A STUDY OF THE VALUE OF A SECOND YEAR OF GENERAL MATHEMATICS FOR LOW ABILITY STUDENTS OF OLATHE HIGH SCHOOL

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CHAPTER I

INTRODUCTION

Since the launching of the first Russian Sputnik, educators, particularly in science and mathematics, have been subjected to much criticism. There have been many cries for an improved curriculum in these fields. In order to meet this challenge various groups have been formed and have taken positive action toward improving the science and mathematics curriculum offerings for American high schools.

In mathematics several groups have taken the lead in preparing new, and in some cases different, course material in place of the traditional. Such groups as those involved in the Maryland Project, the University of Illinois Committee on School Mathematics, and the School Mathematics Study Group have prepared special text material for classes in mathematics from grades seven to twelve. Some of the topics are new, but most of them are similiar to those of the traditional course material; however, the presentation and the point of view are different.[1] It is hoped that the new approach to mathematics will increase understanding and interest for students taking courses in this field.

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[1] School Mathematics Study Group, Mathematics For High School--First Course in Algebra, (New Haven: Yale University, 1959), p. v.

Most of this work has been specifically aimed at the above average, college bound student, with little attention being given to the problems of the below aberage, non-college bound student. That the latter group exists and has somewhat different needs than those of the former group is recognized by many educators, including Mallory[2], Reeve[3], Norris[4], Sausen[5], and others. Sausen makes the following point:

> By the time a student reaches the ninth grade, he should be proficient in those basic mathematical skills necessary in making, or learning to make, evaluations, comparisons, and computations necessary in every-day life. The ninth grade student in mathematics must, therefore, be proficient in the fundamental operations and must have an understanding of fractions, percentage, and decimals before more difficult problems can be presented to him.[6]

If this applies for ninth grade pupils, it also should apply to tenth grade, eleventh grade, and twelfth grade pupils.

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[2]Virgil S. Mallory, The Relative Difficulty of Certain Topics in Mathematics for Slow-Moving Ninth Grade Pupils, (New York: Teachers College, Columbia University, 1939).

[3]William David Reeve, Mathematics for the Secondary School, (New York: Henry Holt and Company, 1954), pp. 1-16.

[4]Ruby Norris, "General Mathematics or Algebra for the Ninth Grade?", Workshop in High School Mathematics, (Emporia, Kansas: Kansas State Teachers College, 1955), pp. 10-12.

[5]Inez I. Sausen, "A Study of Corrective Mathematics for Ninth Grade Pupils in Mathematics", (unpublished Master's thesis, Kansas State Teachers College, Emporia, Kansas, 1956).

[6]Ibid., p. 1.

In general, the mathematical needs of ninth grade pupils have been recognized and are being met by general mathematics courses. For some this has been adequate; for many it is their last course in mathematics. Some may be motivated to attempt algebra, but those whose background is still insufficient find there is no standard mathematics course which will fit their needs.

I. THE PROBLEM

Statement of the Problem. The purpose of this study was to determine the value of a second year of general mathematics to students of Olathe High School who are of below average mental ability or who have shown an extremely low achievement level in mathematics. Among the questions to be considered were the following: (1) Using achievement tests for comparisons, what changes might be expected in the achievement of the students?; (2) Was this change great enough to be significant?; (3) Did the grade placement of a student affect his reaction and relative success in the course?; and (4) What were some student attitudes toward the value of the course?

Limitations of the Study. This study has been limited to those students who enrolled in the course of High School Mathematics at Olathe High School during the school year 1959-1960. Of these, students who failed to complete the course have not been considered as in their cases information was not complete.

II. DEFINITION OF TERMS

Mathematics. Mathematics itself does not necessarily identify a course, but rather it is an intangible term which in general refers not only to a sequence of courses, but also to a philosophy and method. We find this intangibility in the opinion of Courant and Robbins who say:

> Mathematics as an expression of the human mind reflects the active will, the contemplative reason, and the desire for aesthetic perfection. Its basic elements are logic and intuition, analysis and construction, generality and individuality.[7]

This may be compared with the opinion of Reeve who states, "The term 'mathematics' is loosely used and is supposed to cover other loosely used terms like 'arithmetic' and 'algebra' and even terms from higher fields."[8]

The phrase "a second year of general mathematics" will be recognized throughout this study as those mathematical topics which would be studied in a remedial course in mathematics, largely arithmetic, with some basic principles of algebra and geometry. The calibre of the students involved in such a course will require that the material be

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[7] Richard Courant and Herbert Robbins, What is Mathematics?, (London: Oxford University Press, 1941), p. xv.

[8] Reeve, op. cit., p. 4.

individual in nature with the students working at various levels, appropriate to their abilities.

Mental Ability. Webster[9] defines mental as "of or for the mind or intellect" and ability as "power to do" or "talent". If these definitions are combined, mental ability may then be defined as "power of the mind to do" or "talent of the intellect". Such definitions indicate a variable factor which differentiates mental abilities of various individuals.

Mental ability is often discussed in terms of average, high, and low. Such concepts may be formed through observation, but more often they are formed through the results of intelligence tests which have been designed to measure mental ability. In general an intelligence test score of 100 is considered average. Anything above 120 is considered high; anything below 80 is considered low. In this study below average mental ability will refer to students whose mental ability is 90 or below. This group may at times be refered to as "slow learners".

Achievement level. Achievement may be defined as the accomplishment of a feat, ordinarily successfully. In this

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9 _____, et al. (eds.), Webster's New World Dictionary of the American Language, (Cleveland: The World Publishing Company, 1954), pp. 3 and 919.

study achievement level will refer to a relative position of achievement as measured by a reputable scale. A student with a low achievement level will be described by (1) a mathematical grade placement, as measured by the California Achievement Test, of one year below the chronological grade placement; (2) consistently low grades, D's and F's, in mathematics courses over a period of two to four years; or (3) a percentile rank, as determined by the California Achievement Test, of twenty or below.

III. IMPORTANCE OF THE STUDY

Student attitudes vary greatly concerning the relative importance of mathematics to the high school curriculum. Generally, students interested in mathematics or who have never failed a mathematics course will agree that a good mathematics background is necessary, but a student with poor mathematics grades or experiences will advocate only the bare essentials of arithmetic.[10] Attitudes such as the latter have led Cooley, Gans, Kline, and Wahlert to state:

> . . . most students who do not specialize in mathematics leave its study without having acquired any real understanding of the character of the subject or its relation to the sciences, the arts, philosophy, and to knowledge in general. Too often they have been taught little more than a variety of techniques in special branches of mathematics and thus have acquired

---

[10] Reeve, _op. cit._, p. 2.

> a narrow, distorted, and hence incorrect view of mathematics.[11]

One purpose of studying mathematics is to help the student to better understand the meaning of science, and to apply methods of the mathematician to daily problems. Any portion of the subject may seem to be individually useless, but there are underlying factors which apply to many fields of human knowledge. The purpose is not to make experts of each general mathematics student, but rather to familiarize him with mathematical methods, tools, and skills.

Students who take a general mathematics program are normally of the group interested in vocational training. Thus another basic aim of general mathematics is to equip the student with useful skills for business. Skills such as estimating, making comparisons, measuring, and countless others make arithmetic the "tool of business". Wilson, Stone, and Dalrymple make the following estimates:

> Yet 90 per cent of adult figuring is covered by the four fundamental processes, addition, subtraction, multiplication, and division. Simple fractions, percentage, and interest, if added to the four fundamental processes, will raise the percentage to over 95 per cent.[12]

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[11] Hollis R. Cooley, _et al._, _Introduction to Mathematics--A Survey Emphasizing Mathematical Ideas and Their Relations to Other Fields of Knowledge_, (Boston: Houghton Mifflin Company, 1937) p. iii

[12] Guy M. Wilson, Mildred B. Stone, and Charles O. Dalrymple, _Teaching the New Arithmetic_, (New York: McGraw-Hill Book Company, Inc., 1939), p. 7.

The question arises, "Are the needs of this group of students being met?" Reeve indicates that they are not,

> Regardless of individual differences, each student should be given the opportunity to exercise his ability in a way which will permit him to achieve his fullest development. This cannot be done in the majority of classes in the schools of this country today. It is this failure to recognize and to handle individual differences of ability among secondary school students, which gives rise to the large and unwarranted number of failures in many school subjects.[13]

Furthermore, Reeve quotes Professor D. S. Babb, Department of Electrical Engineering, University of Illinois, as saying,

> We are seeking a one-track program for all students who reach the ninth year with normal competence in arithmetic through percentage and in intuitive geometry. We are not claiming to meet the needs of the students who arrive in the ninth year with a fourth-grade or even sixth-grade mathematical maturity.[14]

In general this also applies to grades ten through twelve.

American schools have adopted the policy of equal educational opportunities for all. Conant states:

> The American way of life affords equal opportunity for all. Our public high schools open their doors to <u>all</u> students--brilliant, average, and slow. That's why most U. S. secondary schools are called 'comprehensive' high schools. These fill three needs: (a) general education for <u>all</u> citizens; (b) a college preparatory course for students who want to attend a college or university; and (c) a vocational course for students who intend to take a job immediately after graduation.[15]

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[13]Reeve, *op. cit.*, p. 57.

[14]*Ibid.*, p. 440, citing *An Experimental High School Mathematics Program*, a report by Professor D. S. Babb, University of Illinois, Urbana, Illinois, slides 3 and 4, pp. 2-4.

[15]"High Schools . . . U. S. A.", *Senior Scholastic*, 74:12-23, February 13, 1959.

