PREDICTING SUCCESS OF NINTH GRADE MATHEMATICS STUDENTS IN
MANHATTAN JUNIOR HIGH SCHOOL

by

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INTRODUCTION

The problem and obligations of the mathematics teachers have been greatly increased in recent years due to the advanced and growing interest in scientific development, such as space travel, sputniks, atomic energy, improvement in travel, communication, etc.

It has become apparent that if our nation is to cope with, or outdistance other nations in the field of scientific advancement, the mathematics curricula of our schools must be improved upon. The success of scientists, as well as economists and others, will depend largely upon their competency in the field of mathematics. This investigator feels that a scientific method is needed for proper guidance of those students enrolling in ninth grade mathematics.

The recent national demand for mathematicians and scientists, especially scientists with competency in mathematics, and the promise of scholarships to students showing exceptional ability and interest in these fields, has greatly increased the number of students enrolled in algebra, geometry, and other mathematics courses beyond arithmetic.

Administrators, counselors, and educators are seeking methods of encouraging those who have the ability and interest to embark on a successful mathematics career. Those students whose abilities and aptitudes do not indicate chances for success in algebra, geometry, and other more advanced mathematics courses need to be skillfully guided into other mathematics courses that will meet their needs and interests.

In 1916 a National Committee on Mathematical Require-
ments was organized under the auspices of the Mathematical
Association of America for the purpose of making a compre-
hensive study of the whole mathematical program on secondary
and college levels, including suggestions for the comparative-
ly new, yet fairly well-established junior high school mathe-
matics program.[1] In 1933, the Committee, then called a
Commission to Study the Place of Mathematics in Secondary
Education, was incorporated into a Joint commission of the
Mathematical Association and the National Council of Teachers
for organizing the work in ninth grade mathematics. The
first was the traditional algebra course, the second, that
of general mathematics. General mathematics was a kind of
"fused" course in which some additional work in arithmetic
and an intuitive geometry were combined with some of the
simpler basic concepts of algebra. The purpose of the general
mathematics course was to meet general educational needs in
mathematics for those students who had neither the need for,
nor the interest in, the traditional algebra and geometry
sequence. The general mathematics movement spread rapidly in
the junior high school.[2]

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1. The National Committee on Mathematical Requirements.
The Reorganization of Mathematics in Secondary Education.
Boston: Houghton-Mifflin Co., 1927. pp. 6-7.

2. National Council of Teachers of Mathematics Fifteenth
Yearbook. The Place of Mathematics in Secondary Education.
New York: Bureau of Publication, Teachers College, Columbia
University, 1940. p. 101.

It is assumed that there are certain basic concepts in mathematics which are essential for all students and that it is necessary to include in the mathematics curriculum those courses which will provide the mathematical competence which all future citizens need. It is also assumed that there are some who are academically qualified to reach outstanding proficiency in the field and will become the leaders in science, technology, industry, and business.

With the offering of two mathematics courses in the ninth grade came the problem of determining who should pursue the study of traditional algebra and who should be guided into the general mathematics course. Teachers of mathematics and counselors were faced with two significant problems. The first was recognizing and classifying varying degrees of mathematical ability among students; the second was concerned with the advising and counseling of students with regard to their interests and plans for the future.

It was the belief of many educators that some ninth grade students had not yet acquired a mathematical "readiness" for the abstract symbolism of algebra. Students might not have a working vocabulary of mathematical terms, nor a clear understanding of basic arithmetic principles when they were ready for the ninth grade. They could lack facility in fundamental skills, or a comprehension of relationships necessary to think in generalized terms.[1]

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1. Edward A. Krug, *Curriculum Planning.* New York: Harper and Brothers, 1954.

There was reason to believe that some students lacked
the necessary mental ability to do satisfactory work in
mathematics, particularly in the formal course of algebra and
geometry. Students were often enrolled in courses in which
they had no chance for success because of lack of the necessary
mental ability. On the other hand, some capable students
avoided difficult subjects even though these subjects were
needed as preparatory courses. Either of these situations
represented educational waste of time and effort. To some
extent, situations such as these could have been avoided by
wise guidance based on careful prognosis.

> "The prediction of academic achievement is import-
> ant from two standpoints. First, when an educational
> program is such that only a limited group can profit
> by it, predictions of the probable success of those
> who wish to take the course are important. Second, the
> prediction of academic achievement is important in the
> guidance of the individual student."[1]

The curriculum of Manhattan Junior High School has for
many years offered both algebra and general mathematics in the
ninth grade, and has recently offered geometry to a very small
number of carefully selected ninth graders. The choice of
courses presented the problem of guiding students into the
subject which seemed most suitable for their future needs and
the one in which they would be more likely to succeed. The
accelerated program, in which a few students are selected
to take geometry following eighth grade algebra is still in

1. Robert M. W. Travers, Educational Measurement.
New York: The Macmillan Co., 1955.

the experimental stage as to whom should be included in this program. Also, the choice between general mathematics and algebra is largely left to the student with the advice of the counselor. It was felt that a study by which success in the various ninth grade mathematics courses could be predicted would be a great help in the guidance of these students. The problem was made more imperative by the presence of Kansas State University in which approximately 70 percent of Manhattan High School graduates enroll, many in engineering and other scientific and mathematical curriculums.

