form Test of Mental Maturity.[17] This test provides

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[15]Lloyd M. Dunn, Manual, Peabody Picture Vocabulary Test (Minneapolis, Minnesota: American Guidance Service, Inc., 1959), p. 25.

[16]*Ibid.*, p. 32.

[17]Outline of Community Unit District Number Two Testing Program.

information about the individual's capacity to solve problems and to respond to new situations, each of which are basic to learning.[18]

The rate and scope of the individual's mental development are measured at each level of testing in terms of four distinct factors. The first of the factors, Logical Reasoning, consists of three separate tests which involve opposites, similarities, and analogies. Each of these tests consist of fifteen items involving relationships with pictures.

The second factor tested is Numerical Reasoning. This area stresses the ability to comprehend numerical concepts and to apply mathematical principles to problem solving. The two separate tests in this section involve, first of all, numerical value, requiring the individual to make a certain sum from a given number of coins. The second part is number problems, involving quantitative reasoning.

Verbal Concepts is the third factor tested. The person being examined must identify, from a choice of five words, two words which have a similar connotation.

The final test, involving the factor of memory, is entitled Delayed Recall. For this portion of the test, a story is read to the examinee at the beginning of the testing period, and the test items relate to this story. The first

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[18] Willis W. Clark, Elizabeth T. Sullivan, Ernest W. Tiegs, Examiner's Manual, California Short-Form Test of Mental Maturity, Level Two (Monterey, California: California Test Bureau, 1963), p. 5.

six tests provide standardized conditions for the testing of delayed recall.

The entire test has a time limit of forty-three minutes including the reading of the story for test number seven. During these forty-three minutes, the examinee must answer one hundred twenty items which are both verbal and non-verbal in nature.

A mental age and intelligence quotient are obtained from both verbal and non-verbal sections. In addition to these separate scores, a total mental age and intelligence quotient are obtained.[19] The total intelligence quotient is recorded on each student's cumulative record.

APTITUDE TESTS

The Lee Test of Algebraic Ability consists of four separate tests. These tests, assembled from a group of nine tests, include arithmetic problems, analogy, number series, and formulas.[20]

According to the manual, this test can be used to determine whether or not a student should take algebra. Standards for making this determination are available, but it is suggested in the test manual that the school using this test should devise its own standards.

Having the results from a test such as this may enable a teacher to determine the relative levels of ability within

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[19] *Ibid.*, pp. 5-7.

[20] J. Murray Lee, *Manual of Directions for Lee Test of Algebraic Ability, Revised* (Indianapolis, Indiana: Bobbs-Merrill Company, Inc., 1964), p. 3.

the class as an aid in instruction. This measure of ability might also provide a means of diagnosing causes of poor work, whether the cause be lack of ability or some problem which might possibly be corrected.

This particular test instrument is given before the student begins the study of algebra. The test does not cover general mathematical ability, but it covers only algebraic ability.

The validity of this test depends on how well the results correlate with success in algebra. Such success can be measured either by final marks in algebra or by an algebra achievement test given at the end of the school year. According to the test manual, the correlation between standardized achievement test scores and results from the Lee Test of Algebraic Ability is from five to ten points above that between the Lee Test and final marks in algebra. This might well be expected because the achievement test would involve pure knowledge of the subject, while final marks include subjective decisions and might be influenced by a student's attitude in class, his promptness in turning in assignments, and perhaps even the student's sex.[21]

The table on the following page is taken from the test manual of the Lee Test of Algebraic Ability and shows data on validity by means of correlation of the test of Algebraic Ability and final marks in ninth grade algebra in a number of schools.[22]

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[21] Ibid., pp. 4-6.

[22] Ibid., p. 6.

TABLE 2

DATA ON VALIDITY
NINTH GRADE ALGEBRA CLASSES

School	Number of Cases	Correlation between Test of Algebraic Ability and First Semester Marks	Number of Cases	Correlation between Test of Algebraic Ability and Second Semester Marks
1	22	.66	16	.59
2			37	.73
3	90	.67	87	.66
4			138	.43
5	103	.53	102	.44
6/2				
A	50	.54		
T	47	.21		
M	38	.42		
7	79	.60	78	.48

School 6/2 A- Accelerated; T- Traditional Course;
M- Minimum Course

The usual size of correlation of marks between the first and second semester was approximately .80.

Unlike the Lee Test, the Differential Aptitude Test consists of eight tests. Each test "is intended to make a unique contribution to the understanding of the individual student".[23]

[23]George K. Bennett, Harold G. Seashore, Alexander G. Wesman, Manual for the Differential Aptitude Tests (New York: The Psychological Corporation, 1959), p. 5.

The Verbal Reasoning test measures one's ability to understand concepts framed in words and may be expected to predict success in areas involving complex verbal relationships and concepts. The test consists of analogy-type questions which are the same type used in general mental ability tests. The analogies which constitute the items for the test use a relatively simple vocabulary and reasonably familiar content. Such a choice of items reduces the possibility of solution based on association instead of real thinking. These choices also overcome the probability of missing items due to a lack of knowledge in a specific subject matter field or of unusual vocabulary terms.