In the field of mathematics this means that teachers and educators have a duty to perform; that is to impart a competent knowledge of mathematics to all students at their various ability levels. "The abstractions of arithmetic, the techniques with numbers, and the concepts and understandings involved with number symbolism are not simple."[16] Thus a general mathematics program should be provided for the student who is unprepared in arithmetic for the traditional algebra course.

In a report on plans for post-war mathematics the Joint Commission on Mathematics made the following comments:

> I. The school should insure mathematical literacy to all who can possibly achieve it.
>
> II. We should differentiate on the basis of needs, without stigmatizing any group, and we should provide new and better courses for a high fraction of the schools' population whose mathematical needs are not well met in the traditional sequential courses.
>
> III. We need a completely new approach to the problem of the so-called slow learning student.
>
> IV. The teaching of arithmetic can be and should be improved.
>
> V. The sequential courses should be greatly improved.[17]

The importance of these suggestions applies as strongly today as it did fifteen years ago when they were made.

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[16] H. C. Christofferson, "Who Said 'Simple Arithmetic'?", NEA Journal, 48:51-2, January 1959.

[17] "First Report of the Commission on Post-War Plans", The Mathematics Teacher, 27:226-232, May 1944.

CHAPTER II

REVIEW OF THE LITERATURE

This study approached the related literature with a dual purpose: (1) to survey briefly some topics closely related to the study and (2) to review three former studies which are related to this study.

I. RELATED TOPICS

Importance of mathematics. The rapid development of science, industry, and commerce in the past quarter century has expanded the value of mathematics to the high school student. Opportunities for mathematicians are numerous, and as a result an increasing number of students are enrolling in advanced mathematics courses. Students from lower ability levels are beginning to realize the importance of a good mathematical background and are asking for courses which will fit their needs. Figure 1 gives an indication of the percentage of students who complete mathematics courses in high school by the number of years completed. It is significant that only 1.9 per cent of the high school graduates in 1957 had not completed a course in mathematics while in high school.

How is high school mathematics important to the student? In a previous discussion concerned with the importance of this study the value of mathematics to the below-average student was discussed.[1] To the above average student mathematics presents a variety of opportunities. Figure 2 indicates some of these opportunities and indicates which mathematics courses are needed for background work.

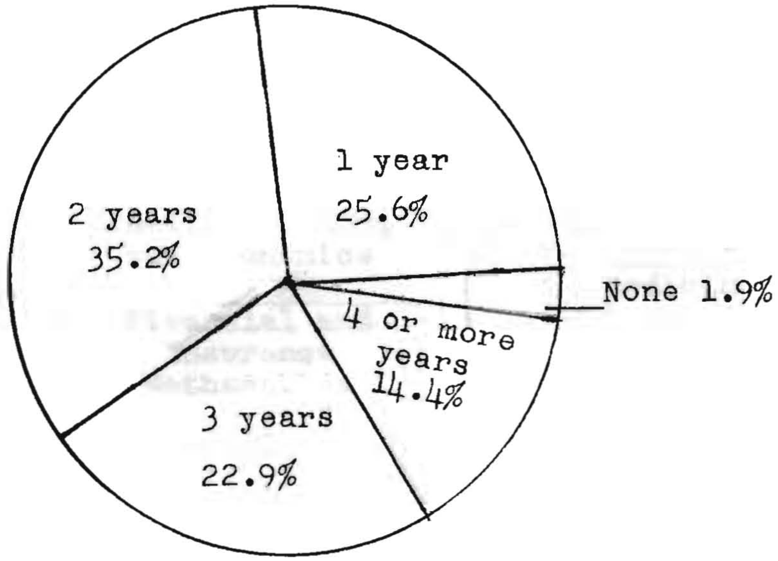

FIGURE 1

YEARS OF HIGH SCHOOL MATHEMATICS COMPLETED BY 1957 HIGH SCHOOL GRADUATES (FROM SENIOR SCHOLASTIC, FEBRUARY 13, 1959)

<u>Arithmetic background</u>.[1] The school mathematics sequence starts in the elementary school with the teaching of arithmetic. In the early years, at the first and second

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[1] William H. Thompson, "This 'Thang' Called Algebra," Workshop in High School Mathematics, (Emporia, Kansas: Kansas State Teachers College, 1955), p. 14.

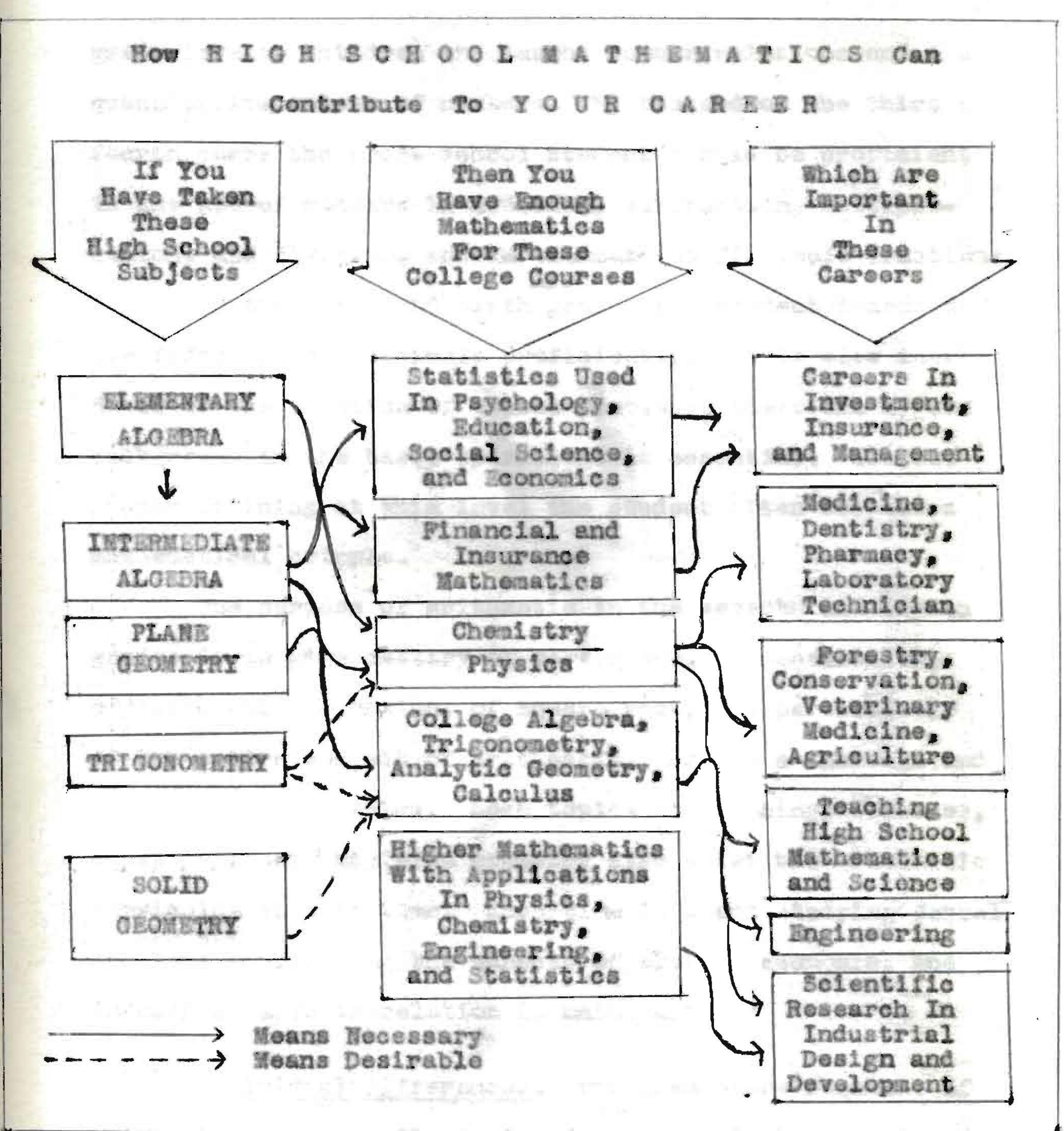

FIGURE 2

HOW HIGH SCHOOL MATHEMATICS CAN
CONTRIBUTE TO YOUR CAREER
(FROM REEVE, P. 17)

grade levels, children are taught number relations and the quantitative values of numbers. By the end of the third and fourth years the grade school student should be proficient in the use of numbers in addition, subtraction, multiplication, and division, and in the meaning of simple fractions.

In the fifth and sixth grades the student learns to use fractions and decimals proficiently. He is also introduced to the solution of verbal problems, therefore a good background in the basic operations is essential. Without proper training at this level the student often becomes a mathematical cripple.

The purpose of arithmetic in the seventh and eighth grades is to give mastery of percentage, of mensuration, of ratio and proportion, of square root, and particularly of the entire subject of arithmetic, through a thorough and a comprehensive review. Such topics as graphing, formulas, equations, and intuitive geometry also enter the arithmetic curriculum at this time. Much time is spent studying verbal problems emphasizing the aspects of social, economic, and industrial life in relation to mathematics.

Individual differences. The elementary sequence of arithmetic is basically designed as a continuing growth in the subject, with each year reviewing former topics and introducing new topics. As a result some students fall behind and can not maintain the normal pace of the class, while others develop abilities beyond those introduced in the material being studied. These ranges in ability are termed individual differences and are partially explained by Morton. "Children differ greatly in native intelligence and in the extent to which they have had the background experiences which are essential if success in arithmetic is to be achieved."[2]

Children begin arithmetic concepts at the same level in the elementary school, but differences in intelligence begin to become more and more conspicuous as the children grow older. As a result the elementary teacher finds there are many places where she can and should differentiate the program to suit the varying ability levels found in her class.[3] By the time the student reaches high school it is quite evident that there is a need for differentiated educational procedures. As Reeve expresses it:

> It is consummate folly to attempt to teach the best 10 per cent of a normal distribution of secondary school students with the poorest 10 per cent of the same group, without doing an enormous injustice to both. It may not be possible even to teach them together at all, in the best sense of the word.[4]

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[2]Robert Lee Morton, Teaching Children Arithmetic, (New York: Silver Burdett Company, 1953), p. 5.