REVIEW OF LITERATURE

Until the beginning of the twentieth century the problem of predicting achievement was necessarily based on the principle that an individual would perform in the future as he had performed in the past. However, during the last three decades much progress has been made in the field of prognostic testing. In academic areas of study in which there are large numbers of failures there has been a real and persistent need to develop tests to be coupled with past achievement to be used eliminating those who were likely to fail.

From a survey of the literature that is concerned with prognosis and classification, it seemed that prediction studies had been of three types. First were those based on intelligence or elementary school marks; second, those that were analytic of the skill involved; and third, those that gave preliminary learning tests.

Of considerable interest in the guidance field has been the construction and use of prognostic or aptitude tests which supply reliable information by which can be predicted success or failure in algebra. Successful predictions have been made from tests which sample directly the individual's ability to learn by testing him in similar learning situations.

Probably more prognostic studies have been made in algebra than in any other field because of the need of finding a solution for the great number of failures.[1] Many of these

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1. W. S. Guiler, "Forecasting Achievement in Elementary Algebra," Journal of Educational Research, September, 1944, p. 25.

studies have attempted to determine what single criterion
or what multiple-combination of criteria were better predictors
of success in algebra. A brief review of the work done on
this problem of selecting and guiding ninth grade students into
algebra and other ninth grade mathematics courses was helpful
in outlining this study. The reports of these studies have
been published in educational periodicals or were unpublished
studies made by students working on graduate degrees.

The first attempt to measure mathematical ability was
made by Rogers[1] in 1916. From a battery of tests including
arithmetic, algebra, geometry, language tests, and Thorndike
reading tests, Rogers developed the Rogers Tests of Mathematical
Ability which were administered to 114 high school freshmen
in two schools. The results of the tests were used for
careful analysis of abilities in algebra, but not specifically
for selection since algebra was a required subject at that time.

Orleans[2] was the first to deal with prognosis in high
school mathematics using as criteria other factors in addition
to intelligence quotients. Orleans studied the effect of a
combination of criteria for predicting success in algebra.
He tested over 300 students in New York City in 1926, using

1. Agnes L. Rogers, "Experimental Tests of Mathematical
Ability and Their Prognostic Value," Teachers College
Contribution to Education, No. 190., 1918.

2. Joseph B. Orleans, "A Study of Prognosis of Probable
Success in Algebra and in Geometry," The Mathematics Teacher,
May, 1934. pp. 225-246.

I. Q. scores, The Orleans Algebra Prognostic Test, and teachers'
marks. His investigation revealed that nearly sixty percent
of all failures in algebra were found in the lower quartile
of the distribution of the algebra test scores, while only
thirty-six percent of failures were in the lower quartile of the
distribution of the I. Q. scores, and forty-three percent were
in the lower quartile of the distribution of teachers' marks.
Orleans concluded that the prognostic test indicated a better
possibility of determining success in algebra.

As a result of a study by Lee and Hughes[1] in California,
it was found that the aptitude test gave the best single
predictor of achievement as measured by standardized tests.
However, teachers' ratings of previous mathematical ability
correlated higher with teachers' marks received by pupils in
algebra or geometry.

A recent and extensive study was conducted by Shaw[2] in
New York with 387 freshmen. The purpose of the study was to
consider the factors of I. Q., reading ability, and "algebraic
aptitude" in various mulitiple-combinations, and also as isolated
factors in an attempt to produce greater accuracy of prediction.
The Iowa Algebra Aptitude Test was given at the end of the
eighth year while The Otis Quick Scoring Mental Ability Test

1. J. Murray Lee and W. Hardin Hughes, "Predicting
Success in Algebra and Geometry," School Review, March, 1934,
pp. 188-196.

2. Geraldine Sax Shaw, "Prediction of Success in El-
ementary Algebra," The Mathematics Teacher, March, 1956,
pp. 173-178.

and The Iowa Silent Reading Test were given at the beginning
of the ninth year. Two criteria were used for success at the
close of the year's course. They were a departmental final
examination devised by the mathematics department, and the
Lankton First Year Algebra Test. The conclusions of the study
were that The Iowa Algebra Aptitude Test, The Otis Quick
Scoring Mental Test, and The Iowa Reading Test were, in
descending order, good indicators of group success in algebra.
A greater degree of success was indicated by using the com-
bined scores of the three tests. Shaw recommended an area
for further investigation to determine cutoff scores and
multiple screening, not to eliminate students from enrolling
in algebra, but to identify those who may have difficulty, but
can succeed in algebra if placed in classes that proceed at
a slower rate.

Major findings of McMillan[1] in a study of 236 pupils
indicated that marks in eighth grade arithmetic seemed a good
predictor of success in elementary algebra, although a test
of algebraic ability was helpful.