Problems in the Numerical Ability segment of the test are of the type usually referred to as arithmetic computation. This type of problem is contrasted with the type present in the usual arithmetic reasoning problem. Arithmetic reasoning problems involve elements of language. Such elements often require a significant amount of reading ability. In this test, a need to avoid differences in reading ability determines the use of computation problems rather than reasoning problems.[24]

Although computation types of problems are used, the measurement of reasoning ability is not eliminated. Many of the problems require an understanding of numerical relationships and are as complex as items of a verbal nature. Intelligent answering of test items is required. Such a requirement

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[24] *Ibid.*, p. 6.

is typified by an example taken from the test manual:

> In problem 17 of Form A of the test, the answer 47 ft., 24 in. is scored as wrong, even though it is the correct sum arithmetically; only 49 ft. is accepted. The student who has given the former response has not responded intelligently; he has failed to perceive the relationship in the feet and inches combination. An employer or teacher would look askance at someone who, when asked to measure a table, replied "4 feet, 12 inches." The same approach to evaluation of numerical understanding is applied in this test.[25]

The Numerical ability test can be used as a predictor in mathematics, according to the test manual. A combination of the Numerical Ability and the Verbal Reasoning tests yields a measure of general learning ability.

The Abstract Reasoning test requires the student to discover an operating principle in changing figures and to show his understanding by indicating the diagram which would follow a series of diagrams. Because the actual differences are apparent, the test is to decide why the patterns differ.[26]

Another test attempts to determine one's ability both to visualize a constructed object from a picture and to imagine how an object would look if it were turned in a number of different ways. Both of these factors are important in the ability to think in spatial terms.

The Spatial Relations test is designed to evaluate " ... ability to manipulate things mentally, to create a structure in one's mind from a plan."[27]

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[25] *Ibid.*

[26] *Ibid.*, p. 7.

[27] *Ibid.*

The results of the Mechanical Reasoning test are most useful in predicting success in areas involving the use of principles of physical forces.[28] Care was taken, in this portion of the test, to use items employing mechanisms which are simple and do not require special knowledge. Scores are increased by only a few points even with formal training in physics.

In this study, one other score is used from the Differential Aptitude Tests. This score is a combination of the Numerical Ability and Verbal Reasoning scores. The abilities measured in these two separate tests are those abilities represented in intelligence or scholastic aptitude tests.[29]

In the tables from page forty-two of the test manual, the test with the highest degree of correlation with course grades in mathematics is the test of Numerical Ability. This test has a median correlation of .47.

ACHIEVEMENT TESTS

Ten sub-tests are contained in the Advanced Battery of the Metropolitan Achievement Tests. Of these ten tests, the results of only two were used in this study. The two sub-tests whose results were used are those dealing specifically with mathematics. The first of these is the test entitled Arithmetic Computation. This test covers most aspects

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[28] _Ibid_., pp. 7-8.

[29] _Ibid_., p. 20.

of computation, primarily through the use of fundamental operations with whole numbers, fractions, and decimals.

The second test used is Arithmetic Problem Solving and Concepts. One's understanding of the number system, measures, vocabulary, and arithmetic processes are measured in the first part of this test. In the second part emphasis is placed on one's ability to apply numbers and to make sound judgments in quantitative problems. In this test the primary emphasis is on reasoning in numerical situations.[30]

Recognizing the need for the establishment of local norms and the need for valid predictors, other persons have made studies similar to this one. In one such study, Barnes and Asher found the best single predictor to be marks received in mathematics at the eighth grade level. Using multiple correlation, the only other factor which greatly increased the correlation was a mathematics achievement test.[31]

A study of the prediction of success in eighth grade algebra, by Roger Duncan, found the best predictors to be (1) intelligence quotient (2) interest scores in science and literature (3) scores on the Orleans Algebra Prognostic Test and (4) grade placement in arithmetic computation. These four items were found to be the best predictors out of a total of twenty-one variables.[32]

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[30]Directions for Administering Metropolitan Achievement Tests, Advanced Battery. ed. Walter N. Durost (New York: Harcourt, Brace and World, Inc., 1959), pp. 4-5.

[31]Ward E. Barnes and John W. Asher, "Predicting Students' Success in First Year Algebra," The Mathematics Teacher, LV (December, 1962), p. 652.

[32]Ivanoff, op. cit.

CHAPTER III

PROCEDURES

In an effort to locate sufficient information for this study, an interview was conducted with Mr. Roy Sheppard, principal of Mattoon Senior High School, Mattoon, Illinois. During this interview it was determined that the high school records had not been used previously for such a study. Permission was granted to use these records, and the gathering of data was begun.

Examination of several students' cumulative record folders led to the selection of specific items for purposes of prediction. Such items were those which were available from a majority of the records and, in the opinion of this writer, had the highest relationship with achievement in mathematics.

The data was collected from the records of students who attended Jefferson Junior High School for two consecutive years and who had completed their ninth grade education during either 1966 or 1967. Sub-groupings of the data were then made, depending upon the mathematics course - algebra, functional, or basic - which the student had selected.

