PREDICTIVE VALIDITY OF CERTAIN CRITERIA FOR FIRST YEAR ALGEBRA

BY

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PREDICTIVE VALIDITY OF CERTAIN CRITERIA

FOR FIRST YEAR ALGEBRA

A Research Paper

Presented to

the Graduate Council

Austin Peay State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts in Education

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by

Beatrice Boehms Jobe

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To the Graduate Council:

I am submitting herewith a Research Paper written by Beatrice Boehms Jobe entitled "Predictive Validity of Certain Criteria for First Year Algebra." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts in Education with a major in Mathematics.

William G. Stokes

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Chapter 1

INTRODUCTION

Wise selection of students for first-year algebra and general mathematics courses in the ninth grade has been a pressing problem in our schools for many years. The complexity of our present age has placed even greater demands on guidance personnel and mathematics teachers. There exists an ever-increasing shortage of those with mathematical training to satisfy the ever-increasing demands for persons with such an educational background. Early recognition of students with mathematical talents, and cultivation of these abilities and interests to the greatest extent possible, should be a major goal of our educational systems.

The change in our mathematics curriculum, with more content being taught at a lower grade, has increased the desirability of predicting mathematics ability at an earlier level. In a study made by The Committee on the Undergraduate Program in Mathematics (1961), the recommendation was that college mathematics begin with calculus. They recommended that all calculus prerequisites, including analytic geometry, be taught in high school (CUPM, 1962). For the college-bound high school student to take algebra in the ninth grade is very important and for the most capable students to begin it in the eighth grade may be desirable. Early selection of those who are mathematically capable would enable the elementary teachers to cultivate this ability to the fullest extent possible.

How can the average elementary teacher tell if a child has the ability to advance to algebra at the proper time, and how soon can this prediction be made? Much has been written about predictive criteria in the eighth grade, and a review of related literature revealed that the single best predictor of success in algebra seems to be the eighth grade mathematics grade. No reference was found regarding the use at a level earlier than the eighth grade of predictive criteria for success in algebra. Since early recognition of these students is so important, the results of the arithmetic subtests of the Stanford Achievement Test given in the fourth grade were used as predictive criteria in this study. Two accounts of this test being used to predict success in algebra were reviewed. Since results of the Metropolitan Achievement Test given in the eighth grade were available in the local school system, scores on the arithmetic subtests of this test were also chosen as predictive variables in this study. No account of the use of this test as a means of predicting success in algebra was found in related literature. Eighth grade mathematics grades were also used to see if results of this study were somewhat comparable to earlier research on the subject.

The purpose of this research was basically to study factors which relate to success in algebra in the Dickson County School System. It was expected that those students for which the predictive criteria indicated success would take algebra in the ninth grade or sooner and others would take general mathematics.

In order to make the placement of students in general mathematics or algebra in the ninth grade, the guidance personnel or responsible teacher must be able to use information which is readily available. For that reason the source of data for this study was the cumulative records of the subject with the exception of arithmetic scores from the Stanford Achievement Test administered in the fourth grade. Although these scores are presently posted on the cumulative records of fourth graders, they were kept in the files of the elementary schools at the time these subjects were in the fourth grade. The dependent variable, or the variable upon which judgment of success in algebra was based, was the final average grade received in the ninth grade. The independent variables were: (1) eighth grade mathematics grade; (2) eighth grade scores on Metropolitan Achievement Test in arithmetic computation and in problem solving; and (3) fourth grade scores on subtests of Stanford Achievement Test in arithmetic computation, in arithmetic reasoning, and on arithmetic average.

computation score, and the fourth grade SAT arithmetic average score as predictors of success in first-year algebra.

Chapter 2

REVIEW OF LITERATURE

There has been much written on the subject of the prediction of success in algebra as well as prediction of success in other subjects or vocations. This chapter contains summaries of studies related to the prediction of success in algebra. The variables used, methods of analysis, and summary of results were included in each. This resume provided a background for the present study.