Layton[2] administered a battery of tests to students in
Jackson, Mississippi. Contradictory to many studies made in
algebra prognosis, Layton's conclusion was that the eighth

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1. LaVerne Ruth McMillan, A Comparative Study of the
Prediction of Achievement in Ninth Grade Algebra. Unpublished
Master's Thesis, The University of Texas, 1957.

2. R. B. Layton, "A Study of Prognosis in High School
Algebra," Journal of Educational Research, April, 1941.
pp. 601-605.

grade mathematics mark was the best single criterion for indicating achievement in algebra. He found a correlation of .82 between eighth grade mathematics marks and mathematics achievement tests scores.

Ayres,[1] Douglass,[2] and Dickter[3] made studies of the effectiveness of using a composite of three criteria for predicting success in elementary algebra. The three criteria included an intelligent quotient, a prognostic test, and teachers' marks. Results indicated that a combination of criteria predicted more accurately than a single test.

It seemed of value to refer to a recent survey by Robert Benignus,[4] a mathematics teacher of Kansas. In his Master's report, Benignus made a summary of the information and techniques used in 154 Kansas high schools in 1956-1957 for helping students select their ninth grade mathematics subject. Information derived from this survey indicated that the criterion most frequently used for determining the mathematics assignment of ninth grade pupils was previous eighth grade mathematics marks. This criterion was used by approximately

1. G. H. Ayres, "Predicting Success in Algebra," School and Society, January 6, 1934. pp. 17-18.

2. Harl R. Douglass, "The Prediction of Pupil Success in High School Mathematics," The Mathematics Teacher, December, 1935. pp. 389-504.

3. Richard Dickter, "Predicting Algebraic Ability," School Review, October, 1933. pp. 604-606.

4. Robert Benignus, Information and Techniques Used in Selected Kansas Schools for Helping Students Elect Their Ninth Grade Mathematics Subject. Unpublished Master's Report, Kansas State College, Manhattan, Kansas, 1958.

ninety percent of the 154 schools responding to the survey.
Other criteria used in order of frequency of responses were
intelligent quotients, anecdotal records by previous teachers,
counseling and results of standardized mathematics tests.
Administrators in Kansas seemed to recognize that a problem
existed in the assigning of ninth grade mathematics pupils, and
most of them indicated there was room for improvement in their
programs.

The review of literature was very helpful in structuring
the present study, in that it gave a good indication as to the
usefulness of various criterion for predicting success in
mathematics, such as intelligent quotients, previous accom-
plishments in mathematics, and standardized tests. It also
brought to light the results of previous studies with which
the results of the present study might be compared.

STATEMENT OF PROBLEM AND PROCEDURE

The curriculum of Manhattan Junior High School offers four mathematics courses to ninth grade students. These are general mathematics and algebra, which are open to all students, and advanced algebra and geometry which are open only to a few carefully selected students. The choice between algebra and mathematics is left to the student with the advice of the counselor. The classes of advanced algebra and geometry are not open to all students, but only to those whom the counselors and mathematics teachers feel have the necessary ability to succeed in these more advanced courses. Mathematics prognosis tests, DAT results, and grades received in former mathematics courses are used as criteria to decide which students may enroll in advanced algebra and geometry.

It was believed that some definite facts about the ability and mathematical success of students who had already gone through the various mathematics courses would be useful in counseling prospective ninth grade mathematics students of the future. By looking at what students of various abilities had achieved in the past, it was thought to be possible to demonstrate what the future student's chances for success were by looking at his past achievement and abilities.

The sample consisted of the 350 ninth grade students of Manhattan Junior High School during the school year 1961-1962.

The study was set up so as to compare the ninth grade mathematics achievement of these students as measured by the grades received in ninth grade mathematics courses with the following factors:

1) Grades received in eighth grade mathematics courses.

2) Grade rank achieved on the Arithmetic Reasoning and Arithmetic Computation Batteries of the Stanford Achievement Test, which was taken by the students in grade six.

3) Percentile rank achieved on the Numberical Ability Part of the Differential Aptitude Test, which was taken by the students in grade eight.

4) I. Q. score, as measured by the Henmon-Nelson I. Q. test.

The statistical presentation of this material was accomplished through the use of expectancy tables. Presentation of the data in the form of correlation coefficients was considered, but it was felt that the expectancy table was a more practical means of presentation. By the use of expectancy tables, the counselor is able to translate the results into "chances of success" statements.[1]

The grades received by the students in all four mathematics courses were compared with the four factors mentioned above making a total of sixteen expectancy tables in the presentation of the data.

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1. George K. Bennett, Harold G. Seashore, and Alexander G. Wesman, Differential Aptitude Test Manual. The Psychological Corporation, New York, 1959.

It should be mentioned that all students took the same mathematics course in the eighth grade with the exception of the one class of geometry. These students, who were selected as having superior potentialities at the end of their seventh grade work, took algebra as eighth graders.

