A COMPARISON OF METHODS USED TO PREDICT SUCCESS IN
NINTH GRADE ELEMENTARY ALGEBRA

by
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ABSTRACT

A Comparison of Methods Used to Predict Success in Ninth Grade Elementary Algebra

by

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A study was conducted at North Cache Junior High School in Richmond, Utah, during the 1967-68 school year to determine an effective method of predicting which students would be able to succeed in algebra in the ninth grade. Eighth grade marks in mathematics, two algebra aptitude test scores, and student self-success ratings were compared with the final algebra grades to determine the best single predictor of success in algebra and to determine the best combined predictors of success.

The best single predictor of success in algebra was the student's final mark in eighth grade mathematics. The best combined predictors of success included the eighth grade marks in mathematics and the Survey Test of Algebra Aptitude scores.

(25 pages)
INTRODUCTION

Since algebra proves to be a difficult subject for many ninth grade students, school administrators and teachers are confronted with the problem of deciding which students should be advised to enroll in algebra each year. The students entering the ninth grade at North Cache Junior High School in Richmond, Utah, have a choice between taking algebra or general mathematics. In the past the placement decisions have been determined by the eighth grade teacher and the school counselor who administered the California Algebra Aptitude Test to all eighth grade students. Since there are generally a large group of students who could conceivably be placed in either algebra or general mathematics, it is a difficult task deciding where to place each student. The problem is to determine an effective and efficient method of predicting which students will be able to succeed in algebra in the ninth grade.

In recent years there has been a trend to offer algebra to select groups of eighth grade students. Although North Cache has not offered algebra to eighth graders, there has been some discussion of it. If they should adopt this policy, there would be an additional need for an effective method of screening students to determine which ones would be successful in algebra.
The objective of this research was to compare the following variables in predicting success in ninth grade elementary algebra at North Cache Junior High School: eighth grade marks in mathematics, algebra aptitude test scores, and student self-success ratings. The following two questions were considered:

1. Which is the best single predictor of success in algebra?

2. Which predictors can be combined in a multiple regression equation to yield the best combined predictors of success in algebra?
In the past numerous studies have attempted to predict algebra success employing a wide variety of predictive instruments. Blick and Braman (1954) studied counseling practices used with students prior to enrollment in elementary algebra and found eighth grade arithmetic marks and the estimate of pupils' ability by eighth grade teachers used most extensively. They reported that achievement test scores and general intelligence test scores were also used frequently and that many schools combined all four factors in counseling students prior to algebra enrollment. In the studies reviewed for this research, it was most frequently found that eighth grade mathematics marks or algebra prognostic tests were the best single predictors although these two factors were seldom considered in the same study.

Layton (1941) compared the predictive value of the Lee Test of Algebraic Ability, the New Stanford Arithmetic Test, intelligence, eighth grade marks in mathematics, and chronological age. He found eighth grade marks in mathematics to be the best basis for prognosis.

Callicutt (1961) also found eighth grade marks in mathematics to be the best predictor of algebra success when he considered the relationship between success in algebra and intelligence, achievement test scores in
mathematics, eighth grade composite grades, and eighth grade marks in mathematics.

A third study which found eighth grade marks in mathematics to be the best single predictor of success in algebra was done by Barnes and Asher (1962) in which they considered the following variables: seventh grade marks in mathematics, eighth grade marks in mathematics, seventh grade reading grades, eighth grade reading grades, intelligence test scores, achievement test mathematics scores in seventh and eighth grades, achievement test reading scores given in seventh and eighth grades, and an algebra prognostic test (Orleans Prognosis Test in Algebra).

Dickter (1933) compared the prognostic value of intelligence, teachers' marks, and a prognostic test (the Rogers Test of Mathematical Ability) for predicting achievement in algebra and found the prognostic test to be the best single predictor.

A study done by Lee and Hughes (1934) also found an algebra aptitude test to be the best single predictor of algebra achievement. They compared the following factors for prediction: Lee Test of Algebraic Ability, Hughes Trait Rating Scale, teachers' ratings on mathematics ability, Kuhlman Anderson Intelligence Test, Terman Group Test of Mental Ability, and chronological age.