Douglass (1935) presented a summary of studies relating to this subject prior to 1935. He published a table of correlation coefficients between scholastic success in high school mathematics and a number of predictive bases. He concluded that achievement in algebra and geometry might be predicted with only a fair degree of accuracy. He said that achievement cannot be successfully predicted with any one variable for purposes of homogeneous or ability groups or for definite advice regarding taking or not taking algebra or geometry. A combination of the following variables, according to Douglass, seemed the best predictor of achievement: (1) a good prognostic test, (2) I.Q., and (3) average mark in previous year or two years of school work.

A study of prognosis in high school algebra using junior high students for whom the desired data was available was made by Layton (1941). The following were used as independent variables: (1) The Test of Algebra Ability, (2) New Stanford Arithmetic Test, (3) Otis-SA Test of MA, (4) eighth grade mathematics grades, and (5) chronological ages. These tests were given at the end of the eighth grade or beginning of ninth grade. The dependent variables were algebra grades and Cooperative Algebra Test scores obtained at the close of the ninth grade.

Simple correlations were used to determine prediction within crucial limits of mastery or superiority by a single measure. Multiple correlations were used to determine prediction of mastery or superiority by various combinations of the criteria.

Results indicated that the eighth grade mathematics grade is the single most valid criterion for predicting individual attainment in algebra. That the correlation of the eighth grade mathematics grade with algebra grade was higher than that of eighth-year mathematics grade with Cooperative Algebra Test was explained by the uniformity that seemingly existed in the grading systems used in the mathematics classes of the two grades.

The multiple correlations revealed that eighth grade mathematics grades alone were as good a predictor as a combination of eighth grade mathematics grades with the other four variables. It was noted that what might be the best criterion for mastery or superiority of algebra in one school situation might not be the same in another.

The purpose of a study made by Guiler (1944) was to investigate the following:

1. the comparative value of certain standardized measures of algebra aptitude, or arithmetic achievement, and of initial algebra achievement in forecasting success in elementary algebra

2. the degree to which this success can be predicted from various combinations of three predictive measures.

The predictive measures used were Iowa Algebra Aptitude Test, Christofferson-Rush-Guiler Analytical Survey Test in computational arithmetic, and Form A of Breslich Algebra Survey Test. The latter was given at the end of the first semester of work in algebra.

Pearson product-moment correlations were used to study the relationships between predictive measures and semester achievement in algebra. A plan was used to determine how well the pupils' semester achievement placement was forecasted by placement on the predictive measures.

One conclusion was that the predictive values in this study were somewhat higher than those reported in any of the related studies in which standardized algebra survey tests were used to measure achievement. Another result of the study was that the initial test in algebra did not add enough predictive value to justify its inclusion in the battery. The writer felt that forecasting efficiency might have been improved by using items like study habits, pupil motivation, teacher personality and skill, and home and school relationships.

Guiler's study contained an extensive review of related research with a summary of the studies in which teacher's marks were used as criteria of achievement with scores on arithmetic achievement tests being used as predictive measures.

Sister Mary Rosilda (1951) conducted research to study if I.Q. was an index to algebraic ability and to show to what extent one's I.Q. might be a determining factor in the mastery of algebra. In the latter part of the ninth grade, her subjects were given the Cooperative Elementary Algebra Test to determine algebraic achievement. The California Test of Mental Maturity was used to determine intelligence quotient.

A correlation coefficient of 0.42 was found between the two tests which the author interpreted as showing negligible relationship. Calculations showed only 10 percent of the students having an intelligence quotient of more than 120 made a score below the fiftieth percentile and as many as 32.4 percent of students with an intelligence quotient less than 90 made scores above the fiftieth percentile. This seemed to indicate a moderate relationship between intelligence quotient and ability to master algebra, according to the investigator. However, in individual cases I.Q. was not considered an indicating factor in mastery of algebra since a number of students with high intelligence quotients made scores below the fiftieth percentile on the algebra test.