[3]Ibid., pp. 5-7.

[4]William David Reeve, Mathematics for the Secondary School, (New York: Henry Holt and Company, 1954), p. 57.

Homogeneous grouping. In order to solve the problem involving individual differences many educators have advocated the use of homogeneous grouping procedures. These educators agree with Reeve, that all students are not able to cope with the same mathematics program and therefore separate courses should be developed for those of high ability and for those of low ability. As expressed by Pickell:

> I believe that it is absolutely impossible to meet the needs of pupils who wish to study more mathematics but do not care to prepare for college and at the same time meet the needs of the groups of pupils who wish mathematics solely for the purpose of preparing for college, . . .[5]

A basic criticism of homogeneous grouping has been the feeling that some students would realize they were in the low ability group and would therefore be humiliated. To the contrary, Reeve points out that new student leaders often emerge in homogeneously grouped low ability classes. These leaders are often students who had formerly subdued their opinions because they lacked confidence.

> Moreover all students should be placed in classes where, under properly qualified teachers, they can feel a sense of achievement, and where their mathematical abilities can be improved so as to enable them to satisfactorily fill their roles as future citizens.[6]

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[5]Virgil S. Mallory, The Relative Difficulty of Certain Topics in Mathematics for Slow-Moving Ninth Grade Pupils, (New York: Teachers College, Columbia University, 1939), p. 5, citing F. J. Pickell, "Junior High School Mathematics," Fifth Yearbook, Department of Superintendence, p. 184.

[6]Reeve, op. cit., p. 3.

One of the most ardent proponets of homogeneous grouping has been Dr. James Bryant Conant.[7] Using the results of his recent study of American high schools, Dr. Conant has written articles for various prominent periodicals advocating grouping procedures for general subjects in American high schools. It is his opinion that students who are slow in a subject would profit most by a "watered down" course which was conducted at their ability level; while students with high abilities could bypass certain routine material for more difficult and stimulating topics.

A program of homogeneous grouping such as Conant advocates would appear to be advantageous to all students. The fast student could advance as rapidly as he desired. The average student would not be hindered by either the fast or the slow student. Particularly, the slow student would benefit, for such a course would eliminate many of the pressures often placed upon him. As Ogle indicates:

> Mathematics is an orderly, disciplined study, and can be presented to a slow learner in such a manner that he can master the parts within his ability range with success and self-respect. It is probably better to teach the slow learner the basic facts and to emphasize

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[7] James Bryant Conant, "Diversified Studies for Diversified Students," National Parent-Teacher, 53:4-6, October 1958 and James Bryant Conant, Dr. Conant Reports to American People," Scholastic Teacher (Senior Scholastic), 74:1T-4T, January 30, 1959.

the by-products of accuracy, neatness, and industry. These qualities will carry a student a long way toward personal success and good citizenship.[8]

II. PREVIOUS STUDIES

The following studies are discussed because of points they raise which are related to this study. Although they discuss the use of a general mathematics course for ninth grade students, many arguments presented by these studies could also be applied to tenth, eleventh, and twelfth grade students.

The Mallory Study.[9] Results of a study by Mallory on the relative difficulty of certain topics in mathematics for slow-moving ninth grade pupils was published in 1939. The study was the result of the author's observation, as a teacher, of the increasing rate of failure by slow students taking algebra. The object of the study was to develop a course, with subject matter, applicable at the ability level of the slow student.

The Mallory Study involved 511 students in twenty-seven experimental classes in schools located in eleven different New Jersey communities. These communities were

[8] Esther Ogle, "The Slow Learner", Workshop in High School Mathematics, (Emporia, Kansas: Kansas State Teachers College, 1958), pp. 98.

[9] Mallory, op. cit.

chosen in such a manner that various social and economic backgrounds were represented. The students involved were given an intelligence test at the commencement of the course, as well as achievement tests at the commencement and at the conclusion of the course. Text material and chapter tests were standardized for all participating classes.[10]

Important conclusions of the Mallory Study were as follows:

1. There are students whose ability is below ninth grade level and insufficient for the first course in algebra.

2. There is a strong relation between the pupil's IQ and his achievement.

3. Improvement of ability after a year of course work in general mathematics was significant for most items studied. Also students of the lower IQ levels showed the most significant progress.

4. Some of the more fundamental topics of algebra and geometry may be introduced with understanding to the slow student.

5. Slow students may enjoy mathematics course work under certain circumstances.

6. The students involved in the study found five elementary algebra topics extremely difficult and would probably have failed a first year algebra course.

7. There was a need for a general mathematics course for the mathematically slow student.[11]

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[10] *Ibid.*, pp. 31-36.

[11] *Ibid.*, pp. 129-33.

<u>The Norris Report</u>.[12] In 1955 Norris reported upon various studies which applied to the development of a general mathematics course for ninth grade students who were not prepared for the traditional algebra course. Of particular interest was the criteria used in selecting students who were enrolled in general mathematics. The general conclusion was that no single pattern of placement could be followed; that in most cases placement should depend upon a variety of factors.

<u>The Sausen Study</u>.[13] The Sausen Study, <u>A Study of Corrective Mathematics For Ninth Grade Pupils in Mathematics</u>, was completed in 1956. It involved an evaluation of the remedial mathematics program from 1951-1954 of Eureka High School, Eureka, Kansas, and an investigation of the ninth grade mathematics programs in 1954 of seventy-two Class A high schools in Kansas.[14] The purpose was to determine a "sound and practical" program of remedial mathematics for ninth grade mathematics students.

The Eureka students enrolled in general mathematics were tested at the commencement of the course and at the

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[12] Ruby Norris, "General Mathematics or Algebra for the Ninth Grade?", Workshop in High School Mathematics, (Emporia, Kansas: Kansas State Teachers College, 1955), pp. 10-12.

[13] Inez I. Sausen, "A Study of Corrective Mathematics for Ninth Grade Pupils in Mathematics", (unpublished Master's thesis, Kansas State Teachers College, Emporia, Kansas, 1956).

[14] <u>Ibid</u>., p. 3.

conclusion of the course. Comparison of the percentile rankings indicated an average improvement of thirty percentile points. It was felt this indicated a substantial gain in achievement for the students enrolled in the general mathematics course.

In the investigation of the programs of Class A high schools, Sausen used an inquiry form. As seventy-nine per cent of seventy-two inquiry forms were returned, it was felt there was a significant reply. Replies indicated that although tests were available, sixty-six per cent of the students were enrolled in general mathematics of their own choice or because of poor grades in the past in mathematics courses. The majority of replies indicated that general mathematics should provide a fairly broad mathematical training needed by the student for everyday use. In general the general mathematics courses were not designed for remedial mathematics.

Among the conclusions and recommendations of Sausen are the following:

1. If the retention rate of a student is low, he should be given remedial work in a remedial mathematics course.

2. The class size of remedial mathematics classes should not be large. If more than one class of remedial mathematics is taught, high-low grouping should be used.

3. Students should be steered into a remedial mathematics class if testing indicates such a need.

4. There should be standardized texts and tests for remedial courses in mathematics.[15]

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[15] Ibid., pp. 44-48.

CHAPTER III

PROCEDURE OF THE STUDY

The study was approached from a limited experimental standpoint with the investigation involving the class, High School Mathematics, at Olathe High School for the school year 1959-1960. This chapter will introduce the various procedures involved in the experiment and discuss the tools used in compiling and analyzing the data.

I. ESSENTIALS OF THE COURSE

Course material. The course material used in the High School Mathematics class was designed for a remedial group in mathematics. It was prepared by the instructor, and it involved a comprehensive review of the basic concepts of arithmetic, as well as an introduction to fundamental algebra. It was designed to include an introduction to fundamental geometry; however, none of the 1959-1960 class members advanced to that level.

As Halmos relates, "One way to classify a mathematical contribution is this: It may be a new proof of an old fact, it may be a new fact, or it may be a new approach to several facts at the same time."[1] Although the text material

[1] Paul R. Halmos, "Innovation in Mathematics," Scientific American, 199:66-73, September, 1958.

followed largely the same sequence as the traditional course in ninth grade general mathematics, there were several innovations peculiar to this material. Among these were:

1. An introductory chapter discussing the history of mathematics, with special emphasis upon the development of number concepts.

2. The use of the number line to introduce, illustrate, and compare number values.

3. The introduction and discussion of negative numbers as a natural extension of the number system of arithmetic.

4. The use of various symbols used in mathematics which are not normally discussed extensively in texts of general mathematics.

5. The introduction of sets, structure, and sentences as adapted from text materials developed by the School Mathematics Study Group.[2]

The exercises at the end of each presentation were of particular importance. They were divided into two sections, the first including theory and drill, and the second involving verbal problems. Thus the student first practiced the manipulations of a process, then was introduced to common uses of the process.

Class procedure. An important facet of the class involved the rate of speed at which the students were allowed to progress. The class was not conducted as a lecture course, but rather the students were allowed to

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[2]School Mathematics Study Group, Mathematics For High School--First Course in Algebra, (New Haven: Yale University, 1959), pp. 1-60.

progress at their own individual rate. This is in agreement with the views of Mallory who states:

> There must be no element of haste, hurry, or impatience in teaching. This does not mean that dawdling or waste of time was permitted, but that there was ample time to permit each pupil to gain a concrete, vivid picture of the concept of problem under discussion.[3]

Such a method also allowed the instructor free time to assist each student individually when help was needed.