The arithmetic average of each student's intelligence test scores was computed and recorded as a single score.

Some of the records used had as few as two scores, while others had as many as five scores.

The grade equivalence of both arithmetic computation and problem solving was derived from the Metropolitan Achievement Tests. This particular score was obtained from a graph of grade equivalence which is recorded each year for each student. The score from the Lee Test of Algebraic Ability and the six scores from the Differential Aptitude Tests were all gathered directly from each student's folder.

Having gathered all of the data, including final eighth and ninth grade mathematics grades, it was determined that the whole number value of the mathematics grades (i.e. A = 4, B = 3, C = 2, D = 1, F = 0) are, in effect, discrete values. Such values, used in a study of correlation, would yield spurious results because the theory of correlation is based on functions of a continuous nature. Therefore, records were obtained from Jefferson Junior High School in order to compute continuous values of grades for each student.

The number of students in each group is enumerated in the following table.

TABLE 3

NUMBER OF STUDENTS IN EACH SUB-GROUP

	Algebra	Functional	Basic	Total
1966	47	28	18	93
1967	51	53	17	121
Total	98	81	35	214

When all the data had been collected, it was transferred to IBM cards and processed by the IBM 1620 computer in the Data Processing Center at Eastern Illinois University. The statistics obtained by computer processing included the Pearson product-moment correlation, a mean score, and the standard deviation.

CHAPTER IV

FINDINGS

The dual purpose of this study was (1) to evaluate current practices being used to aid incoming ninth grade students in selecting a mathematics course at Jefferson Junior High School, Mattoon, Illinois, and (2) to determine the existence of other factors which might be used further to aid these students in their mathematics course selection. The study was conducted using the records of students who completed their ninth grade education at Jefferson Junior High School in either 1966 or 1967. These students also attended this school for their eighth grade education.

Eleven variables were selected as having relevance to mathematical ability and success. The data were separated according to the mathematics course taken in the ninth grade. Computer processing was utilized then in order to obtain a mean and a standard deviation for each variable as well as a correlation coefficient between each variable and the appropriate ninth grade mathematics course.

The data for each mathematics course were processed further according to each year being studied. The results of this processing were then subjected to the critical ratio or t-test as a test of significance. The results of the t-test indicated the existence of no significant difference, at the .01 level, for any single variable during the two years being studied. The data in this chapter are derived, therefore, from the total population of each mathematics group, and the correlation study is conducted with respect to those populations.

According to Garrett, a general guide for interpretation of significance of a correlation coefficient (r) can be as follows:

TABLE 4

SIGNIFICANCE OF VALUES OF CORRELATION COEFFICIENT[33]

r from .00 to .20	very low or negligible
r from .20 to .40	low; present but slight
r from .40 to .70	substantial or marked
r from .70 to 1.00	high to very high

Numerical values of *r* can be either positive or negative.

This guide is utilized in the analysis of the data in this study.

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[33]Henry E. Garrett, *Elementary Statistics* (New York: Longmans, Green and Company, 1956), p. 116.

TABLE 5

MEANS AND STANDARD DEVIATIONS OF VARIABLES FOR ALGEBRA STUDENTS

Variable	Mean	Standard Deviation
X_1	111.81	8.52
X_2	44.41	7.07
X_3	2.75	.56
X_4	8.99	.99
X_5	9.52	.74
X_6	74.82	18.52
X_7	72.90	21.79
X_8	67.41	20.57
X_9	61.84	26.46
X_{10}	63.40	25.08
X_{11}	77.37	18.89
X_{12}	1.62	.92

X_1 - Arithmetic average of intelligence test scores
X_2 - Lee Test of Algebraic Ability
X_3 - Eighth grade mathematics mark
X_4 - Arithmetic Computation, Metropolitan Achievement Test
X_5 - Problem Solving, Metropolitan Achievement Test
X_6 - Verbal Reasoning, Differential Aptitude Test
X_7 - Numerical Ability, Differential Aptitude Test
X_8 - Abstract Reasoning, Differential Aptitude Test
X_9 - Spatial Relations, Differential Aptitude Test
X_{10} - Mechanical Reasoning, Differential Aptitude Test
X_{11} - Combination of Verbal Reasoning and Numerical Ability, Differential Aptitude Test
X_{12} - Algebra mark

TABLE 6

MEANS AND STANDARD DEVIATIONS OF VARIABLES FOR FUNCTIONAL MATHEMATICS STUDENTS

Variable	Mean	Standard Deviation
X_1	104.85	7.58
X_2	35.01	7.95
X_3	1.78	.55
X_4	7.64	.88
X_5	8.30	.95
X_6	53.02	22.09
X_7	45.24	24.17
X_8	45.37	24.42
X_9	41.92	27.35
X_{10}	53.76	26.61
X_{11}	49.01	22.19
X_{13}	2.16	.68