Callicutt (1961) made efforts to determine the relationship between success in algebra and four variable factors: (1) intelligence, (2) achievement on mathematics test, (3) eighth grade composite grades, and (4) eighth grade mathematics grades. He strived to obtain a sample of ninth grade students representative of the total city enrollment in the ninth grade by arbitrarily choosing fifty students from each of three schools representing a broad section of economic backgrounds. The sample included an equal number of boys and girls.

The Lorge-Thorndike I.Q., level four, verbal test was administered to the subjects in November of their ninth grade school year. The Stanford Achievement Test was administered in May prior to the ninth grade school year. The raw scores on arithmetic computation and arithmetic reasoning were averaged. Final eighth grade marks in arithmetic, English, history, and science were averaged to be used as the composite score. Mastery of success in algebra was based on the first semester's algebra grades obtained from the teacher's class record book.

Determined in the analysis of data were scatter diagrams, Pearson product-moment correlations, intercorrelations, and standard error of correlations. A correlation of 0.58 between eighth grade mathematics grades and algebra achievement was found and considered significant. This grade was a better basis for prognosis than intelligence quotient, achievement test scores, or eighth grade composite scores. The correlation between scores on the arithmetic sections of the Stanford Achievement Test and algebra grade was 0.56.

In research conducted by Barnes and Asher (1962), the following data were used as predictors of success with ninth algebra grades used as criterion of success:

1. seventh grade mathematics grade
2. eighth grade mathematics grade
3. seventh grade reading grade
4. eighth grade reading grade
5. eighth grade intelligence test scores
6. seventh grade arithmetic total score on achievement test
7. eighth grade arithmetic total score on achievement test
8. eighth grade algebra prognosis test scores.

The subjects were one hundred ninety-two students having six different algebra teachers from two junior high schools in the community. Intercorrelations and multiple correlations were used and a multiple regression equation was found using an IBM 7070 computer. Means and standard deviations for each variable were also computed.

The best single predictor of success in algebra was found to be the eighth grade mathematics grade. The only other variable greatly raising the multiple correlation was the grade-equivalent score on the arithmetic part of the achievement test given near the end of the seventh grade.

Osburn and Melton (1963) studied the prediction of proficiency in a modern and traditional course of beginning algebra. Three groups of each type of class which were reasonably comparable as to initial ability were used as subjects.

Predictive measures used were: (1) the Iowa Algebra Aptitude Test, revised edition; (2) the Orleans Algebra Prognosis Test, revised edition; (3) the SRA Primary Mental Abilities, third edition; and (4) the Differential Aptitude Tests, Form A. Proficiency measures were three proficiency tests given during the year, the Cooperative Algebra Test, and a final examination in first year algebra.

The Iowa Algebra Aptitude Test and the Orleans Prognosis Test showed validity in predicting proficiency in both groups. The SRA Primary Mental Abilities test showed lower validities than the other two, but the pattern of correlations tended to be rather consistent across the proficiency tests. Both space and word fluency subtests showed higher correlations for experimental (modern) math groups, particularly on the three proficiency tests given during the year of ninth grade algebra. Verbal meaning and reasoning were generally the best predictors of success, and numbers was the least effective.

The best predictors of achievement in algebra in the Differential Aptitude Test Battery were verbal reasoning and numerical ability subtest scores. The sum of these two scores showed validities of the same magnitude as those of the Iowa Algebra Aptitude Test and the Orleans Algebra Prognosis Test. The Differential Aptitude mechanical reasoning and space relations scores showed higher correlations in the modern math courses, whereas the spelling test showed consistently higher validities for traditional algebra.

The results of this study might suggest a method of determining placement in a traditional or in a modern course of algebra, but the authors felt that the study was not conclusive.

The purpose of research conducted by Ivanhoff and DeWane (1965) was to determine whether, on bases of entrance data of freshmen students at a certain high school, it was possible to discriminate between students who successfully completed ninth grade algebra and those who completed the general mathematics program.