At the end of each chapter the student took a teacher-made proficiency test. If he passed it satisfactorily he proceeded to the next chapter, but if he failed, review work was assigned and had to be completed before he could continue. Several students completed the entire text material, while others did very little.

II. BACKGROUND OF THE GROUP

Method of selection. Two criteria were used in a selection of enrolees: Mental ability and achievement level. The mental ability requirement involved an intelligence test score of 90 or below, which was chosen arbitrarily, but based to some extent upon suggested ability levels listed in various readings of the instructor. The achievement level requirement was determined by the student's performance

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[3]Virgil S. Mallory, The Relative Difficulty of Certain Topics in Mathematics for Slow-Moving Ninth Grade Pupils, (New York: Teachers College, Columbia University, 1939), p. 29.

in former mathematics courses and, when records were available, by the student's achievement percentile. In the latter case a percentile ranking of 20 or below was chosen arbitrarily.

The actual enrollment of the group was done by the principal and the guidance counselor during the month before school began. Although the enrollment for the class in High School Mathematics was selective in nature, based on the listed ability and achievement qualifications, there were some unscreened persons who were enrolled in the course by accident. In most cases such students were transferred to another class as soon as their cases were discovered. At the end of the nine week period those students who were failing algebra were given the opportunity to transfer to the High School Mathematics class. This completed enrollment into the experimental group.

Academic background. To obtain knowledge of the academic background of the students enrolled in High School Mathematics reference was made to the student records available in the office of the guidance counselor. Table I contains the data collected concerning classification, intelligence quotient, mathematics percentile ranking, and course grades for mathematics classes from grade seven through algebra. The intelligence quotient was determined by the California Test of Mental Maturity (CMM), and the percentile ranking was determined by the California achievement Test (CAT).

TABLE I

ACHIEVEMENT AND ABILITY DATA FOR THE TWENTY-SEVEN STUDENTS AT THE TIME OF ENROLLMENT IN HIGH SCHOOL MATHEMATICS CLASS

Case No.	Grade or Class.	CMM I.Q.	CAT % tile	Mathematics Grades 7th	8th	9th	Alg.
1	Jr.	82	50	D	C	C	F
2	So.	72	10	B	D	D	
3	Jr.	80	**	D	D	D	
4	So.	77	30	C	D	D	
5	So.	105	50	C	D	C	*
6	Sr.	93			C	C	F
7	Jr.	89	10			D	
8	So.	75	5	D	D	D	
9	Jr.	88	30		D	D	
10	Sr.	79			C	D	D
11	So.	96	30	C	D	D	
12	So.	82	70	D	D	D	
13	Sr.	90		D	D	D	F
14	So.	91	10	D	D	C	
15	So.	71	10		C	D	*
16	Jr.	88	50			D	F
17	Jr.	77	5	D	D	D	*
18	So.	96	30	D	D	D	
19	So.	75	2	D	D	D	
20	Jr.	115	70			D	F
21	So.	89	60	C	D	C	
22	So.	103	10	D	D	D	
23	Jr.					D	
24	So.	85	80	B	C	D	
25	So.	95		D	D	D	*
26	So.	76	10	B	D	C	
27	So.	113	60	C	D	C	*

*Starred items indicate algebra students transferred.

**Blank items indicate no available information.

Table II is an analysis of the student deficiencies, as indicated in Table I, which led to the student's enrollment in the High School Mathematics Course.

TABLE II

STUDENT DEFICIENCIES WHICH QUALIFIED THEM FOR THE HIGH SCHOOL MATHEMATICS COURSE

Case No.	CMM I.Q.	CAT %-tile	Low Grades	Failed Algebra	Failing Algebra
1	X			X	
2	X	X	X		
3	X		X		
4	X		X		
5					X
6				X	
7	X	X	X		
8	X	X	X		
9	X		X		
10	X		X		
11			X		
12	X		X		
13	X		X	X	
14		X	X		
15	X	X	X		X
16	X		X	X	
17	X	X	X		X
18			X		
19	X	X	X		
20			X	X	
21	X				
22		X	X		
23			X		
24	X				
25			X		X
26	X	X			
27					X
Col. Totals	17	9	20	5	5

X indicates a deficiency

III. TOOLS OF MEASUREMENT

Data for this study were obtained through the results of achievement tests given the students, and through the information obtained from an inquiry form distributed to the students.

The achievement test. The California Achievement Test in Mathematics, by Ernest W. Tiegs, Ph.D., University of Minnesota, and Willis W. Clark, Ph.D., University of Southern California, were used to measure achievement for this study. Two of the three forms, W and X, were involved.

> The *California Achievement Tests* are especially designed instruments for the measurements evaluation, and diagnosis of school achievement. This series is composed of highly reliable and valid tests of skills and understandings in reading, arithmetic, and language. The items in the 1957 Edition were first rated for balance and appropriateness by competent curriculum and achievement test specialists. The separate elements of the battery were then integrated to yield meaningful and useful results.[4]

The forms were divided into two test sections, mathematical reasoning and mathematics fundamentals, which were in turn divided into two sections; A, B, C, and D, E, F, G. The test forms contained 140 items for which 68 minutes work time was allotted.

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[4]Ernest W. Tiegs and Willis W. Clark, "Manual, California Achievement Tests," Publishes by California Test Bureau, Los Angeles, California, 1957, p. 2.

Inquiry form. The inquiry form was adapted to a great extent from questions used by Mallory in his study concerning a ninth grade general mathematics course.[5] Minor changes and revisions were adopted, however, to fit the purpose and scope of this study. A copy of the inquiry form may be found in the appendix.

The inquiry form was distributed to the students near the completion of the course, during one class period. Of the twenty-seven students queried one hundred per cent answered. These answers provided the data concerning students' reactions to the course.

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[5]Mallory, *op. cit.*, pp. 115-128.

CHAPTER IV

ANALYSIS OF THE ACHIEVEMENT DATA

The purpose of this chapter is to present the data collected from the achievement tests and to use this data in making an analysis of the effectiveness of a second year of general mathematics for the students enrolled in the course, High School Mathematics, at Olathe High School during the 1959-1960 school year. In making this presentation and analysis the data will be considered from a dual standpoint: (1) the effectiveness for the class in general and (2) the effectiveness for upperclassmen as compared to sophomores.

I. PRESENTATION OF THE DATA

The California Achievement Test in Mathematics was administered to the students in the fall near the commencement of the course, and in the spring near the completion of the course. It is the purpose of this section to present in a tabular form, Table III, the data collected from these testings. The rest of the chapter consists of an analysis of information furnished in this table.

An explanation of Table III is necessary to better understand the data which is to be considered. Columns I and II refer to the student tested and the actual grade placement of this student. The abbreviations for sophomore, junior, and senior were used for actual grade placement

TABLE III

ACCUMULATED ACHIEVEMENT DATA

I	II	III	IV	V	VI	VII	VIII	IX
Case No.	Class	CAG FT	MG FT	DM-C FT	CAG ST	MG ST	DM-C ST	I-DM
1	Jr.	11.0	9.4	-1.6	11.7	13.6	1.9	3.5
2	So.	10.0	6.5	-3.5	10.6	7.3	-3.3	0.2
3	Jr.	13.5	8.8	-4.7	14.1	12.1	-2.0	2.7
4	So.	10.9	7.7	-3.2	11.6	9.1	-2.5	0.7
5	So.	9.8	8.6	-1.2	10.2	12.2	2.0	3.2
6	Sr.	12.1	9.7	-2.4	12.7	14.0	1.3	3.7
7	Jr.	10.8	7.6	-3.2	11.5	8.0	-3.5	-0.3
8	So.	10.5	6.4	-4.1	11.1	7.7	-3.4	0.7
9	Jr.	11.2	7.3	-3.9	11.8	10.7	-1.1	2.8
10	Sr.	12.0	7.4	-4.6	12.6	10.3	-2.3	2.3
11	So.	10.7	9.0	-1.7	11.3	9.6	-1.7	0.0
12	So.	10.8	7.8	-3.0	11.5	8.9	-2.6	0.4
13	Sr.	14.2	8.3	-5.9	14.9	12.8	-2.1	3.8
14	So.	9.6	7.3	-2.3	10.2	8.4	-1.8	0.5
15	So.	10.2	8.0	-2.2	10.8	7.3	-3.5	-1.3
16	Jr.	11.7	7.8	-3.9	12.3	8.7	-3.6	0.3
17	Jr.	11.7	6.7	-5.0	12.1	10.3	-1.8	3.2
18	So.	9.5	8.8	-0.7	10.1	9.3	-0.8	-0.1
19	So.	9.6	7.1	-2.5	10.2	8.1	-2.1	0.4
20	Jr.	10.7	11.4	0.7	11.3	14.2	2.9	2.2
21	So.	9.8	7.2	-2.6	10.4	11.1	0.7	3.3
22	So.	10.6	7.3	-3.3	11.2	8.2	-3.0	0.3
23	Jr.	11.7	8.4	-3.3	12.3	10.7	-1.6	1.7
24	So.	9.9	9.0	-0.9	10.4	13.0	2.6	3.5
25	So.	9.8	6.9	-2.9	10.2	8.1	-2.1	0.8
26	So.	9.7	9.2	-0.5	10.2	9.4	-0.8	-0.3
27	So.	11.4	7.2	-4.2	12.0	6.6	-5.4	-1.2

NOTE: This table should be read as follows: Student 1, a junior, at the time of the first testing had a chronological age grade of 11.0 but scored a mathematics grade of 9.4, a deficit of -1.6. At the time of the second testing this student had a chronological age grade of 11.7 and a mathematics grade of 13.6, which was 1.9 above that expected. The total gain in mathematics achievement was 3.5.

because these terms adequately describe the grade placement of the student throughout the school year. Other references made to types of grade placement were made in terms of assigned number values because such grade placements may fluctuate with variable factors.