X_1 - Arithmetic average of intelligence test scores
X_2 - Lee Test of Algebraic Ability
X_3 - Eighth grade mathematics mark
X_4 - Arithmetic Computation, Metropolitan Achievement Test
X_5 - Problem Solving, Metropolitan Achievement Test
X_6 - Verbal Reasoning, Differential Aptitude Test
X_7 - Numerical Ability, Differential Aptitude Test
X_8 - Abstract Reasoning, Differential Aptitude Test
X_9 - Spatial Relations, Differential Aptitude Test
X_{10} - Mechanical Reasoning, Differential Aptitude Test
X_{11} - Combination of Verbal Reasoning and Numerical Ability, Differential Aptitude Test
X_{13} - Functional Mathematics mark

TABLE 7

MEANS AND STANDARD DEVIATIONS OF VARIABLES FOR BASIC MATHEMATICS STUDENTS

Variable	Mean	Standard Deviation
X_1	96.71	8.43
X_2	24.37	8.60
X_3	.85	.48
X_4	6.59	.71
X_5	6.64	1.20
X_6	35.20	19.80
X_7	19.08	14.01
X_8	31.57	23.58
X_9	34.85	24.62
X_{10}	43.71	22.21
X_{11}	24.51	16.84
X_{14}	2.01	.71

X_1 - Arithmetic average of intelligence test scores
X_2 - Lee Test of Algebraic Ability
X_3 - Eighth grade mathematics mark
X_4 - Arithmetic Computation, Metropolitan Achievement Test
X_5 - Problem Solving, Metropolitan Achievement Test
X_6 - Verbal Reasoning, Differential Aptitude Test
X_7 - Numerical Ability, Differential Aptitude Test
X_8 - Abstract Reasoning, Differential Aptitude Test
X_9 - Spatial Relations, Differential Aptitude Test
X_{10} - Mechanical Reasoning, Differential Aptitude Test
X_{11} - Combination of Verbal Reasoning and Numerical Ability, Differential Aptitude Test
X_{14} - Basic Mathematics mark

TABLE 5, 6, AND 7

MEANS AND STANDARD DEVIATIONS OF VARIABLES FOR NINTH GRADE MATHEMATICS STUDENTS

When applied to any two of the three groups of students in the different ninth grade mathematics courses, the t-test indicated a significant difference at the .05 level for each variable, with only two exceptions. The Spatial Relations scores for the functional mathematics group and the basic mathematics group do not differ significantly at the .05 level. The other variable which shows no significant difference at this level is the mark obtained in both the functional and basic mathematics courses.

With one notable exception, the mean of each variable for algebra students is greater than the mean of the like variable for the functional mathematics students. The mean of the mark obtained in the ninth grade mathematics course is greater for the functional mathematics students than for the algebra students. The mean of each variable for the algebra group is greater than the mean of the like variable for the basic mathematics group, with the exception of the mark obtained in ninth grade mathematics.

When the functional mathematics group is compared with the basic mathematics group, the results indicate a higher mean score for the functional mathematics group, for each variable. As mentioned before, no significant difference is found for two different pairs of variables.

TABLE 8

INTERCORRELATION MATRIX OF VARIABLES
FOR ALGEBRA STUDENTS

	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}
X_1	.43	.19	.25	.27	.46	.35	.23	.20	.21	.45	.21
X_2		.34	.39	.25	.38	.48	.30	.15	.13	.48	.42
X_3			.53	.29	.29	.32	.26	.08	.04	.35	.75
X_4				.53	.27	.38	.15	.08	-.02	.37	.55
X_5					.44	.37	.12	.18	.11	.45	.35
X_6						.49	.36	.25	.11	.83	.29
X_7							.26	.29	.11	.85	.49
X_8								.33	.11	.34	.29
X_9									.21	.31	.16
X_{10}										.10	.03
X_{11}											.44

X_1 - Arithmetic average of intelligence test scores
X_2 - Lee Test of Algebraic Ability
X_3 - Eighth grade mathematics mark
X_4 - Arithmetic Computation, Metropolitan Achievement Test
X_5 - Problem Solving, Metropolitan Achievement Test
X_6 - Verbal Reasoning, Differential Aptitude Test
X_7 - Numerical Ability, Differential Aptitude Test
X_8 - Abstract Reasoning, Differential Aptitude Test
X_9 - Spatial Relations, Differential Aptitude Test
X_{10} - Mechanical Reasoning, Differential Aptitude Test
X_{11} - Combination of Verbal Reasoning and Numerical Ability, Differential Aptitude Test
X_{12} - Algebra mark

TABLE 8

INTERCORRELATION MATRIX OF VARIABLES
FOR ALGEBRA STUDENTS

A total of ninety-eight students constitute this group. Of this total, forty-seven were ninth graders in 1966, and fifty-one were ninth graders in 1967.

In this study the only variable which has a significant correlation coefficient for use in predicting algebra marks is that of marks received in eighth grade mathematics. This correlation, of .75, is .20 higher than the correlation between the Arithmetic Computation Test from the Metropolitan Achievement Test Battery. The correlation of .55 between Arithmetic Computation and algebra marks is the second highest correlation when using algebra marks as one of the variables. This value of correlation is marked, although not extremely high.