The subjects included a total of 448 students from a boys' school selected over a successive two-year period. The dependent variable was whether the student successfully completed the algebra course or whether he completed the general mathematics course. Independent variables were: (1) I.Q., (2) Reading, Arithmetic, Language, and Composite Scores on High School Placement Test, and (3) eighth grade mathematics mark.

The data was processed in an IBM 1620 computer using a two-group multiple variable stepwise discriminant analysis program written in Fortran II by Monroe. The Composite score on the High School Placement Test was found to be the best means of discriminating between students who successfully completed ninth grade algebra or general mathematics, although all six of the predictor variables were related to the criterion beyond the 0.01 level of significance. The writers concluded that the use of discriminant analysis was a feasible and practical way to select students for programs in high school mathematics.

Impellitteri (1967) also used the High School Placement Test as a predictor of success, but in ninth grade academic achievement in general rather than just in mathematics. It was found that the Composite Score on the High School Placement Test individually was as useful a predictor of final ninth grade achievement as either of the subtests of the High School Placement Test or a composite of them as computed in the multiple regression analysis.

Sabers and Feldt (1968) designed a study concerned with the predictive validity of the third edition of the Iowa Algebra Aptitude Test for prognosis in ninth grade modern math and traditional algebra. Since one part of this test was specifically designed to assess unique abilities which might be required in newer mathematics courses, the test was divided into four part scores and a total score.

Subtest scores of the Iowa Test of Basic Skills and the Iowa Test of Educational Development (1960 edition) were also used in the analysis as predictive variables. Criteria of success were achievement tests designed by the writers and math teachers as well as teachers' marks of achievement. The latter was exclusive of such factors as homework, neatness, or tardiness in turning in assignments.

Correlations and multiple correlations were used in the analysis of data. Results were that the Iowa Algebra Aptitude Test possessed relatively high validity and the sum of part scores was a satisfactory way of arriving at a composite score for the total test. Scores from the Iowa Test of Basic Skills and Iowa Test of Educational Development were also found to be valid predictors, and the authors concluded that the special algebra prognosis test might be an unnecessary luxury in most schools.

Various measures of prognosis in algebra were used in the studies that have been summarized in this chapter.

The criterion measure most commonly used was the semester or final average in first-year algebra although some experimenters used standardized tests. In each of the sources of related research there was found to be a significant predictor of success. The predictive measures most commonly used seemed to be the eighth grade mathematics grade and the Iowa Algebra Aptitude Test. The most general conclusion that could be stated as a result of the review of literature was that the eighth grade mathematics scores were the single variable found most often to seemingly be the best predictor of success in algebra. Callicutt (1961), Layton (1941), and Barnes and Asher (1962) all reached this conclusion based on their research. The only contradiction to this was Ivanhoff and DeWane (1965) who found the composite score on the High School Placement Test to be a better predictor of success than the eighth grade mathematics score. These researchers found, however, that the eighth grade mathematics score correlated significantly with success in algebra.

The statistic used to determine the single best predictor and to determine if there existed a common variance between two variables was the correlation coefficient. Several of the studies also used the multiple coefficient and multiple regression equation to determine what combination of the predictors was the best. A discriminant analysis was used in one case.

Chapter 3

DESIGN OF THE EXPERIMENT

The problem in this experiment was to investigate the predictive validity of certain criteria for success in algebra in Dickson County schools. The criterion, or dependent variable, was the final average grade in algebra based upon 100 percent. Other means of measuring success such as standardized tests might have been used, but the measure of success according to the pupils, teachers, and school is ordinarily the final average grade in the subject. Hence, this seemed the reasonable criterion for this experiment.

The predictive measures, or independent variables, were:

1. eighth grade mathematics grade using four-point system (A = 4, B = 3, C = 2, D = 1, and F = 0 points);

2. eighth grade scores on Metropolitan Achievement Test in arithmetic computation (using percentile score);

3. eighth grade scores on Metropolitan Achievement Test in arithmetic problem solving (using percentile scores);

4. fourth grade scores on Stanford Achievement Test in arithmetic computation (using grade-equivalent scores);

5. fourth grade scores on Stanford Achievement Test in arithmetic reasoning (using grade-equivalent scores);

6. fourth grade scores on Stanford Achievement Test on arithmetic average (using grade-equivalent scores).