DISCUSSION OF FINDINGS

Table 1 reveals that the students had more success
in ninth grade general mathematics than they had had in
eighth grade mathematics. In fact, their grade in general
mathematics in ninth grade averaged almost one whole grade

Table 1. Expectancy table for the prediction of ninth
grade general mathematics grades in Manhattan
Junior High School using eighth grade mathematics
grades as criterion.

Grades in 8th Grade Math.		General Mathematics Grades in 9th Grade					Total
		F	D	C	B	A	
A	No. %					1 100%	1 1%
B	No. %			2 14%	10 66%	3 20%	15 14%
C	No. %		1 2%	19 43%	23 51%	2 4%	45 40%
D	No. %	1 2%	14 36%	19 49%	5 13%		39 35%
F	No. %	2 18%	8 73%	1 9%			11 10%

higher than the grade received in eighth grade mathematics.
This was especially true among those students receiving the
low grades. For example, of the 39 students receiving D's in
eighth grade mathematics, 24 or 62 percent of them received C's
or better in ninth grade general mathematics, and of the 11

students who received F's in eighth grade mathematics, nine of
them or 82 percent received D's of better in ninth grade
mathematics. The A's and B's from eighth grade repeated to a
large extent, and the C's from eighth grade were for the most
part about equally divided between C's and B's in ninth grade.

The trend to achieve higher grades in ninth grade general
mathematics was probably due to the fact that the competition
was not nearly so keen in ninth grade general mathematics.
Except for one accelerated class who took algebra, the eighth
grade mathematics classes were not grouped according to ability.
Thus, there were a large number of students who made D's and
F's in eighth grade mathematics who, when entering ninth grade
general mathematics found the competition not nearly so keen
because of the fact that the better students were then in
algebra courses and no longer furnishing competition for these
weaker students. This fact is made clearer by noticing that
only one student took ninth grade general mathematics who had
earned an "A" in eighth grade mathematics. The rest, of course,
were enrolled in algebra and geometry courses.

This would indicate to the student of the future enrolling
in ninth grade mathematics that even though he has received
an F in eighth grade mathematics, on the basis of what others
have done before him, he has nine chances out of eleven of
passing the ninth grade course with a D or better if he takes
general mathematics. The same would not hold true of algebra
in ninth grade as we shall see later.

In Table 2, we see the reverse trend in operation. In comparing ninth grade algebra marks with marks received in eighth grade mathematics courses, there is a tendency for the student to receive a lower grade in algebra than was received in eighth grade mathematics. Of the 35 students taking algebra who had received an A in eighth grade mathematics, only nine,

Table 2. Expectancy table for the prediction of ninth grade algebra grades in Manhattan Junior High School using eighth grade mathematics grades as criterion.

Grades in 8th : Grade Math. :		F :	D :	C :	Algebra Grades in 9th Grade B :	A :	Total
A	No. %		1 3%	6 17%	19 54%	9 26%	35 30%
B	No. %		11 17%	39 60%	16 23%		66 54%
C	No. %		9 64%	5 36%			14 11%
D	No. %		6 100%				6 5%
F	No. %						

or 26 percent received an A in algebra, and seven received C's or lower. The same is true of those receiving B's in eighth grade mathematics, with only 16 out of 66 or 23 percent making B's in algebra in ninth grade.

It is also interesting to note that the six students enroll-

ed in algebra who had received D's in eighth grade mathematics all received D's also in ninth grade algebra. It would seem reasonable then, to encourage those who receive a D in eighth grade mathematics to take general mathematics in ninth grade where their chances of getting a C or better would be 24 out of 39, while their chances of getting a grade above a D in algebra were practically nil. It seems reasonable to explore the possibility of initiating a policy whereby only those who have received a C or better in eighth grade mathematics would be allowed to take algebra in ninth grade.

Beyond the scope of this study, but an interesting question to raise at this time would be whether these students did not possess the mental ability to succeed in algebra, or whether they did not yet possess the "mathematical readiness" some people believe to be necessary before a student can grasp algebraic concepts to a satisfactory degree.

Table 3 which deals with advanced algebra grades as compared to eighth grade mathematics grades shows the same trend as Table 2 only the trend is even more pronounced in the relation of eighth grade mathematics grades to grades received in advanced algebra in the ninth grade.

Of the twelve students taking advanced algebra who had received A's in eighth grade mathematics, only two or 17 percent repeated with A's in advanced algebra, while two of the same groups received only C's in advanced algebra. The contrast of students who received B's and C's is even more striking.

Ten students received B's in eighth grade mathematics and all
ten dropped to C's in advanced algebra, and the one student
who received a C in eighth grade mathematics dropped to a D.

On the basis of this evidence, it would seem reasonable
to recommend that no student be allowed to take advanced algebra
who had not received a B or better in eighth grade mathematics.

Table 3. Expectancy table for the prediction of ninth grade
          advanced algebra grades in Manhattan Junior High
          School using eighth grade mathematics grades as
          criterion.