Contrary to this information is the correlation of .32 between the marks earned in eighth grade mathematics and the scores derived from the Numerical Ability Test of the Differential Aptitude Test. Further study of the matrix indicates a rather low correlation of .38 between Arithmetic Computation of the Metropolitan and Numerical Ability of the Differential Aptitude Test.

A correlation of .53 exists between the two portions of the Metropolitan Achievement Test. A correlation of .53 also is present between marks in eighth grade mathematics and the computation portion of the Metropolitan. These equal correlation coefficients might suggest a similar correlation between the eighth grade marks and the problem solving portion of the Metropolitan. Such is not the case, however, as the actual correlation between those two variables is .29.

Although designed as a predictor of success in algebra, the Lee Test of Algebraic Ability is rather conspicuous in its absence from a place of high correlation with algebra grades. The correlation here of .42 is marked but is far from significant.

With the exceptions of two other places in the matrix, no significantly high correlation can be found between two variables. These exceptions are the relationships between each of the scores on two of the individual tests of the Differential Aptitude Test - Numerical Ability and Verbal Reasoning - and the score derived from the combination of these two tests. The high correlation, above .80 in each case, should be expected from the knowledge that one of the variables being compared is, in fact, a portion of the score of the other variable.

TABLE 9

INTERCORRELATION MATRIX OF VARIABLES
FOR FUNCTIONAL MATHEMATICS STUDENTS

	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{13}
X_1	.46	.18	.21	.25	.45	.14	.01	.03	.27	.35	.10
X_2		.31	.44	.53	.42	.35	.39	.24	.18	.46	.38
X_3			.46	.40	.22	.41	.19	.12	.12	.36	.50
X_4				.71	.35	.48	.27	.13	.15	.48	.50
X_5					.42	.43	.32	.12	.20	.50	.58
X_6						.45	.38	.22	.36	.83	.26
X_7							.30	.12	.13	.86	.44
X_8								.50	.37	.39	.21
X_9									.37	.22	.26
X_{10}										.28	.02
X_{11}											.43

X_1 - Arithmetic average of intelligence test scores
X_2 - Lee Test of Algebraic Ability
X_3 - Eighth grade mathematics mark
X_4 - Arithmetic Computation, Metropolitan Achievement Test
X_5 - Problem Solving, Metropolitan Achievement Test
X_6 - Verbal Reasoning, Differential Aptitude Test
X_7 - Numerical Ability, Differential Aptitude Test
X_8 - Abstract Reasoning, Differential Aptitude Test
X_9 - Spatial Relations, Differential Aptitude Test
X_{10} - Mechanical Reasoning, Differential Aptitude Test
X_{11} - Combination of Verbal Reasoning and Numerical Ability, Differential Aptitude Test
X_{13} - Functional Mathematics mark

TABLE 9

INTERCORRELATION MATRIX OF VARIABLES FOR FUNCTIONAL MATHEMATICS STUDENTS

Eighty-one students comprise the population of functional mathematics students. Twenty-eight of these completed their ninth grade education in 1966, and the remaining fifty-three completed their ninth grade education in 1967.

Not one variable has a significantly high correlation with marks earned in functional mathematics. The highest correlation, .58, exists between the marks of functional mathematics and the derived scores of the Problem Solving Test of the Metropolitan. Marks in eighth grade mathematics and the computation portion of the Metropolitan each have a correlation with marks in functional mathematics of .50.

A relatively high correlation exists between the two portions of the Metropolitan. For this group the correlation coefficient is .71 between these two tests.

A correlation between the Lee Test of Algebraic Ability and marks in functional mathematics is .38. This value of r is not too different from that present with the algebra group.

A correlation of .48 is present between the computation portion of the Metropolitan and the Numerical Ability Test from the Differential Aptitude Test. This coefficient is .10 greater than the coefficient between the same two variables for the algebra group.

A high correlation is present between the Verbal

Reasoning score and the combined score of Verbal Reasoning and Numerical Ability. Likewise, a high correlation exists between Numerical Ability and the combined score. Each of these correlations is greater than .80.

TABLE 10

INTERCORRELATION MATRIX OF VARIABLES
FOR BASIC MATHEMATICS STUDENTS

	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{14}
X_1	.45	.28	.49	.45	.39	.06	.45	.18	.19	.32	.30
X_2		.38	.54	.64	.53	.47	.26	.18	.12	.60	.63
X_3			.64	.36	.29	.34	.32	.28	-.17	.33	.56
X_4				.73	.38	.34	.38	.11	-.07	.42	.48
X_5					.65	.34	.31	-.21	-.07	.62	.37
X_6						.37	.27	.06	.22	.87	.40
X_7							.03	.12	-.14	.75	.55
X_8								.41	.31	.26	.42
X_9									.43	.08	.40
X_{10}										.11	.06
X_{11}											.54

X_1 - Arithmetic average of intelligence test scores
X_2 - Lee Test of Algebraic Ability
X_3 - Eighth grade mathematics mark
X_4 - Arithmetic Computation, Metropolitan Achievement Test
X_5 - Problem Solving, Metropolitan Achievement Test
X_6 - Verbal Reasoning, Differential Aptitude Test
X_7 - Numerical Ability, Differential Aptitude Test
X_8 - Abstract Reasoning, Differential Aptitude Test
X_9 - Spatial Relations, Differential Aptitude Test
X_{10} - Mechanical Reasoning, Differential Aptitude Test
X_{11} - Combination of Verbal Reasoning and Numerical Ability, Differential Aptitude Test
X_{14} - Basic Mathematics mark

TABLE 10

INTERCORRELATION MATRIX OF VARIABLES FOR BASIC MATHEMATICS STUDENTS

The total number of students in this group is thirty-five. Eighteen students were graduated from the ninth grade in 1966, and seventeen of them were graduated in 1967.