All of this information is now readily available to school personnel although it was not for this particular class. The Stanford Achievement Test subtest scores were on file in the elementary school office of one feeder school for their students only; consequently, a large number of possible subjects had to be eliminated from the study. To compensate for this, the study consisted of two phases. The sample for the first phase contained forty-eight students selected from the 1968-69 Dickson High School first-year algebra classes. The sample for the second phase consisted of fifty students from both Dickson High School and Charlotte High School first-year algebra classes. These subjects were chosen at random by assigning each a number and using a partial Table of Random Numbers (Bryant, 1960).

The data for both phases of the study was accumulated and then processed by an IBM 1401 electronic computer using a revised form of a program written by an Austin Peay State University student (Sexton, 1969). The program computed the Pearson, or product-moment, correlation coefficients; standard deviations; means; sums of dependent variables and sums of their squares; and sums of independent variables and sums of their squares. The computational formula used in writing the program was from Spence (1968:121).

Reference was made to a table of significance in Spence (1960:236) to determine the significance of the correlations obtained. Unfortunately, no satisfactory formula was readily available to test for significance of the differences between the correlations within a sample. Formulas given by Garrett (1953) for standard error of the difference between two "z" coefficients and for critical ratio were used to determine if differences between the correlations found in the two different samples were significant.

Chapter 4

ANALYSIS OF DATA

The data was submitted to the IBM 1401 digital computer, and computations were performed which resulted in correlations of the independent variables with the dependent variable along with standard deviations, means, sums, and sums of squares of all variables. Tables 1 and 2 indicate the results relative to each phase of the study. Note that all of the obtained correlations were clearly significant at the 0.01 level of confidence for both phases of the study. Consequently, the hypothesis was rejected that these correlations would not be different from zero. It was concluded that there is some linear correlation between success in first-year algebra and each of the predictive measures in the population from which our subjects were drawn.

Upon analysis of the correlations of independent variables with the first-year algebra grade, it is noted from Tables 1 and 2 that the highest correlation was between success in algebra and eighth grade mathematics grade. The second highest correlation was between success in algebra and the eighth grade score on Metropolitan Achievement Test arithmetic problem solving subtest. This

Table 1

A Comparison of Predictive Measures and Ninth Grade Final Grades for Algebra in Phase One of Study

Predictive Measures	N	r	Mean	S. D.
Eighth Grade Math Grade	48	0.716	3.042	0.611
MAT Arithmetic Problem Solving (given in eighth grade)	48	0.663	64.813	21.347
SAT Arithmetic Computation (given in fourth grade)	48	0.604	4.471	0.617
SAT Arithmetic Average (given in fourth grade)	48	0.572	4.777	0.699
SAT Arithmetic Reasoning (given in fourth grade)	48	0.532	5.021	0.877
MAT Arithmetic Computation (given in eighth grade)	48	0.503	46.917	17.788

Note: r at 1 percent level of confidence is 0.368

r at 5 percent level of confidence is 0.285

Table 2

A Comparison of Predictive Measures and Ninth Grade Final Grades for Algebra in Phase Two of Study

Predictive Measures	N	r	Mean	S. D.
Eighth Grade Math Grade	50	0.752	3.157	0.751
MAT Arithmetic Problem Solving (given in eighth grade)	50	0.577	61.588	22.580
MAT Arithmetic Computation (given in eighth grade)	50	0.441	48.843	22.040

Note: r at 1 percent level of confidence is 0.361

r at 5 percent level of confidence is 0.279

was true in both phases of the study. The correlation between algebra grade and the fourth grade score on Stanford Achievement Test arithmetic computation subtest was third highest. The least significant correlation was surprisingly that between the subtest score on the eighth grade Metropolitan Achievement Test arithmetic computation and success in algebra. Ranking above this correlation were all three of the correlations between the fourth grade Stanford Achievement Test results and success in algebra.