Columns III and VI refer to chronological age grade placements; placement by the age of the student. Such placement refers to the grade in which a student should be enrolled in terms of his chronological age. Number values were used in this case because each month a person's chronological age grade will be increased. Column III refers to the fall testing; column VI refers to the spring testing.

Columns IV and VII refer to mathematical grade placements. The number values represented in these columns are computed by means of tables and norms from the results of the mathematics achievement tests. They represent the grade placement of the students in terms of their mathematical achievement. The fall testing is represented by column IV; the spring testing is represented by column VII.

The number values in columns V and VIII represent the difference in years between the student's chronological age grade and his mathematical achievement grade. These values were found by subtracting the chronological grade from the mathematical grade. If the value is positive the student is achieving in mathematics above his chronological grade level, but if the value is negative the student is achieving in mathematics below his chronological grade level. It was observed from column V that all but one student were achieving below their level on the first testing. From column VIII, concerning the second testing, a majority were still below level in mathematical achievement, but the number of positive values had been increased by five.

Such comparisons in change of mathematical achievement levels were summarized in column IX. The number values in this column represent an increase or decrease in achievement level with respect to a corresponding increase in chronological age. The values were obtained by subtracting column V from column VIII. A positive value indicates an improvement in achievement; a negative value indicates less achievement than expected.

II. AN ANALYSIS OF GENERAL CLASS ACHIEVEMENT

Notation. For convenience of identification and of reference the following notations have been adopted for clarification in this section.

i - the interval into which the data was divided.

f - the frequency of representatives in a given interval. A subscript indicates a tallied frequency.

N - the total number of cases involved.

X - the raw score values of the first testing as taken from column V, Table III.

Y - the raw score values of the second testing as taken from column VIII, Table III.

Z - the raw score values described in column IX, Table III.

x, y, z - deviation scores in correspondence to the raw scores X, Y, Z respectively. These are introduced to simplify computation.

fx, fy, fz - the frequency multiplied by the deviation score.

fx^2, fy^2, fz^2 - the frequency multiplied by the squared deviation score.

M - the mean score. A value indicating an average of the raw scores involved.

m - the assumed mean score. The center of the interval chosen by assumption to be the mean.

σ - the standard deviation score. A value measurement of the dispersion of the group.

r - the correlation coefficient. A value of 1.00 indicates perfect correlation; a value of .00 indicates no correlation.

Subscripts were used when it was necessary to indicate the raw scores for which the number reference was made.

Analysis of achievement deficiencies. Tables IV and V represent a closer study of columns V and VIII, Table III respectively. Construction consisted of the grouped data method[1] in which a convenient interval was chosen and the data was tallied for frequency distribution over the intervals. Expansion of the raw scores was then developed

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[1]Lester Guest, Beginning Statistics, (New York: Thomas Y. Crowell Company, 1957), pp. 54-56.

TABLE IV

TABULATION AND COMPUTATION OF ACHIEVEMENT DATA FOR THE FIRST TESTING

Highest Value 0.7 Range 6.6

Lowest Value -5.9 $\frac{6.6}{15} = 0.44$; i = 0.5

X	f_t	f	x	fx	fx^2
0.5 -	1	1	8	8	64
0.0 -		0	7	0	0
-0.5 - -0.1	1	1	6	6	36
-1.0 - -0.6	11	2	5	10	50
-1.5 - -1.1	1	1	4	4	16
-2.0 - -1.6	11	2	3	6	18
-2.5 - -2.1	1111	4	2	8	16
-3.0 - -2.6	111	3	1	3	3
-3.5 - -3.1	11111	5	0	0	0
-4.0 - -3.6	11	2	-1	-2	2
-4.5 - -4.1	11	2	-2	-4	8
-5.0 - -4.6	111	3	-3	-9	27
-5.5 - -5.1		0	-4	0	0
-6.0 - -5.6	1	1	-5	-5	25
		27		25	265
		N		Σfx	Σfx^2

$$M_x = -3.3 + \left(\frac{25}{27} \cdot 0.5\right) = -3.3 + (.93 \cdot 0.5) = -2.8$$

$$\sigma x = 0.5 \sqrt{\frac{265}{27} - \frac{25}{27}^2} = 0.5 \sqrt{9.81 - .86} = 0.5(2.99)$$

$$\sigma = 1.50$$

TABLE V

TABULATION AND COMPUTATION OF ACHIEVEMENT DATA FOR THE SECOND TESTING

Highest Value 2.9 Range 8.3

Lowest Value -5.4 $\frac{8.3}{15}$ = 0.62; i = 0.7

Y	f_t	f	y	fy	fy^2
2.8 - 3.4	1	1	7	7	49
2.1 - 2.7	1	1	6	6	36
1.4 - 2.0	11	2	5	10	50
0.7 - 1.3	11	2	4	8	32
0.0 - 0.6		0	3	0	0
-0.7 - -0.1		0	2	0	0
-1.4 - -0.8	111	3	1	3	3
-2.1 - -1.5	11111111	8	0	0	0
-2.8 - -2.2	111	3	-1	-3	3
-3.5 - -2.9	11111	5	-2	-10	20
-4.2 - -3.6	1	1	-3	-3	9
-4.8 - -4.3		0	-4	0	0
-5.6 - -5.0	1	1	-5	-5	25
		27 N		13 Σfy	227 Σfy^2

$$M_y = -1.8 + \left(\frac{13}{27} \cdot 0.7\right) = -1.8 + (.48 \cdot 0.7) = -1.5$$

$$\sigma_y = 0.7\sqrt{\frac{227}{27} - \left(\frac{13}{27}\right)^2} = 0.7\sqrt{8.41 - .23} = 0.7(2.84)$$

$$\sigma = 1.99$$

by means of deviation scores. From these the mean score and standard deviation were calculated. For convenience these calculations have been included in the tables.

In Table IV the interval was 0.5. Tallied deficiencies indicated a frequency of five between -3.1 and -3.5 years. This interval was given the deviation value of zero and other deviation values were assigned accordingly to intervals of greater or lesser deficiency. The fx and fx^2 columns were developed from the f and x columns. The value of the mean[2]

$$M = m + \left(\frac{\sum_{i=1}^{n} f_i x_i}{N} \cdot i \right)$$

was established to be -2.8 which indicated an average deficiency of two and eight tenths years in mathematics for the class in general. The standard deviation[3]

$$\sigma = i \sqrt{\frac{\sum_{i=1}^{n} f_i x_i^2}{N} - \left(\frac{\sum_{i=1}^{n} f_i x_i}{N} \right)^2}$$

was found to be 1.50 which was approximately one-fourth of the range, and indicated a reasonable dispersion.

Table V was constructed in a similar fashion, however the interval was 0.7 and the deviation value zero was assigned to the interval -1.5 to -2.1. The mean was found to be -1.5 and the standard deviation was 1.99.

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[2] *Ibid.*, p. 43.

[3] *Ibid.*, p. 55.

A comparison of the mean value, Table IV, and the mean value, Table V, gives an indication of the effectiveness of the course in general mathematics. The average class deficiency at the time of the first testing was -2.8. At the time of the second testing the class average had improved to -1.5 deficiency, a gain of 1.3 years on the average. This represents a substantial gain in mathematical achievement.

Analysis of changes in achievement. Table VI allows deeper insight into the change in achievement level, making use of column IX, Table III. Although the majority of cases were grouped near 0.0, the expected change in mathematical achievement level, there were several students who tallied over two grades better than expected, as indicated from the results of the first testing. Only five cases involved less gain in mathematical achievement than expected.

The mean was 1.4 which checks with the 1.3 established by comparing Tables IV and V. (The 0.1 discrepancy was the result of rounding decimals to tenths and does not invalidate the values.) The standard deviation was 1.58.

Correlation of achievement deficiencies. In order to check the correlation between the student's achievement on the first test and his achievement on the second test, a scattergram was prepared from the information given in

TABLE VI

TABULATION AND COMPUTATION OF THE CHANGE IN ACHIEVEMENT FOR THE GENERAL CLASS

Highest Value 3.8   Range 5.1

Lowest Value -1.3 $\frac{51}{15} = 0.34$; $i = 0.4$

Z	f_t	f	z	fz	fz^2
3.6 - 3.9	11	2	6	12	72
3.2 - 3.5	11111	5	5	25	125
2.8 - 3.1	1	1	4	4	16
2.4 - 2.7	1	1	3	3	9
2.0 - 2.3	11	2	2	4	8
1.6 - 1.9	1	1	1	1	1
1.2 - 1.5		0	0	0	0
0.8 - 1.1	1	1	-1	-1	1
0.4 - 0.7	11111	5	-2	-10	20
0.0 - 0.3	1111	4	-3	-12	36
-0.4 - -0.1	111	3	-4	-12	48
-0.8 - -0.5		0	-5	0	0
-1.2 - -0.9	1	1	-6	-6	36
-1.6 - -1.3	1	1	-7	-7	49
		27		1	421
		N		Σfz	Σfz^2

$$M_z = 1.35 + \left(\frac{1}{27} \cdot 0.4\right) = 1.35 + (.04 \cdot 0.4) = 1.4$$

$$\sigma_z = 0.4 \sqrt{\frac{421}{27} - \left(\frac{1}{27}\right)^2} = 0.4 \sqrt{15.59} = 0.4(3.95)$$

$$\sigma = 1.58$$

Tables IV and V. This scattergram and related computation are found in Table VII.