Of the data collected one aspect which is noticeably different from that of the two previous groups is the correlation which exists between the Lee Test of Algebraic Ability and marks in basic mathematics. The correlation of .63 between these two variables is much higher than for either of the other groups.

A relatively high correlation of .64 exists between marks in eighth grade mathematics and the computation portion of the Metropolitan.

In this group, marks in eighth grade mathematics have the second highest correlation with marks in basic mathematics. However, that correlation of .56 ranks second, only slightly ahead of the correlation of .55 between the Numerical Ability Test of the Differential Aptitude Test and marks in basic mathematics.

As should be expected, both from the previous groups and the nature of the tests, a high correlation is present between the combined score of the Verbal Reasoning and Numerical Ability Tests of the Differential Aptitude Tests and each of those individual scores.

CHAPTER V

SUMMARY AND CONCLUSIONS

SUMMARY

The purpose of this study was to evaluate practices currently used to aid incoming ninth grade students in selecting a mathematics course at Jefferson Junior High School. More specifically, it was designed to determine of what value these current practices are in predicting success in ninth grade mathematics.

The investigation was conducted in order to find more reliable information which might be used in predicting success. It was further planned to yield information to enable a student to plan his academic future more realistically.

In addition, the investigation was conducted with the hope that it might provide information regarding local norms, contribute useful information regarding the testing program, and indicate topics in which more research is needed.

CONCLUSIONS

The lowness of the mean of the marks in algebra, when compared to those in both functional and basic mathematics, probably can be accounted for by the nature of the different courses. Predominantly, the functional and basic mathematics courses consist of review of previously learned material, with an emphasis on computational skills. The algebra course, on the other hand, contains many new areas of learning and requires the use of a logical reasoning process. In addition to the difference in the content of each course, the self-directing approach used in the algebra course probably has an adverse effect on the marks received by some of the students.

For predicting success in algebra, the Lee Test of Algebraic Ability does not sufficiently serve its purpose. Two other variables are more likely to provide a more valid prediction than the Lee Test. These variables are (1) final mark in eighth grade mathematics and (2) grade equivalence on the computation portion of the Metropolitan Achievement Test.

No very significant correlation exists between any of the predictors and marks received in functional mathematics. However, the grade equivalence of the problem solving portion of the Metropolitan Achievement Test is probably the best predictor of success in functional mathematics.

The score from the Lee Test of Algebraic Ability probably can be the most useful predictor with reference to a final mark in basic mathematics.

With the exception of the correlation between the final mark in eighth grade mathematics and the final mark in algebra, there is no truly significant correlation between any predictor and the final mark in ninth grade mathematics.

The relatively low correlation between algebra marks and the Lee Test scores indicates a need for further investigation of a more valid predictive instrument. The existence of several other algebra aptitude tests indicates that a test more applicable to this local situation might be found.

RECOMMENDATIONS

Finally, it is the opinion of this writer that a continual longitudinal study needs to be carried out in the area of predicting academic success at the local level. It is hoped that the information contained in this study will be utilized both in counseling with students at Jefferson Junior High School and as a step toward further educational research.

APPENDIX

APPENDIX A

Linear correlation such as is being used in this study implies a relationship that can be expressed by a straight line, called a regression line.

The equation for the regression line for predicting some score, Y, from a known score, X, is

$$Y = r\left(\frac{s_y}{s_x}\right)(X - \bar{X}) + \bar{Y}$$

in which (1) r is the correlation between X and Y; (2) s_y and s_x are the standard deviations of Y and X respectively; (3) $\bar{X}$ and $\bar{Y}$ are the means of X and Y respectively.

The tables on the following page are equations of lines of regression for predicting ninth grade marks in mathematics. The equations illustrated are those containing the four variables of highest correlation with the appropriate mathematics mark. In each case, Y represents the predicted score.