In order to test the second hypothesis of our study, a measurement of the difference between two correlations obtained from the same sample was needed. According to Garrett (1953), this presents certain complications because correlations from the same group are presumably correlated and there are no satisfactory formulas for computing the significance of the relationship between two correlated distributions. Also, there is no direct method for determining correlations between the corresponding Fisher "z" scores. However, Garrett (1953:240) feels sure that

> ...if the correlations are positively correlated in our group, and the Critical Ratio as determined by the Standard Error is significant, that the Critical Ratio would be even more significant if the correlations between the correlations were known.

In view of this information and using the formulas for standard error of the difference between two "z" coefficients and for critical ratio given by Garrett (1953), correlations were converted into Fisher's "z" functions and the investigator attempted to determine the significance of the greatest difference existing between any two correlations in the first phase of the study. If this test had proved significant, the next largest difference would have been tested.

The greatest difference existed between the correlations of algebra grade average with eighth grade mathematics grade and of algebra with eighth grade Metropolitan Achievement subtest score on arithmetic computation. These correlations were 0.716 and 0.503, respectively. The difference between these correlations (assuming they were not from the same sample) was not significant, so no conclusion could be drawn about the significance of differences between the correlations in this phase of the study.

In the second phase of the study using a random sample from Dickson High School and Charlotte High School, the largest difference between correlations existed between those for eighth grade mathematics grade and for eighth grade Metropolitan Achievement Test arithmetic computation subtest. These correlations were 0.752 and 0.441, respectively. The difference between these correlations proved significant at the 0.05 level, so if the correlations are positively correlated within the sample, according to Garrett (1953), this significance of difference can be accepted. Similar tests revealed no other significant differences between the correlations within the sample of the second phase of this study.

The question of whether or not there was a significant difference between corresponding correlations obtained in the first and second phase of the study was tested using the formulas for standard error and critical ratio. Since the greatest difference existed between the correlations of algebra grade with Metropolitan Achievement Test problem solving score, these correlations were used first. The resulting critical ratio was 0.62 which was much less than the required 1.96 for significance at the 0.05 level. Thus, it was concluded there was no significant difference between any correlation of the first phase and a corresponding correlation of the second phase of the study.

The relationship of the arithmetic problem solving subtest score to the arithmetic computation subtest score at the different grade levels and on the different achievement tests was of interest. Note from Table 1 that at the eighth grade level, Metropolitan Achievement Test arithmetic problem solving scores correlated higher with first-year algebra grades than did arithmetic computation scores. This was reversed at the fourth grade level on the Stanford Achievement Test since the correlation of arithmetic computation scores with achievement in algebra ranked above the correlation of arithmetic reasoning with achievement in algebra. Hence, at the fourth grade level a student's arithmetic computational ability on this particular test seemed a better predictor of achievement in algebra than his ability as indicated on the arithmetic reasoning subtest.

Upon analysis of the data, the following regression equation for finding the predicted first year algebra grade from the eighth grade mathematics grade was found:

$$Y \text{ (predicted)} = 9.409X + 59.545.$$

The standard error of the algebra grade predicted from this equation is 5.572. Hence, the probability is high ($P = .95$) that the predicted grade does not miss the actual grade by more than ($\pm 5.572 \times 1.96$), or 10.92 points.

The regression equation for finding the predicted algebra grade from the fourth grade Stanford Achievement Test arithmetic computation score was:

$$Y \text{ (predicted)} = 7.860X + 53.025.$$

The standard error of the estimate was 6.423.

An example of how this equation might be used is to determine the limits of the eighth grade mathematics mark a pupil must have in order to probably make 75 percent in algebra, a minimum passing score. Solving for X in the equation

$$75 = 9.409X + 59.545 \pm 10.92,$$

we find the limits are 0.48 to 2.80. If a student is predicted to make a passing grade of 75 in algebra at the 0.05 confidence level, his eighth grade mathematics grade will be within the limits of 0.48 and 2.80, where an A = 4 points, B = 3, C = 2, D = 1, and F = 0. The limits for scores on the fourth grade Stanford Achievement Test arithmetic computation subtest which a pupil must have in order to make a passing grade in algebra were 1.19 to 4.39 based on grade-equivalence scores at the 0.05 confidence level.