Grades in 8th :		Advanced Algebra Grades in 9th Grade					
Grade Math.	:	F :	D :	C :	B :	A :	Total
A	No.			2	8	2	12
	%			17%	66%	17%	52%
B	No.			10			10
	%			100%			44%
C	No.		1				1
	%		100%				4%
D	No.						
	%						
F	No.						
	%						

The students whose grades are presented in Table 4 were
chosen the previous year to take algebra as eighth graders.
After completing the algebra course in grade eight, geometry
is the only mathematics course open to them so this graph is
not too useful as a screening device, but it helps show the

Table 4. Expectancy table for the prediction of ninth
          grade geometry grades in Manhattan Junior High
          School using eighth grade algebra grades as
          criterion.

Grades in 8th :		Geometry Grades in 9th Grade					Total
Grade Algebra :		F :	D :	C :	B :	A :	
A	No.			3	8	8	19
	%			16%	42%	42%	61%
B	No.			6	6		12
	%			50%	50%		39%
C	No.						
	%						
D	No.						
	%						
F	No.						
	%						

prospective ninth grade geometry student what his chances
for various degrees of success are.

It can be readily seen that only those who achieved grades
of A or B in eighth grade algebra were allowed to take geometry
in ninth grade. None of these students received D's or F's
in geometry although nine or 27 percent fell to a C.

To summarize the group of tables in which we compared
grades received in various ninth grade mathematics courses
with grades received in eighth grade mathematics courses we
might say that there is a definite tendency for the student
taking general mathematics to achieve a higher grade than was

achieved in eighth grade mathematics. This is due probably
to the lessening of competition because the better students
went into algebra and geometry classes.

For the students taking algebra, advanced algebra, and
geometry, the reverse was true. They tended to received lower
grades, probably because of harder material, and also because
the poorer students were no longer in class to fill in the
lower parts of the grading scale.

In Table 5, we see a comparison of the ninth grade general
mathematics grades and the grade rank achieved by the students
in taking the Stanford Achievement Test in grade six.

It would seem that these results provide a pretty fair

Table 5. Expectancy table for the prediction of ninth
          grade general mathematics grades in Manhattan
          Junior High School using Stanford Achievement
          Test scores as criterion.

Stanford Achieve.: Test Results	:	General Mathematics Grades in 9th Grade					
	:	F :	D :	C :	B :	A :	Total
8.0 and over	No. %			1 10%	6 60%	3 30%	10 10%
7.0-7.9	No. %		3 13%	7 30%	10 44%	3 13%	23 24%
6.0-6.9	No. %		3 11%	10 36%	15 53%		28 29%
5.0-5.9	No. %	1 5%	4 19%	12 57%	4 19%		21 22%
Under 5.0	No. %	1 7%	11 73%	3 20%			15 15%

means of predicting success. All fifteen students ranking lower than grade five on the Stanford Achievement Test received C's or lower in ninth grade general mathematics, with 11 students or 73 percent receiving a D.

When we compare the students who achieved a rank of fifth grade on the Stanford Test with those who achieved a rank of sixth grade, we see very little difference except that those with a sixth grade rank achieved a higher percentage of B's. This group achieved 53 percent B's, while the group with the fifth grade rank recorded only 19 percent B's.

With the seventh grade ranking, we find the first students who recorded A's in general mathematics, and in the eighth grade rank, 90 percent recorded B's or A's in ninth grade general mathematics.

According to Table 6, it would seem unwise to place students in algebra if they had a Stanford Achievement Test rank of less than seventh grade, because 54 percent of these students achieved grades of D's and F's in algebra in ninth grade.

In Tables 7 and 8 we see that all students except one who took either advanced algebra or geometry ranked at least on the seventh grade level on the Stanford Achievement Test. In fact, all students who took geometry except one achieved a rank of grade eight or higher.

It is interesting to note here the high level of students who are selected for these two advanced classes of advanced algebra and geometry as measured by the Stanford Achievement Test.

Table 6. Expectancy table for the prediction of ninth grade algebra grades in Manhattan Junior High School using <u>Stanford Achievement Test</u> scores as criterion.

Stanford Achieve.: Test Results	:	F	: D	: C	: B	: A	: Total
				Algebra Grades in 9th Grade			
8.0 and over	No. %		2 8%	12 46%	9 35%	3 11%	26 27%
7.0-7.9	No. %		6 13%	19 43%	16 37%	3 7%	44 46%
6.0-6.9	No. %		11 52%	8 38%	2 10%		21 22%
5.0-5.9	No. %		3 60%	2 40%			5 5%
Under 5.0	No. %						

Table 7. Expectancy table for the prediction of ninth grade advanced algebra grades in Manhattan Junior High School using <u>Stanford Achievement Test</u> scores as criterion.

Stanford Achieve.: Test Results	:	F	: D	: C	: B	: A	: Total
				Advanced Algebra Grades in 9th Grade			
8.0 and over	No. %			3 43%	3 43%	1 14%	7 50%
7.0-7.9	No. %			4 66%	1 17%	1 17%	6 43%
6.0-6.9	No. %			1 100%			1 7%
5.0-5.9	No. %						
Under 5.0	No. %						

Table 8. Expectancy table for the prediction of ninth
grade geometry grades in Manhattan Junior High
School using Stanford Achievement Test scores
as criterion.