Grime (1947) considered intelligence test scores, measures of opinion of achievement in arithmetic, and the
Iowa Algebra Aptitude Test in predicting success in algebra and found the scores on the aptitude test to be the most valuable as predictors.

A study by Shaw (1956), in which he studied factors of intelligence, reading ability, and algebra aptitude (Iowa Algebra Aptitude Test), found the best single predictor of success in algebra to be the aptitude test.

In all of the above studies either eighth grade marks in mathematics or an algebra aptitude test gave the best prediction for success in algebra. However, only two of the studies considered these two variables together as possible predictors.

As a result of a study done in Cleveland on the methods used to select students for algebra and geometry, Kraft (1946) supported aptitude tests for the selection of algebra students. The Cleveland schools used the Iowa Algebra Test at that time. Torgerson (1933), who also supported the use of algebra prognostic tests, did a study comparing the Lee Test of Algebraic Ability, the Orleans Algebra Prognosis Tests, and the Otis Self Administering Test of Mental Ability and found all three tests about equally valid and effective in predicting grades in algebra.

Seagol (1938) found that while the Orleans Prognosis test in algebra was somewhat superior to tests of general intelligence for the prediction of achievement in algebra, the Stanford Arithmetic Test was a better predictor than
either the prognostic test or general intelligence tests. Other studies have also indicated that intelligence test scores do not give accurate predictions of success in algebra.

Lee (1932) found that most studies which correlated intelligence tests with success in various subjects showed a comparatively low correlation between intelligence and success in mathematics. In a study done by Rosilda (1951) to specifically determine the relationship between IQ and algebra achievement, she found that IQ was not an indicating factor for algebra ability in individual cases.

Instead of reporting the best single factors, some studies gave the best combination of factors for predicting success in algebra. Ayers (1934) compared the South Pasadena Prognostic Test in Algebra, 8A Mechanics Tests, 8A Reasoning Tests, teachers' estimate of mathematics ability, and IQ as determined by the Terman Group Test. He found the best combination of these measures to be the prognostic test, 8A reasoning test, and the teachers' estimate of mathematics ability.

As a result of a study done by Dinkel (1959) at Culver City, California, their school uses the Survey Test of Algebraic Aptitude, IQ, and teacher recommendations to predict success in algebra. The variables considered in the study were IQ (California Test of Mental Maturity), Orleans Algebra Prognosis Test, previous teachers' grades, arithmetic competency (Cooperative Math Tests for Grades
7, 8, and 9), and a prognostic test constructed by Dinkel consisting of multiple choice items. Dinkel's test has been lengthened and published as the Survey Test of Algebraic Aptitude.

The two measures used to indicate success in algebra in the previously mentioned studies were either grades received in algebra or algebra achievement test scores. Seagol (1938) and Callicutt (1961) used the first semester algebra grades while Torgerson (1933), Ayers (1934), and Barnes and Asher (1962) used the final algebra grades. Achievement test scores were used by Grover (1932), Dichter (1933), Lee and Hughes (1934), Layton (1941), Grime (1947), Shaw (1956), and Dinkel (1959).

In the studies reviewed for this research, it was consistently found that either eighth grade marks in mathematics or algebra prognostic tests were the best single predictors of success in algebra, but only two of the studies considered these two variables together as possible predictors. These two variables were considered together in the present study with the third variable being a student self-success rating because none of the studies reviewed contained students' predictions of success. For this study, the measure of success in algebra was the final grade which was an average of the four quarterly marks.
METHODS OF PROCEDURE

This study was done at North Cache Junior High School in Richmond, Utah, during the 1967-68 school year. The students involved in the study were those who attended North Cache as eighth and ninth graders. Of the 156 ninth grade students, 90 were enrolled in algebra when school started in the fall of 1967. Four algebra students changed to general mathematics, and one withdrew from school in the middle of the year. A complete set of data could not be obtained for eight of the algebra students so the sample size was reduced to 77 students enrolled in algebra.