Chapter 5

SUMMARY AND CONCLUSIONS

The purpose of this study was to investigate certain criteria which relate to success in first year algebra in the Dickson County school system. Subjects were chosen from the ninth grade classes of two Dickson County high schools during the 1968-69 school year. Data was taken from the cumulative records with the exception of subtest scores on the Stanford Achievement Test given in the fourth grade. This information was not available on many of the students so the study was divided into two phases accordingly. The first phase included forty-eight students from Dickson High School for whom completion of all the desired information was available. The second phase included a sample of fifty students chosen at random from both Charlotte High School and Dickson High School for whom only part of the desired information was available.

The dependent variable, or criterion, was the final average in first year algebra. The independent variables for the first phase of the study were: (1) eighth grade mathematics grade; (2) eighth grade scores on Metropolitan Achievement Test subtests in arithmetic computation and in arithmetic problem solving; (3) fourth grade scores on subtests of Stanford Achievement Test in arithmetic computation, in arithmetic reasoning, and on arithmetic average. The independent variables in the second phase of the study were the same as in the first part excluding the Stanford Achievement Test scores.

Data was collected and analyzed, and eighth-grade mathematics grade seemingly was the best single predictor of success in algebra in both phases of the study. This was consistent with findings in related research. The second best predictor seemed to be the eighth grade Metropolitan Achievement Test score on arithmetic problem solving. The poorest predictor, according to size of correlation, seemed to be the eighth grade Metropolitan score on arithmetic computation. In the first phase of the study, there were indications that the fourth grade Stanford Achievement subtest scores were more related to success in algebra than the eighth grade Metropolitan Achievement computational scores.

On the fourth grade level the best predictor of success in algebra as indicated in this study seemed to be the result of the Stanford Achievement Test subtest in arithmetic computation. The reason for this might be attributed to the limited learning experiences the students have had at this stage of their schooling in actual problem solving or reasoning tasks. The first three or four years in traditional mathematics were devoted primarily to the learning of basic computational skills, and this particular group of students did not begin a study of modern mathematics until after the fourth grade. A later study of this type might show different results.

The poorest predictor of success in algebra seemed to be the eighth grade Metropolitan Achievement Test computational score. Perhaps this was because by the time a child is in the eighth grade he has had ample time to become reasonably proficient in computational skills. The student with mathematical ability will be noticeably more proficient in reasoning or problem solving ability than in computation. These are the skills one would expect to be necessary for achievement in algebra.

All of the correlation coefficients were significant at the 0.05 level which is also consistent with related research. The only difference in correlations found to be significant within either sample was in the second phase of the study between the correlation of success in algebra with eighth grade mathematics grade and the correlation of success in algebra with the eighth grade Metropolitan Achievement Test subtest in arithmetic problem solving. This difference was significant at the 0.05 level. Because of the absence of a satisfactory formula, no other differences could be proved either significant or insignificant except when comparing correlations of one phase of the study with the other. None of these proved to be significantly different, implying that the absence of a random sample in the first phase did not alter to a noticeable extent the validity of the study.

The regression equation for finding the predicted first-year algebra grade using the eighth grade mathematics grade was:

$$Y \text{ (predicted)} = 9.409X + 59.545.$$

The standard error of the predicted algebra grade was 5.572.

The regression equation for determining the predicted first-year algebra grade using the fourth grade Stanford Achievement Test subtest in arithmetic computation was:

$$Y \text{ (predicted)} = 7.860X + 53.025$$

The standard error of the estimate was 6.423.

These equations could be used to determine a pupil's probable passing or failure of algebra based upon the appropriate criteria and within certain limits.