TABLE 11

EQUATIONS OF LINES OF REGRESSION
FOR PREDICTING ALGEBRA MARKS

$$Y = 1.245X_3 - 1.80$$

$$Y = 0.520X_4 - 3.06$$

$$Y = 0.021X_7 + 0.13$$

$$Y = 0.055X_2 - 0.80$$

TABLE 12

EQUATIONS OF LINES OF REGRESSION
FOR PREDICTING FUNCTIONAL MATHEMATICS MARKS

$$Y = 0.411X_5 - 1.25$$

$$Y = 0.614X_3 + 1.07$$

$$Y = 0.382X_4 - 0.76$$

$$Y = 0.012X_7 + 1.60$$

TABLE 13

EQUATIONS OF LINES OF REGRESSION
FOR PREDICTING BASIC MATHEMATICS MARKS

$$Y = 0.052X_2 + 0.74$$

$$Y = 0.830X_3 + 1.30$$

$$Y = 0.028X_7 + 1.47$$

$$Y = 0.023X_{11} + 1.46$$

X_2 - Lee Test of Algebraic Ability
X_3 - Eighth grade mathematics mark
X_4 - Arithmetic Computation, Metropolitan Achievement Test
X_5 - Problem Solving, Metropolitan Achievement Test
X_7 - Numerical Ability, Differential Aptitude Test
X_{11} - Combination of Verbal Reasoning and Numerical Ability, Differential Aptitude Test

APPENDIX B

TABLE 14

DISTRIBUTION OF ALGEBRA MARKS ACCORDING
TO MARKS IN EIGHTH GRADE MATHEMATICS

Eighth Grade	Algebra				
	F	D	C	B	A
A			4	5	3
B	4	16	30	8	1
C	10	16	1		
D					
F					

TABLE 15

DISTRIBUTION OF ALGEBRA MARKS BY PER CENT
IN RELATION TO MARKS IN EIGHTH GRADE MATHEMATICS

Eighth Grade	Algebra				
	F	D	C	B	A
A			33	42	25
B	7	27	51	13	2
C	37	59	4		
D					
F					

TABLE 16

DISTRIBUTION OF ALGEBRA MARKS ACCORDING TO SCORES EARNED ON THE LEE TEST OF ALGEBRAIC ABILITY

Scores on Test of Algebraic Ability	Algebra				
	F	D	C	B	A
60 +			1		
50 - 59	2	4	10	6	4
40 - 49	7	18	14	5	
30 - 39	5	9	9	2	
20 - 29		1	1		
10 - 19					
0 - 9					

TABLE 17

DISTRIBUTION OF ALGEBRA MARKS BY PER CENT IN RELATION TO SCORES EARNED ON THE LEE TEST OF ALGEBRAIC ABILITY

Scores on Test of Algebraic Ability	Algebra				
	F	D	C	B	A
60 +			100		
50 - 59	8	15	38	24	15
40 - 49	16	39	34	11	
30 - 39	16	40	36	8	
20 - 29		50	50		
10 - 19					
0 - 9					

TABLE 18

DISTRIBUTION OF ALGEBRA MARKS
ACCORDING TO I. Q. SCORES

I.Q. Scores	Algebra				
	F	D	C	B	A
135 - 139			1		
130 - 134			1	1	1
125 - 129	1				1
120 - 124	2	4	5	3	
115 - 119	2	6	9		
110 - 114	1	8	8	5	1
105 - 109	3	9	6	1	1
100 - 104	3	4	4	2	
95 - 99	1	1		1	
90 - 94	1		1		
85 - 89					
80 - 84					
75 - 79					
70 - 74					

TABLE 19

DISTRIBUTION OF FUNCTIONAL MATHEMATICS MARKS
ACCORDING TO MARKS IN EIGHTH GRADE MATHEMATICS

Eighth Grade	Functional				
	F	D	C	B	A
A			1		
B			2	3	
C		5	32	15	
D	1	9	11	2	
F					

TABLE 20

DISTRIBUTION OF FUNCTIONAL MATHEMATICS MARKS BY PER CENT
IN RELATION TO MARKS IN EIGHTH GRADE MATHEMATICS

Eighth Grade	Functional				
	F	D	C	B	A
A			100		
B			40	60	
C		10	62	28	
D	4	39	48	9	
F					

TABLE 21

DISTRIBUTION OF FUNCTIONAL MATHEMATICS MARKS ACCORDING TO SCORES EARNED ON THE LEE TEST OF ALGEBRAIC ABILITY

Scores on Test of Algebraic Ability	Functional				
	F	D	C	B	A
60 +					
50 - 59			1	1	
40 - 49		2	10	8	
30 - 39		7	24	10	
20 - 29	1	5	9	1	
10 - 19			2		
0 - 9					

TABLE 22

DISTRIBUTION OF FUNCTIONAL MATHEMATICS MARKS BY PER CENT IN RELATION TO SCORES EARNED ON THE LEE TEST OF ALGEBRAIC ABILITY

Scores on Test of Algebraic Ability	Functional				
	F	D	C	B	A
60 +					
50 - 59			50	50	
40 - 49		10	50	40	
30 - 39		17	58	25	
20 - 29	7	31	55	7	
10 - 19			100		
0 - 9					

TABLE 23

DISTRIBUTION OF FUNCTIONAL MATHEMATICS MARKS
ACCORDING TO I.Q. SCORES

	Functional				
I.Q. Scores	F	D	C	B	A
135 - 139					
130 - 134					
125 - 129					
120 - 124			2	1	
115 - 119			5	2	
110 - 114		1	6	1	
105 - 109		7	10	8	
100 - 104	1	2	13	3	
95 - 99		4	3	5	
90 - 94			5		
85 - 89			2		
80 - 84					
75 - 79					
70 - 74					