In the spring of 1967 the school counselor at North Cache Junior High School supervised the administration of the California Algebra Aptitude Test to all the eighth grade students. At the same time the eighth grade mathematics teacher was asked to indicate which eighth grade students he felt would be successful in ninth grade elementary algebra. On the basis of this information, the students were then placed in either algebra or general mathematics for the following year.

During the first week of the 1967-68 school year, the Survey Test of Algebra Aptitude was given to all the ninth grade students. This test was chosen because it was one of the most recently published tests available, and it was easy to administer and score.
Each student tested was asked to respond to the following questions:

1. Do you think you should be taking algebra?
   yes  no

2. What grade do you expect to receive in algebra?
   A  B  C  D  F

During the first week of the 1967-68 school year, the eighth grade marks in mathematics were obtained from the permanent records kept at North Cache Junior High School. At the close of the school year, the algebra grades were also obtained from the permanent records.

The predictors (students' expected grades, eighth grade marks in mathematics, California Algebra Aptitude Test scores, and Survey Test of Algebra Aptitude test scores) were each correlated with the final algebra grade to determine the best single predictor of success in algebra, and all the predictors were combined in a multiple regression equation to determine the best combined predictors of success in algebra.
RESULTS AND DISCUSSION

Eighth grade marks in mathematics, algebra aptitude test scores, and student self-success ratings were compared in order to determine the best single predictor of success in algebra and the best combined predictors of success in algebra.

The best single predictor of success in algebra in this study was the student's final grade in eighth grade mathematics. A correlation coefficient of 0.85 was found between the eighth grade marks in mathematics and the final algebra grades. The second best predictor of success in algebra was the score on the Survey Test of Algebra Aptitude which had a correlation coefficient of 0.76 with the final algebra grades. The California Algebra Aptitude Test was the next best predictor of algebra success, and the least effective predictor of the four considered was the student's estimated grade (Table 1).

Since factors other than algebraic aptitude influence the grade of each student, it seems natural for the algebra grades to correlate highest with the mathematics grades. For example, study habits and attitudes play a part in determining grades. Students with less aptitude for algebra may work harder and excell while those with more aptitude may not do as well as expected because they take the work too casually.
Table 1. Correlation coefficients relating the predictive variables to each other and to the final algebra grades

<table>
<thead>
<tr>
<th></th>
<th>Students' expected grades</th>
<th>Eighth grade marks in mathematics</th>
<th>California Algebra Aptitude Test</th>
<th>Survey Test of Algebra Aptitude</th>
<th>Final algebra grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students' expected grades</td>
<td>1.00</td>
<td>0.52</td>
<td>0.42</td>
<td>0.49</td>
<td>0.39</td>
</tr>
<tr>
<td>Eighth grade marks in mathematics</td>
<td>1.00</td>
<td>0.62</td>
<td>0.74</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>California Algebra Aptitude Test</td>
<td></td>
<td>1.00</td>
<td>0.73</td>
<td>0.60</td>
<td></td>
</tr>
<tr>
<td>Survey Test of Algebra Aptitude</td>
<td></td>
<td></td>
<td>1.00</td>
<td>0.76</td>
<td></td>
</tr>
</tbody>
</table>
The Survey Test of Algebra Aptitude may have been a better predictor than the California Algebra Aptitude Test because it is a newer test. There have been some recent changes in the content of algebra books, and North Cache uses the modern textbooks. Therefore, a more recent test would probably give a better indication of how students would do in a modern course in algebra.

The students were not very accurate in their predictions of their algebra grades. This was the least effective predictor of those considered. Of the 77 algebra students, 35 made the correct grade predictions. Twenty students predicted they would receive a grade which was lower than their final algebra grade while 22 students predicted they would receive a higher grade than they did at the end of the year.

The students were also asked if they felt they should be taking algebra. There were only two who felt they should not be in algebra, and one of these students changed to a general mathematics class. The one remaining in algebra received a B average. There were three students in algebra who felt they should be taking algebra, but they later switched to general mathematics.