Stanford Achieve.: Test Results	:	Geometry Grades in 9th Grade					Total
		F : D :	C :	B :	A :		
8.0 and over	No.		9	12	4		25
	%		36%	48%	16%		96%
7.0-7.9	No.				1		1
	%				100%		4%
6.0-6.9	No.						
	%						
5.0-5.9	No.						
	%						
Under 5.0	No.						
	%						

The Numerical score of the Differential Aptitude Test,
which is compared with ninth grade general mathematics grades
in Table 9 was expected to be one of the best means of pred-
iction at the start of this study, but it didn't turn out
to be as good a predictor as was originally believed.

It can still be of some use, however. Of the 40 students
taking general mathematics who achieved a percentile rank of
from one to twenty on the DAT, 24 or 60 percent received grades
of D or lower in ninth grade general mathematics.

Of the 21-40 percentile group, 63 percent received C's and
of the 41-60 group, 53 percent received B's. There were no
students who achieved a DAT percentile rank of 60 or over who

Table 9. Expectancy table for the prediction of ninth
grade general mathematics grades in Manhattan
Junior High School using DAT percentile ranks
as criterion.

DAT Percentile Rank	: :	General Mathematics Grades in 9th Grade						Total
		F	: D	: C	: B	: A	:	Total
81-100	No.			2	1	1		4
	%			50%	25%	25%		4%
61-80	No.			8	8	3		19
	%			42%	42%	16%		14%
41-60	No.			17	20	1		38
	%			44%	53%	3%		29%
21-40	No.		3	19	8			30
	%		10%	63%	27%			23%
1-20	No.	3	21	10	5	1		40
	%	8%	52%	25%	13%	2%		30%

received any grade in general mathematics lower than C. This
criterion for success would seem to be very useful when com-
paring with ninth grade general mathematics students.

Unfortunately, the DAT scores don't seem to be as
accurate when predicting success in the more advanced ninth
grade courses. The tendency still seems to be there, however.
Table 10 shows that of the 45 students in algebra who ranked
below the 60th percentile on the DAT, 48 percent received D's
or below in ninth grade algebra.

On the other hand, of the 96 students taking algebra who
ranked above the 60th percentile on the DAT, 90 percent received

Table 10. Expectancy table for the prediction of ninth
           grade algebra grades in Manhattan Junior High
           School using <u>DAT</u> percentile ranks as criterion.

DAT Percentile Rank		Algebra Grades in 9th Grade					Total
		F	D	C	B	A	
81-100	No.		2	15	19	7	43
	%		5%	35%	44%	16%	31%
61-80	No.	1	6	28	17	1	53
	%	2%	11%	53%	32%	2%	38%
41-60	No.		12	12	4	1	29
	%		41%	41%	14%	4%	20%
21-40	No.		10	3	2		15
	%		67%	20%	13%		10%
1-20	No.			1			1
	%			100%			1%

C's or over, with 45 percent receiving B's and A's. Of the
total of 168 students who ranked above the 60th percentile,
156 or 93 percent received C's or better no matter which mathe-
matics course they took.

By looking at Tables 11 and 12, it can be seen that the
students in these two advanced classes were also of very high
caliber, with only one student in advanced algebra who ranked
lower than the 60th percentile on the DAT. By the same token,
there are only two students in this category taking geometry.

In Table 13, the grades of ninth grade general mathematics
students are compared with the IQ's of the students as measured
by the Henmon-Nelson IQ Test. It may be noted that of those

Table 11. Expectancy table for the prediction of ninth
grade advanced algebra grades in Manhattan
Junior High School using <u>DAT</u> percentile ranks
as criterion.

DAT Percentile :		Advanced Algebra Grades in 9th Grade					
Rank	:	F :	D :	C :	B :	A :	Total
81-100	No.			4	6	2	12
	%			33%	50%	17%	55%
61-80	No.		1	7	1		9
	%		11%	78%	11%		41%
41-60	No.			1			1
	%			100%			4%
21-40	No.						
	%						
1-20	No.						
	%						

Table 12. Expectancy table for the prediction of ninth
grade geometry grades in Manhattan Junior High
School using <u>DAT</u> percentile ranks as criterion.

DAT Percentile :		Geometry Grades in 9th Grade					
Rank	:	F :	D :	C :	B :	A :	Total
81-100	No.			5	8	8	21
	%			24%	38%	38%	70%
61-80	No.			2	5		7
	%			29%	71%		23%
41-60	No.			1	1		2
	%			50%	50%		7%
21-40	No.						
	%						
1-20	No.						
	%						

Table 13. Expectancy table for the prediction of ninth
grade general mathematics grades in Manhattan
Junior High School using Henmon-Nelson IQ as
criterion.