The coefficient of correlation[4], Table VII,

$$r = \frac{\dfrac{\sum_{i=1}^{n} x_i y_i}{N} - \left(\dfrac{\sum_{i=1}^{n} f_i x_i}{N}\right)\left(\dfrac{\sum_{i=1}^{n} f_i y_i}{N}\right)}{\sqrt{\left[\dfrac{\sum_{i=1}^{n} f_i x_i^2}{N} - \left(\dfrac{\sum_{i=1}^{n} f_i x_i}{N}\right)^2\right]\left[\dfrac{\sum_{i=1}^{n} f_i y_i^2}{N} - \left(\dfrac{\sum_{i=1}^{n} f_i y_i}{N}\right)^2\right]}}$$

was established to be 0.67, substantially large to be of importance. Since the mean achievement increase was 1.4 and the standard deviation was a greater 1.58 it can not be assumed that the mean achievement was relatively uniform. Such a correlation could indicate, however, that the student's class achievement position on the first testing was relatively close to the class achievement position he held on the second testing. This would indicate that the students with higher achievement levels tended to gain more than those whose relative achievement positions were lower.

III. AN ANALYSIS OF GRADE PLACEMENT ACHIEVEMENT

During the study it came to the instructor's attention that upperclassmen appeared to do better than sophomores in the class work. It is the purpose of this section to analyze this hypothesis in terms of the achievement data collected. For clarity, the term sophomore will refer to

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[4]Ibid., p. 96.

TABLE VII

SCATTERGRAM AND COMPUTATION OF THE CORRELATION BETWEEN THE FIRST AND SECOND TESTINGS

Y / X	-5.6 -5.0	-4.9 -4.3	-4.2 -3.6	-3.5 -2.9	-2.8 -2.2	-2.1 -1.5	-1.4 -0.8	-0.7 -0.1	0.0 0.6	0.7 1.3	1.4 2.0	2.1 2.7	2.8 3.4	y
0.5- 0.9													1	8
0.0- 0.4														7
-0.5--0.1							1							6
-1.0--0.6							1					1		5
-1.5--1.1											1			4
-2.0--1.6						1					1			3
-2.5--2.1				1		2				1				2
-3.0--2.6					1	1				1				1
-3.5--3.1				3	1	1								0
-4.0--3.6			1				1							-1
-4.5--4.1	1			1										-2
-5.0--4.6					1	2								-3
-5.5--5.1														-4
-6.0--5.6						1								-5
x	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	
Σxy	10	0	3	0	2	0	10	0	0	12	45	30	56	168

$$r = \frac{\frac{168}{27} - \left(\frac{25}{27}\right)\left(\frac{13}{27}\right)}{\sqrt{\left[\frac{265}{27} - \left(\frac{25}{27}\right)^2\right]\left[\frac{227}{27} - \left(\frac{13}{27}\right)^2\right]}} = \frac{6.22 - (.93)(.48)}{\sqrt{(9.81 - .86)(8.41 - .48)}}$$

$$\frac{6.22 - .45}{\sqrt{73.21}} = \frac{5.77}{8.56} = .67$$

those students enrolled in the tenth grade, and the term upperclassmen will refer to those students enrolled in the eleventh and twelfth grades.

Notation. Much of the notation used in this section was the same as that used in the previous section. The raw scores, however, were grouped in a different manner, thus it was necessary to recognize the following additional notation.

Q - the raw score values of the first testing for sophomore students.

S - the raw score values of the second testing for sophomore students.

T - the raw score values as described in column IX, Table III, for sophomore students.

U - the raw score values of the first testing for upperclassmen.

V - the raw score values of the second testing for upperclassmen.

W - the raw score values as described in column IX, Table III, for upperclassmen.

q, s, t, u, v, w - the deviation scores in correspondence to the raw scores Q, S, T, U, V, W respectively.

Comparison of achievement deficiencies. Because the number of cases involved was small, the tables for this section were designed in such a manner that both the sophomore scores and the upperclassmen scores were incorporated into a single table for a given set of data. The ungrouped data method[5] was used, in which direct use was

[5] Ibid., p. 54.

made of the raw scores in the computation of the mean and standard deviation scores. Although the methods were slightly different, the mean score and standard deviation score were essentially the same as would have been computed by the grouped data method.

Table VIII represents the accumulated data from the first testing for sophomore students as compared to upperclassmen. The mean of the sophomore achievement scores[6]

$$M = \frac{\sum_{i=1}^{n} Q_i}{N}$$

was -2.4, a deficiency of two and four-tenths years. The standard deviation[7]

$$\sigma = \frac{\sum_{i=1}^{n} q_i^2}{N}$$

was 1.11. Using similar formulas the mean of the upperclassmen's achievement scores was found to be -3.4 with a standard deviation of 1.75.

Comparison of these values indicates the average sophomore achievement level was 2.4 years below that expected, but the average upperclassmen achievement level was 3.4 years below that expected. The average deficiency for the upperclassmen was 1.0 years greater than the average deficiency of sophomores. Considering the upperclassmen

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[6] *Ibid.*, p. 41

[7] *Ibid.*, p. 54

TABLE VIII

COMPARISON OF THE ACHIEVEMENT DATA FOR SOPHOMORE STUDENTS AND UPPERCLASSMEN FOR THE FIRST TESTING

Q	q	q^2	U	u	u^2
-3.5	-1.1	1.21	-1.6	1.8	3.24
-3.2	-0.8	.64	-4.7	-1.3	1.69
-1.2	1.2	1.44	-2.4	1.0	1.00
-4.1	-1.7	2.89	-3.2	0.2	.04
-1.7	0.7	.49	-3.9	-0.5	.25
-3.0	-0.6	.36	-4.6	-1.2	1.44
-2.3	0.1	.01	-5.9	-2.5	6.25
-2.2	0.2	.04	-3.9	-0.5	.25
-0.7	1.7	2.89	-5.0	-1.6	2.56
-2.5	-0.1	.01	0.7	4.1	16.81
-2.6	-0.2	.04	-3.3	0.1	.01
-3.3	-0.9	.27	-37.8		33.54
-0.9	1.5	2.25	ΣU		Σu^2
-2.9	-0.5	.25			
-0.5	1.9	3.61			
-4.2	-1.8	3.24			
-38.8		19.64			
ΣQ		Σq^2			

$$M_u = \frac{-37.8}{11} = -3.4$$

$$u = \sqrt{\frac{33.54}{11}} = \sqrt{3.05} = 1.75$$

$$M_q = \frac{-38.8}{16} = -2.4$$

$$q = \sqrt{\frac{19.64}{16}} = \sqrt{1.23} = 1.11$$

$$M_q - M_u = -2.4 - (-3.4) = 1.0$$

were one to two years further removed from the freshman general mathematics course than the sophomores, this would tend to agree with the theory that retention decreases over a period of time. It would also indicate that the upperclassmen were in greater need of review work in mathematics than the sophomores.

In Table IX it is indicated that after the second year course in general mathematics the situation was somewhat changed. The mean sophomore achievement level was improved to -1.7 with a standard deviation of 2.02, and the mean upperclassman achievement level was improved to -1.1 with a standard deviation of 2.14. A comparison of these two mean scores indicates that the average upperclassman was achieving on a relative level 0.6 years higher than that of the average sophomore student.

A comparison of sophomore gain in achievement to upperclassmen gain in achievement indicates that the upperclassmen went from a deficit of 1.0 years to an excess of 0.6 years, a total difference of 1.6 years gain in achievement. Such a difference could imply that the course was more effective for upperclassmen than for sophomore students.

Comparison of changes in achievement. The above implication may also be observed in a comparison of the change in achievement for sophomores as compared to the change in achievement for upperclassmen. Such a comparison is presented in Table X.

TABLE IX

COMPARISON OF THE ACHIEVEMENT DATA FOR SOPHOMORE STUDENTS AND UPPERCLASSMEN FOR THE SECOND TESTING

S	s	s^2	V	v	v^2
-3.3	-1.6	2.56	1.9	3.0	9.00
-2.5	-0.8	.64	-2.0	-0.9	.81
2.0	3.7	13.69	1.3	2.4	5.76
-3.4	-1.7	2.89	-3.5	-2.4	5.76
-1.7	0.0	.00	-1.1	0.0	.00
-2.6	-0.9	.81	-2.3	-2.2	4.84
-1.8	-0.1	.01	-2.1	-1.0	1.00
-3.5	-1.8	3.24	-3.6	-2.5	6.25
-0.8	0.9	.81	-1.8	-0.7	.49
-2.1	-0.4	.16	2.9	4.0	16.00
0.7	2.4	5.76	-1.6	-0.5	.25
-3.0	-1.3	1.69	-11.9 ($\sum V$)		50.16 ($\sum v^2$)
2.6	4.3	18.49			
-2.1	-0.4	.16			
-0.8	0.9	.81			
-5.4	-3.7	13.69			
-27.7 ($\sum S$)		65.41 ($\sum s^2$)			