TABLE 24

DISTRIBUTION OF BASIC MATHEMATICS MARKS
ACCORDING TO MARKS IN EIGHTH GRADE MATHEMATICS

Eighth Grade	Basic				
	F	D	C	B	A
A					
B					
C				4	
D		4	15	4	
F	1	4	2	1	

TABLE 25

DISTRIBUTION OF BASIC MATHEMATICS MARKS BY PER CENT
IN RELATION TO MARKS IN EIGHTH GRADE MATHEMATICS

Eighth Grade	Basic				
	F	D	C	B	A
A					
B					
C				100	
D		17	66	17	
F	12.5	50	25	12.5	

TABLE 26

DISTRIBUTION OF BASIC MATHEMATICS MARKS ACCORDING TO SCORES EARNED ON THE LEE TEST OF ALGEBRAIC ABILITY

Scores on Test of Algebraic Ability	Basic				
	F	D	C	B	A
60 +					
50 - 59					
40 - 49				1	
30 - 39		1	3	4	
20 - 29		4	9	3	
10 - 19		3	5	1	
0 - 9	1				

TABLE 27

DISTRIBUTION OF BASIC MATHEMATICS MARKS BY PER CENT IN RELATION TO SCORES EARNED ON THE LEE TEST OF ALGEBRAIC ABILITY

Scores on Test of Algebraic Ability	Basic				
	F	D	C	B	A
60 +					
50 - 59					
40 - 49				100	
30 - 39		13	37	50	
20 - 29		25	55	20	
10 - 19		33	56	11	
0 - 9	100				

TABLE 28

DISTRIBUTION OF BASIC MATHEMATICS MARKS ACCORDING TO I.Q. SCORES

I.Q. Scores	Basic				
	F	D	C	B	A
135 - 139					
130 - 134					
125 - 129					
120 - 124					
115 - 119					
110 - 114				1	
105 - 109		2	6	1	
100 - 104			1	3	
95 - 99		3	2	1	
90 - 94		1	5	2	
85 - 89		1	2		
80 - 84		1	1	1	
75 - 79	1				
70 - 74					

APPENDIX C

TABLE 29

MEANS AND STANDARD DEVIATIONS OF VARIABLES OF ALL NINTH GRADE MATHEMATICS STUDENTS

Variable	Mean	Standard Deviation
X_1	106.71	9.810
X_2	37.57	10.554
X_3	2.07	.883
X_4	8.09	1.281
X_5	8.58	1.371
X_6	59.79	24.839
X_7	53.63	29.370
X_8	53.21	26.507
X_9	49.89	28.798
X_{10}	56.53	26.232
X_{11}	57.99	27.965
X_{15}	1.89	.841

X_1 - Arithmetic average of intelligence test scores
X_2 - Lee Test of Algebraic Ability
X_3 - Eighth grade mathematics mark
X_4 - Arithmetic Computation, Metropolitan Achievement Test
X_5 - Problem Solving, Metropolitan Achievement Test
X_6 - Verbal Reasoning, Differential Aptitude Test
X_7 - Numerical Ability, Differential Aptitude Test
X_8 - Abstract Reasoning, Differential Aptitude Test
X_9 - Spatial Relations, Differential Aptitude Test
X_{10} - Mechanical Reasoning, Differential Aptitude Test
X_{11} - Combination of Verbal Reasoning and Numerical Ability, Differential Aptitude Test
X_{15} - Ninth grade mathematics mark

TABLE 30

INTERCORRELATION MATRIX OF VARIABLES
OF ALL NINTH GRADE MATHEMATICS STUDENTS

	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{15}
X_1	.65	.54	.55	.58	.62	.51	.42	.31	.33	.62	.03
X_2		.69	.70	.74	.65	.68	.56	.38	.29	.73	.15
X_3			.78	.73	.59	.69	.53	.37	.24	.71	.19
X_4				.81	.59	.69	.50	.34	.22	.71	.18
X_5					.68	.69	.52	.32	.27	.75	.10
X_6						.67	.55	.38	.34	.89	.08
X_7							.51	.39	.25	.92	.17
X_8								.53	.35	.58	.09
X_9									.37	.42	.09
X_{10}										.31	-.04
X_{11}											.13

X_1 - Arithmetic average of intelligence test scores
X_2 - Lee Test of Algebraic Ability
X_3 - Eighth grade mathematics mark
X_4 - Arithmetic Computation, Metropolitan Achievement Test
X_5 - Problem Solving, Metropolitan Achievement Test
X_6 - Verbal Reasoning, Differential Aptitude Test
X_7 - Numerical Ability, Differential Aptitude Test
X_8 - Abstract Reasoning, Differential Aptitude Test
X_9 - Spatial Relations, Differential Aptitude Test
X_{10} - Mechanical Reasoning, Differential Aptitude Test
X_{11} - Combination of Verbal Reasoning and Numerical Ability, Differential Aptitude Test
X_{15} - Ninth grade mathematics mark

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