A step-wise deletion multiple regression analysis was used on the predictors to find the best combined predictors of success in algebra. All four variables (students' expected grades, eighth grade marks in mathematics, California Algebra Aptitude Test, and Survey
Test of Algebra Aptitude) together accounted for 78 per cent of the variation (Table 2). The eighth grade marks in mathematics alone accounted for 73 per cent of the variation. The F value of 201.75 was significant at the .99 confidence level. When combined with the Survey Test of Algebra Aptitude, the two variables accounted for 77 per cent of the variation, and the F value of 11.29 indicated that the additional variation accounted for by the Survey Test of Algebra Aptitude was significant. The two remaining variables, students' expected grades and the California Algebra Aptitude Test, did not add significantly to the predictive value.

The best combined predictors of success in algebra would include the eighth grade marks in mathematics and the Survey Test of Algebra Aptitude scores. Using the data from the step-wise deletion multiple regression analysis, an equation was written to predict algebra grades \( y \) using the eighth grade marks in mathematics \( x_1 \) and the Survey Test of Algebra Aptitude percentile scores \( x_2 \). The equation was

\[
y = -2.555 + 0.967x_1 + 0.037x_2.
\]

The Survey Test of Algebra Aptitude was also given to the students in ninth grade general mathematics so it was possible to predict algebra grades for these students using the above equation. Of the 67 students in general mathematics, only four were predicted to receive a C minus
Table 2. Results of the step-wise deletion multiple regression analysis

<table>
<thead>
<tr>
<th>Source of variation&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Error d.f.</th>
<th>R square</th>
<th>Mean square error</th>
<th>F value&lt;sup&gt;b&lt;/sup&gt;</th>
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<tbody>
<tr>
<td>1, 2, 3, 4</td>
<td>72</td>
<td>0.78</td>
<td>1.81</td>
<td>0.00</td>
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<tr>
<td>1, 2, 4</td>
<td>73</td>
<td>0.78</td>
<td>1.79</td>
<td>3.22</td>
</tr>
<tr>
<td>2, 4</td>
<td>74</td>
<td>0.77</td>
<td>1.84</td>
<td>11.29*</td>
</tr>
<tr>
<td>2</td>
<td>75</td>
<td>0.73</td>
<td>2.10</td>
<td>201.75*</td>
</tr>
</tbody>
</table>

<sup>a</sup>Variable 1: Students' expected grades; Variable 2: Eighth grade marks in mathematics; Variable 3: California Algebra Aptitude Test; Variable 4: Survey Test of Algebra Aptitude.

<sup>b</sup>F values indicate significance of variation lost by deleting the least significant variable from each set (Fryer, 1966).

*Significant at .99 level.
or better in algebra, with the highest predicted grade being a C.

The students in general mathematics were also asked if they felt they should be taking algebra instead of general mathematics. There were only four responding in the affirmative. None of these four was in the group of general mathematics students predicted to receive a C minus or better in algebra. The four students who were predicted to receive a C or C minus in algebra all said they should not be taking algebra.
SUMMARY AND CONCLUSIONS

The objective of the study done at North Cache Junior High School in Richmond, Utah, during the 1967-68 school year was to compare eighth grade marks in mathematics, two algebra aptitude test scores, and student self-success ratings in predicting success in ninth grade elementary algebra. These variables were compared with the final algebra grades to determine the best single predictor of success in algebra and the best combined predictors of success.

The most accurate predictor of success in algebra combined the results of the Survey Test of Algebra Aptitude with the final marks in eighth grade mathematics.

The best single predictor of success in algebra was the eighth grade mark in mathematics.

The students' self-success ratings were not very accurate. A large group overrated themselves and a large group underrated themselves.

There were a few students in ninth grade general mathematics who could have been successful in algebra according to a combination of their eighth grade marks in mathematics and their Survey Test of Algebra Aptitude scores.
The Survey Test of Algebra Aptitude may have been a better predictor than the California Algebra Aptitude Test because it was a newer test, and modern textbooks were used in the algebra course.
LITERATURE CITED


Blick, D. J., and S. E. Braman. 1954. Some practices used in counseling students prior to enrollment in elementary algebra and plane geometry. Sch. Sci. and Math. 54:107-115.