$$M_v = \frac{-11.9}{11} = -1.1$$

$$M_s = \frac{-27.7}{16} = -1.7$$

$$\sigma_v = \sqrt{\frac{50.16}{11}} = \sqrt{4.56} = 2.14$$

$$\sigma_s = \sqrt{\frac{65.41}{16}} = \sqrt{4.09} = 2.02$$

$$M_s - M_v = -1.7 - (-1.1) = -0.6$$

TABLE X

COMPARISON OF THE CHANGE IN ACHIEVEMENT FOR SOPHOMORE STUDENTS AND UPPERCLASSMEN

T	t	t^2	W	w	w^2
0.2	-0.5	.25	3.5	1.1	1.21
0.7	0.0	.00	2.7	0.3	.09
3.2	2.5	6.25	3.7	1.3	1.69
0.7	0.0	.00	-0.3	-2.7	7.29
0.0	-0.7	.49	2.8	0.4	.16
0.4	-0.3	.09	2.3	-0.1	.01
0.5	-0.2	.04	3.8	1.4	1.96
-1.3	-2.0	4.00	0.3	-2.1	4.41
-0.1	-0.8	.64	3.2	0.8	.64
0.4	-0.3	.09	2.2	-0.2	.04
3.3	2.6	6.76	1.7	-0.7	.49
0.3	-0.4	.16			
3.5	2.8	7.84			
0.8	0.1	.01			
-0.3	-0.4	.16			
-1.2	-1.9	3.61			
11.1		30.39	25.9		17.99
ΣT		Σt^2	ΣW		Σw^2

$$M_t = \frac{11.1}{16} = 0.7$$

$$\sigma t = \sqrt{\frac{30.39}{16}} = \sqrt{1.90} = 1.38$$

$$M_w = \frac{25.9}{11} = 2.4$$

$$\sigma w = \sqrt{\frac{17.99}{11}} = \sqrt{1.63} = 1.28$$

$$M_w - M_t = 2.4 - 0.7 = 1.7$$

The mean change for sophomore students was found to be 0.7, a gain in achievement of seven-tenths years over that expected. The standard deviation was 1.38. For upperclassmen the mean change was 2.4, or an achievement gain of two and four-tenths years over that expected. The standard deviation was 1.28. A comparison of these scores indicates the average upperclassman had a gain of 1.7 years over that of the average sophomore student. This represents a substantial increase in achievement for upperclassmen as compared to sophomores. It is conjectured by the instructor that a more stable maturity level and recovery of a greater retention loss was partially responsible for this difference in upperclassman and sophomore achievement.

Correlation of age placement and achievement deficiency. Another examination of data concerning achievement is presented in Table XI. This involves the tabulation and computation of a coefficient of correlation between chronological age grade placement and an increase or decrease in achievement as established in column IX, Table III. This is essentially different than the previous comparison because the variable grade placement (chronological) is used rather than the stable grade placement (actual).

The investigation involved a scattergram of the chronological ages of the students at the time of the second testing as compared to their respective increase or decrease in achievement. From the information involved in Table XI the coefficient of correlation was found to be 0.315. Although this correlation was not as great as might be expected from the previous discussion, it was great enough to indicate there is a correlation between the student's chronological age and his expected improvement in achievement.

TABLE XI

SCATTERGRAM AND COMPUTATION OF CORRELATION BETWEEN CHRONOLOGICAL AGE AND IMPROVEMENT OF ACHIEVEMENT LEVEL

Z CA	-1.5 -1.1	-1.0 -0.6	-0.5 -0.1	0.0 0.4	0.5 0.9	1.0 1.4	1.5 1.9	2.0 2.4	2.5 2.9	3.0 3.4	3.5 3.9	f_z	z	fz	fz^2
14.5-14.9											1	1	7	7	49
14.0-14.4									1			1	6	6	36
13.5-13.9												0	5	0	0
13.0-13.4												0	4	0	0
12.5-12.9								1			1	2	3	6	18
12.0-12.4	1			1			1			1		4	2	8	16
11.5-11.9			1	1	1				1		1	5	1	5	5
11.0-11.4				2	1			1				4	0	0	0
10.5-10.9	1				1							2	-1	-2	2
10.0-10.4			2	1	2					1	2	8	-2	-16	32
f_{ca}	2	0	3	5	5	0	1	2	2	2	5	27		14	158
ca	-4	-3	-2	-1	0	1	2	3	4	5	6				
fca	-8	0	-6	-5	0	0	2	6	8	10	30	56			
fca^2	32	0	12	5	0	0	4	18	32	50	180	333			
caz	-4	0	6	-1	0	0	4	9	28	0	42	84			

$$r = \frac{\frac{84}{27} - \left(\frac{37}{27}\right)\left(\frac{14}{27}\right)}{\sqrt{\left[\frac{333}{27} - \left(\frac{37}{27}\right)^2\right]\left[\frac{158}{27} - \left(\frac{14}{27}\right)^2\right]}} = \frac{3.11 - (1.37)(.52)}{\sqrt{(12.33 - 1.88)(5.85 - .27)}}$$

$$= \frac{3.11 - .71}{\sqrt{58.31}} = \frac{2.40}{7.64} = .315$$

CHAPTER V

ANALYSIS OF THE INQUIRY FORM DATA

> The positive relationship between pupil interest and pupil success is generally recognized. If the pupil desires to succeed he will put forth greater efforts and his accomplishments will be greater than if he is indifferent.[1]

In order to obtain the student's reaction to the course work in the High School Mathematics Class an inquiry form was included with the second achievement test. An example of this form may be found in the appendix. In the following chapter the results of this inquiry form are tabulated and analyzed.

In order to preserve honesty and sincerity the students were allowed to leave the space for their name blank and give only their classification in school. They were assured that the answers to the questions would in no way affect their grade for the course. Thus it is assumed that the data collected is a reasonably honest evaluation of student attitudes toward the course.

I. ATTITUDES TOWARD SUBJECT SCHEDULES

Class schedules. The first question referred to the class schedule of each student. The results are summarized

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[1] Virgil S. Mallory, The Relative Difficulty of Certain Topics in Mathematics for Slow-Moving Ninth Grade Pupils, (New York: Teachers College, Columbia University, 1939), p. 111.

in Figure III which represents a floor plan similar to that of Olathe High School, with the numbers in the various rooms indicating the number of students enrolled in that particular class.

Most of the students were enrolled in either four or five classes, although a few were enrolled in six classes. The mean was 4.7 classes. For such courses as English, physical education, and shop, divisions were not outlined, but rather all those enrolled in such courses were grouped together under the general course heading.

All the students, of course, were enrolled in general mathematics. Reading ranked second in enrollment with a total of seventeen pupils enrolled, but was closely followed by physical education with fifteen, biology with thirteen, general shop with twelve, English with eleven, and history with nine. Other enrollments were scattered over a list of nine other course topics.

An indication of the group type may be gained when it is considered that a typical class schedule could include general mathematics, reading, physical education, biology, and shop. These all represent a general type of education which is common for the slow student. Notice the remedial courses: general mathematics, reading, and in some cases biology and general science.

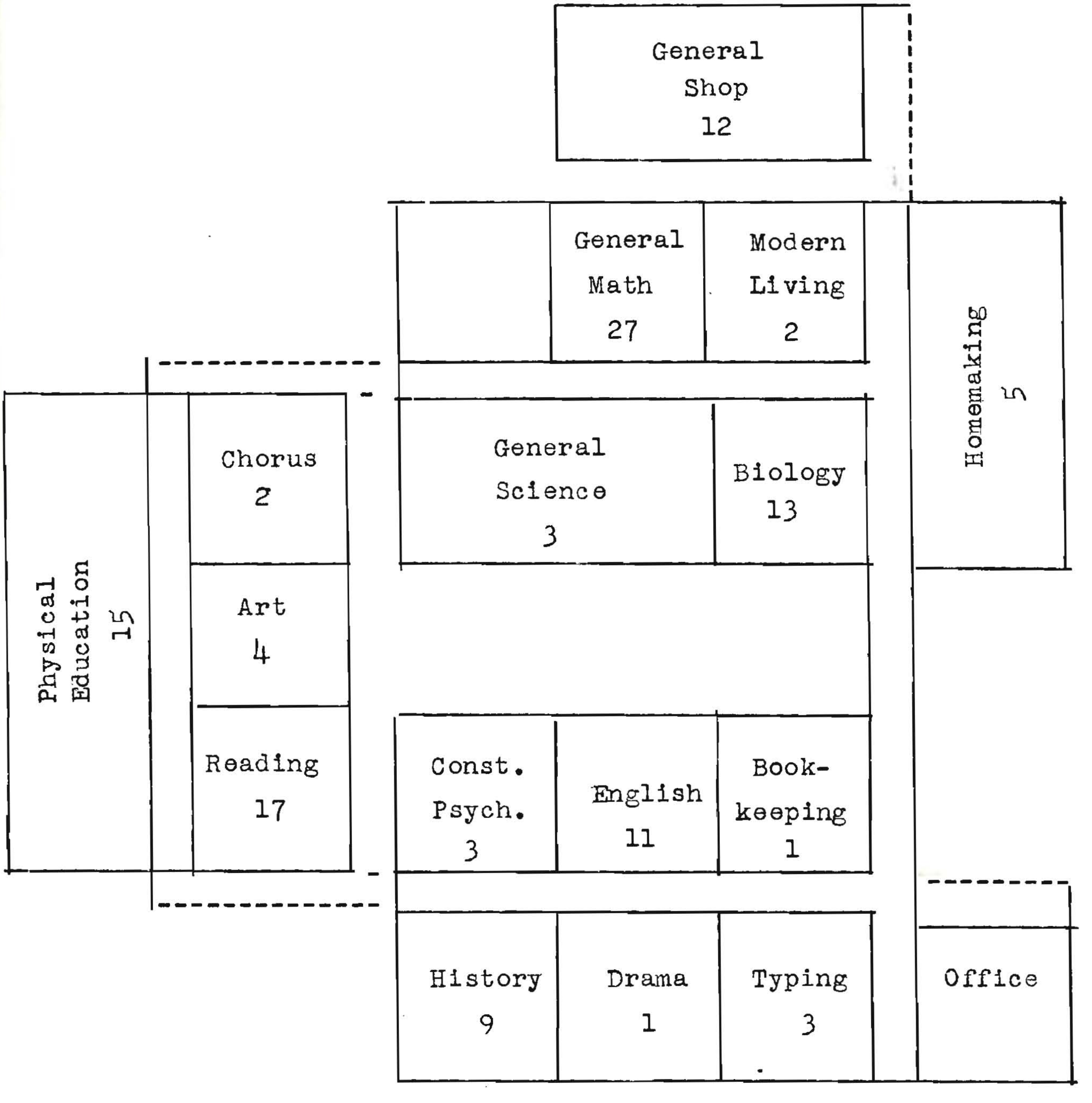

FIGURE 3

COURSE ENROLLMENTS OF THE HIGH SCHOOL MATHEMATICS STUDENTS

Interest ratings. Questions two, three, and four referred to the student's favorite, second favorite, and least favorite courses of his schedule. The results are tabulated in Table XII by classes and the student's first, second, and last choices. Involved were a total of fourteen courses, but seven had four or less comments and were thus classified together in the miscellaneous column. These courses included homemaking, art, constitution-psychology, general science, drama, bookkeeping, and typing.