Intelligence :		General Mathematics Grades in 9th Grade					
Quotient :		F :	D :	C :	B :	A :	Total
Over 130	No.			1	2	1	4
	%			25%	50%	25%	3%
111-130	No.		1	8	12	3	24
	%		4%	34%	50%	12%	18%
91-110	No.	1	9	41	24	2	77
	%	1%	12%	53%	31%	3%	56%
71-90	No.	2	15	10	3		30
	%	7%	50%	33%	10%		21%
70 and Below	No.	1	1				2
	%	50%	50%				2%

students with a measured IQ of less than 70, 100 percent

received D's and F's. Of those with IQ's of 71-90, 57 percent

received D's and F's in general mathematics, while only 10

percent received B's, and there were no A's in this group at

all. Of those "average" students with IQ's of 91-110, there

is a pretty good distribution, with 53 percent in this group

receiving C's. There is however, a predominance of B's over

D's in this category with 31 percent and 12 percent respectively.

This same tendency of general mathematics students to receive

grades a little higher then might be expected, was encountered

also when comparing eighth grade mathematics grades to ninth

grade general mathematics grades. It was mentioned then,
and might be reiterated here, that this is probably due to
the fact that the better students who would normally fill in
the upper portions of the grading scale are enrolled in algebra,
etc.

In Table 14, we see this opposite trend in operation again,
where the "average" student, with an IQ of from 91-110, tends
to receive lower grades. For example, 39 percent of these
students received D's in algebra as opposed to only 12 percent
in general mathematics.

For those students taking algebra, the predominance of
C's fall into the group of students having IQ's of 111-130,
with 49 percent in this category.

Table 14. Expectancy table for the prediction of ninth
grade algebra grades in Manhattan Junior High
School using Henmon-Nelson IQ as criterion.

Intelligence Quotient		Algebra Grades in 9th Grade					Total
		F	D	C	B	A	
Over 130	No.		1	4	7	3	15
	%		7%	26%	47%	20%	11%
111-130	No.		8	34	19	8	69
	%		11%	49%	29%	11%	48%
91-110	No.	1	22	19	12	2	56
	%	2%	39%	34%	21%	4%	39%
71-90	No.		1		1		2
	%		50%		50%		2%
70 and Below	No.						
	%						

About the only significant statement that can be said
about the advanced algebra and geometry students as shown in
Tables 15 and 16 is that there are few students with low
IQ's in these classes, with only 9 percent having IQ's of
less than 110. This is understandable, however, due to the
fact that these students are selected with regard to their
ability as measured by intelligence and aptitude tests as
well as their past performance in mathematics classes.

It would seem from this study that all of these criteria
lose the distinct predictive value that is found among lower
ranking students, when applied to these superior students
enrolled in accelerated mathematics courses. The only group-

Table 15.   Expectancy table for the prediction of ninth
grade advanced algebra grades in Manhattan Junior
High School using Henmon-Nelson IQ as criterion.

Intelligence Quotient		Advanced Algebra Grades in 9th Grade					Total
		F	D	C	B	A	
Over 130	No.			4	1		5
	%			80%	20%		22%
111-130	No.		1	6	5	2	14
	%		7%	43%	36%	14%	61%
91-110	No.			3		1	4
	%			75%		25%	17%
71-90	No.						
	%						
70 and Below	No.						
	%						

Table 16. Expectancy table for the prediction of ninth
           grade geometry grades in Manhattan Junior High
           School using <u>Henmon-Nelson</u> IQ as criterion.

Intelligence Quotient		F : D :	C :	B :	A :	Total
Over 130	No.%		3 19%	7 44%	6 37%	16 52%
111-130	No.%		5 36%	7 50%	2 14%	14 45%
91-110	No.%		1 100%			1 3%
71-90	No.%					
70 and Below	No.%					

ing of grades that are evident in this category is the fact
that there are almost no grades below C, which we would expect
in classes grouped according to high scholastic and mathematical
ability.

SUMMARY AND CONCLUSIONS

In general, the entire educational system is vitally and constantly concerned with prognosis. In the promotion system, every success and every failure is in a real sense a predictive factor.

The growing demand by society for people adequately prepared in mathematics has brought about an increased interest and enrollment in mathematics courses on all levels. To maintain high standards of achievement, there must be a sifting and selecting of students. All students with a fair chance of succeeding should be encouraged to enroll provided, of course, that their interests and ambitions are commensurate with their abilities. In addition to ability and ambition, a student must have a background of skills and habits, and adequate information upon which to proceed when undertaking the study of algebra and other advanced mathematics courses.

One purpose of this study was to discover if there is an abundance of information on the student record cards, if properly used, to aid materially in counseling students concerning their study of mathematics. Consequently, this investigation sought answers to the following questions:

1) What is the relationship between eighth grade mathematics grades and grades received in ninth grade mathematics?

2) What is the relationship between the grade rank achieved on the Arithmetic Reasoning and Arithmetic Computation Batteries of the Stanford Achievement Test and the grades received in ninth grade mathematics?

3) What is the relationship between the percentile rank achieved on the Numerical Ability part of the <u>Differential Aptitude Test</u> and the grades received in ninth grade mathematics?

4) What is the relationship between the student's IQ score as measured by the <u>Henmon-Nelson Test</u> and the grades received in ninth grade mathematics?