A multiple regression analysis would have been helpful in the analysis of data to determine if a combination of the predictors would give a better prognosis of success in algebra. A computer program was not available for the 1401 computer (the computer available for use by the investigator) so this analysis is suggested for further research.

The use of students from general mathematics classes would have broadened the scope of this study since some of those students might have been successful in algebra. A sample of students from both algebra and general mathematics classes is recommended for use in further study of this subject.

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APPENDIX

Data for Phase One

Subject Number	Algebra I Final Average	Eighth Grade Mathematics Grade*
1	86	3
2	81	3
3	90	3
4	86	3
5	84	3
6	90	3
7	93	4
8	94	4
9	69	2
10	92	3
11	98	4
12	83	3
13	97	4
14	83	3
15	86	3
16	75	2
17	95	3
18	89	3
19	94	3
20	91	3
21	90	4
22	80	2
23	96	4
24	98	4
25	87	3
26	57	2
27	77	2
28	90	4
29	91	3
30	93	3
31	97	4
32	88	3
33	94	3
34	96	3
35	94	3
36	96	3
37	95	4
38	80	3

Data for Phase One (continued)

Subject Number	Algebra I Final Average	Eighth Grade Mathematics Grade*
39	92	3
40	92	3
41	87	2
42	89	3
43	83	2
44	75	2
45	95	3
46	85	3
47	94	3
48	85	3

*A = 4
B = 3
C = 2
D = 1
F = 0

Data for Phase One (continued)

Subject Number	Eighth Grade Metropolitan Achievement Test		Stanford Achievement Test		
			Grade-equivalence Score		
	Arithmetic Computation Percentile Score	Arithmetic Problem Solving Percentile Score	Arithmetic Computation	Arithmetic Reasoning	Arithmetic Average
39	85	87	5.0	4.9	5.0
40	65	90	4.3	5.4	4.9
41	35	43	4.4	5.0	4.7
42	50	75	5.0	5.6	5.3
43	35	65	4.3	5.0	4.7
44	35	40	3.9	4.7	4.3
45	35	73	4.8	5.1	5.0
46	28	40	5.5	4.7	5.1
47	35	80	4.6	5.6	5.1
48	40	40	4.6	3.9	4.3

Data for Phase Two

Subject Number	Algebra I Final Average	Eighth Grade Mathematics Final Grade*	Eighth Grade Metropolitan Achievement Test: Arithmetic Computation Percentile Score	Eighth Grade Metropolitan Achievement Test: Arithmetic Problem Solving Percentile Score
1	81	3	20	43
2	90	3	33	43
3	86	3	40	60
4	90	3	55	80
5	91	3	30	75
6	83	3	65	80
7	97	4	65	85
8	86	3	15	45
9	95	3	45	65
10	91	3	50	80
11	90	4	45	68
12	96	4	35	80
13	87	3	50	70
14	93	3	35	45
15	94	4	35	55
16	57	2	28	35
17	94	4	30	40
18	91	3	45	65
19	93	3	75	65
20	97	4	60	92
21	75	2	10	12
22	98	4	85	80
23	95	4	85	92
24	96	3	35	65
25	98	4	80	92
26	96	3	65	80
27	94	3	65	45
28	95	4	87	92
29	92	3	85	87
30	89	3	50	75
31	83	2	35	65
32	91	3	25	20
33	86	2	15	23
34	78	3	30	30
35	75	2	35	40
36	94	3	35	80
37	[illegible]	4	60	50

Data for Phase Two (continued)

Subject Number	Algebra I Final Average	Eighth Grade Mathematics Final Grade*	Eighth Grade Metropolitan Achievement Test	
			Arithmetic Computation Percentile Score	Arithmetic Problem Solving Percentile Score
39	68	3	50	50
40	89	4	90	80
41	94	4	75	98
42	85	4	75	75
43	76	3	70	40
44	89	4	70	83
45	87	4	20	28
46	73	3	43	65
47	82	3	55	60
48	76	3	65	60
49	86	3	60	75
50	82	3	50	55

*A = 4
B = 3
C = 2
D = 1
F = 0