The answers to these questions were sought in the student record files. The eighth grade achievement, mental test scores, achievement test scores, and aptitude test scores of the students along with grades received in ninth grade mathematics courses were assembled to be studied.

It was felt that it would be useful to establish some cut-off points below which success in the particular subject seemed doubtful.

Probably the cut-off point that is most obvious as a result of this study is the B level achieved in eighth grade mathematics courses. Any student with a C or less should probably be advised to take general mathematics in ninth grade, because his chances of achieving a C or better in algebra or advanced algebra are not very great according to this study. Therefore, it seems reasonable to explore the possibility of initiating a policy whereby only those who have received at least a C, and preferably a B in eighth grade mathematics be allowed to take algebra in ninth grade.

With regard to the <u>Stanford Achievement Test</u>, it would seem that a student should have achieved a grade rank of at least grade six to enroll in ninth grade algebra, and at least grade seven and preferably grade eight to be selected for

advanced algebra or geometry.

To achieve any degree of success in all ninth grade mathe-
matics courses, but especially algebra, advanced algebra, and
geometry, it was found that the student generally was to
achieve a percentile rank on the <u>Differential Aptitude Test</u>
of 40 or over.

With regard to IQ's, it would seem that if the student
had an IQ rating of less than 90, he should definitely not
attempt algebra, and even in general mathematics, the com-
petition would be very keen for the individual.

After extensively comparing the four criteria used here
by which to predict grades, it would seem that of the four
means used, the most accurate would definitely be the grades
achieved in eighth grade mathematics, and the poorest and
least reliable method would be the use of IQ scores.

It is believed that the above study will be of good use
when counseling prospective ninth grade mathematics students
in Manhattan Junior High School. It's usefulness will certain-
ly depreciate as the years go by, primarily because of the
teacher turn-over and the consequent change in grading tech-
nique.

This study has given the writer a deeper understanding
of the problems encountered, as well as the techniques in-
volved in doing research of this type and also in counseling
junior high school students.

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PREDICTING SUCCESS OF NINTH GRADE MATHEMATICS STUDENTS IN
MANHATTAN JUNIOR HIGH SCHOOL

by

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B. A., St. Benedict's College, 1960

AN ABSTRACT OF A MASTER'S REPORT

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Due to the recent emphasis on mathematics in our school system, the problems and obligations of the mathematics teachers have been greatly increased. This emphasis has, by the same token, added to the responsibilities of administrators and counselors who must seek methods of encouraging those who have the ability and interest to embark on successful mathematics courses.

The purpose of this study was to predict the success of ninth grade mathematics students in Manhattan Junior High School. The four mathematics courses offered to ninth graders are: general mathematics and algebra, which are open to all students, and advanced algebra and geometry which are open only to a few carefully selected students.

The sample consisted of the 350 ninth grade students of Manhattan Junior High School during the school year 1961-1962. The study was set up so as to compare the ninth grade mathematics achievement of these students as measured by the grades received in ninth grade mathematics courses with the following factors:

1) Grades received in eighth grade mathematics courses.

2) Grade rank achieved on the Arithmetic Reasoning and Arithmetic Computation Batteries of the <u>Stanford Achievement Test</u>, which was taken by the students in grade six.

3) Percentile rank achieved on the Numerical Ability Part of the <u>Differential Aptitude Test</u>, which was taken by the students in grade eight.

4) I. Q. score, as measured by the <u>Henmon-Nelson</u> I. Q. Test.

By looking at what students of various abilities had
achieved in the past, it was thought to be possible to
predict what a future student's chances for success might
be.

The statistical presentation of this material was
accomplished through the use of expectancy tables. The grades
received by the students in all four mathematics courses were
compared with the four factors mentioned above making a total
of sixteen expectancy tables. On the basis of the data
presented in the expectancy tables, certain conclusions are
warranted.

Any student with a grade of C or less in eighth grade
mathematics should probably be advised to take general mathe-
matics in ninth grade because his chances of achieving a C
or better in algebra or advanced algebra are slight. It would
seem reasonable, then, to initiate a policy whereby only
those who have received a C, and preferably a B in eighth grade
mathematics be allowed to take algebra in ninth grade.

With regard to the Stanford Achievement Test, it would
seem that a student should have achieved a rank of at least
grade six to enroll in ninth grade algebra, and at least
grade seven and preferably grade eight to be selected for
advanced algebra or geometry.

To achieve any degree of success in all ninth grade
mathematics courses, but especially algebra, advanced algebra,
and geometry, it was found that the student generally should

achieve a percentile rank on the <u>Differential Aptitude Test</u> of 40 or over.

With regard to I. Q's, it would seem that if the student had an I. Q. rating of less than 90, he should definitely not attempt algebra.

After extensively comparing the four criteria used here to predict grades, it would seem that of the four means used, the most accurate would definitely be the grades achieved in eighth grade mathematics, and the poorest and least reliable method would be the use of <u>Henmon-Nelson</u> I. Q. scores.