TABLE XII

COURSES RATED FAVORITE, SECOND FAVORITE, AND LEAST FAVORITE BY THE STUDENTS OF THE HIGH SCHOOL MATHEMATICS CLASS

	Biol.	Eng.	Hist.	Math.	Gym	Read.	Shop	Misc.
	Number of Votes For Class Interest Position							
Best	4	1	1	5	3	1	6	6
Second	5	0	2	9	2	2	2	4
Least	1	7	3	3	0	6	1	3
	Percentage of Enrollment Involved							
Best	31	9	11	19	20	6	50	30
Second	38	0	22	33	13	12	17	20
Least	8	64	33	11	0	35	8	15

Of particular interest is the position occupied by the general mathematics course. It received the most comment of any subject, and most of it was favorable. Percentagewise general mathematics rated near the middle as first choise, but as second choice it was a close second to Biology. There were only three students who rated general mathematics as their least favorite course, a relatively low 11 per cent. This indicates that with proper instruction and material suited to his ability level, the slow student may find mathematics an interesting and enjoyable school subject.

Value. Question five asked the student to indicate the course he felt would be most useful and valuable to him. Table XIII contains the results. The general mathematics course was the majority choice. This indicates the student's realization of the value of a good mathematical background.

TABLE XIII

COURSES RATED AS THEIR MOST VALUABLE BY THE STUDENTS OF THE HIGH SCHOOL MATHEMATICS CLASS

Type of Class	No. of Ratings
general mathematics.	12
homemaking	3
general shop	2
reading	2
typing	2
American history	1
art	1
English	1
drama	1
biology	1
bookkeeping	1

From Table XIII it may be seen, also, that the students involved in this study were primarily interested in vocational subjects, typical of the program for the slow learner. Other subjects rated as most valuable included such vocational courses as homemaking, shop, reading, typing, and bookkeeping.

II. COMMENTS CONCERNING THE COURSE

Attitudes toward the course. Question six involved the students' attitudes toward the High School Mathematics course. The students were given five choices: (1) I have liked it very much, (2) I have liked it slightly, (3) I do not care much about it either way, (4) I have disliked it slightly, and (5) I have disliked it very much. The results are recorded by a bar graph, Figure 4.

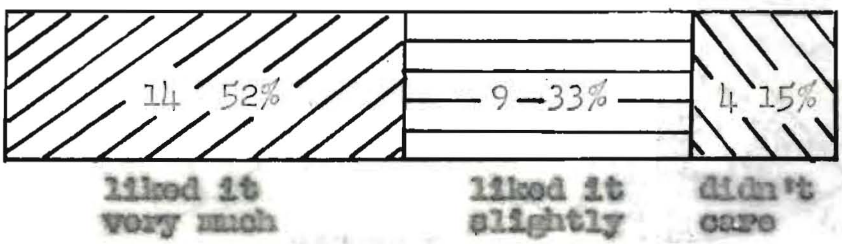

FIGURE 4

THE STUDENT ATTITUDES TOWARD THE HIGH SCHOOL MATHEMATICS COURSE

Figure 4 indicates that the majority of students liked the course to some degree. Four didn't care, and there were no students who stated they disliked the course. This indicates an interest in mathematics by the slow learning high school students involved in this study.

Comments concerning enjoyment of the course. Figure 5 contains two circle graphs representing questions seven and eight concerning the reasons the class was enjoyed by the students, and reasons the class was not enjoyed by the students. In each of these questions the students were given a list of suggestions but were also invited to provide their own.

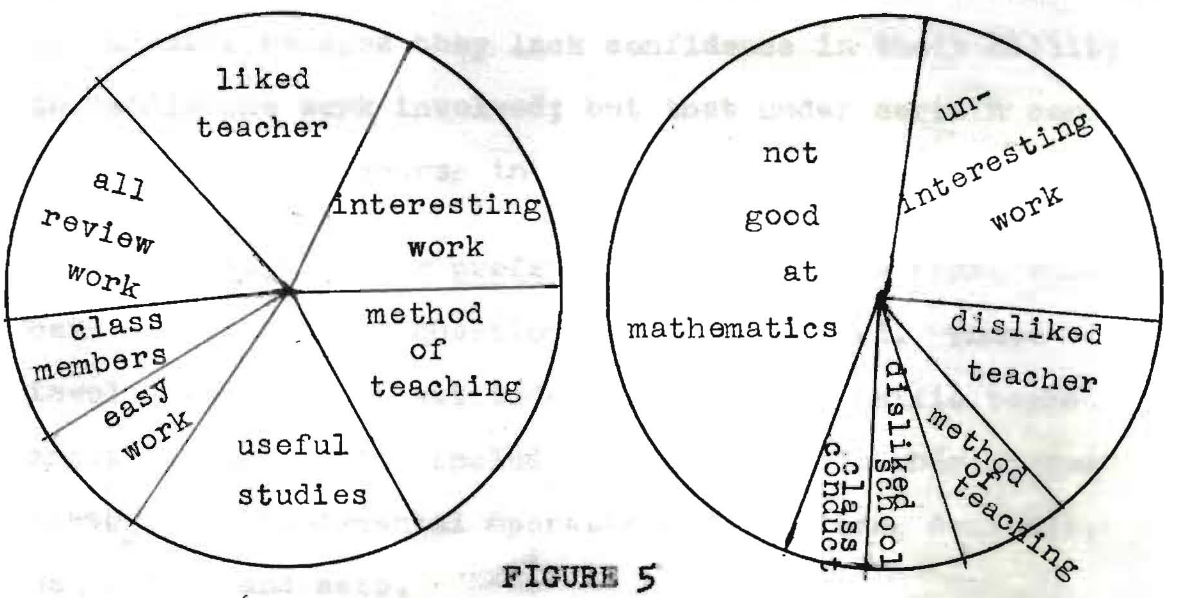

FIGURE 5

STUDENT COMMENTS CONCERNING THEIR ENJOYMENT OF THE HIGH SCHOOL MATHEMATICS COURSE

The reasons for enjoying the class were quite evenly distributed. As indicated such items as the method in which the class was taught, interest in the problems, the usefulness of mathematics, the review obtained, and the teacher were listed most often. The students were allowed to check as many reasons as they desired; thus the total of sixty-four responses indicates there were several students who made multiple selections.

Figure 5 also presents the reasons for not enjoying the class, High School Mathematics. Seventeen selections were made concerning this topic with two dominating the student's feelings: (1) that they were not proficient at mathematics and (2) the work was not interesting. This would indicate that many slow students feel hostility toward mathematics because they lack confidence in their ability to handle the work involved; but that under certain conditions they may enjoy a course in mathematics.

Subject matter preferences. Table XIV represents the data collected from questions nine and eleven. These involve the student attitudes toward the specific topic areas studied, which included history, the number system (integers), fundamental operations, fractions, decimals, per cents, and sets.

It was found that the areas best liked were fractions, decimals, and per cents; topics normally studied at the sixth and seventh grade levels and therefore appropriate for the mathematical grade placement of the students. Many students chose multiple topic areas as subject matter they enjoyed studying.

Concepts and presentations somewhat unfamiliar to their former work in mathematics dominated the list of topics least enjoyed in the course. The history of mathematics, sets, and the number system, using the number line, were the topics included in this category. Multiple choices were common.

TABLE XIV

STUDENT ATTITUDES TOWARD SPECIFIC TOPICS STUDIED IN THE HIGH SCHOOL MATHEMATICS COURSE

Topics Studied	No. of Comments Liked	No. of Comments Disliked
history	7	11
the number system	6	9
fundamental operations	7	3
fractions	13	6
decimals	15	5
percents	11	7
sets	5	8

Summary. More than any other question, the replies to question thirteen indicate the student's attitude toward the course in High School Mathematics. The questions were, "Do you feel the High School Mathematics course has been beneficial to you? Why?". Table XVI contains the results.

Of the twenty-seven students involved twenty-four replied yes, that the course had been beneficial to them. Three sophomore students replied no. This indicates that in general the students felt the material studied in a second year of general mathematics was worthwhile to them.

TABLE XV

SUMMARY OF STUDENT ATTITUDES TOWARD THE HIGH SCHOOL MATHEMATICS CLASS AS TO WHETHER IT WAS BENEFICIAL

Class	Yes	No	Comments
Sophomores	13	3	mathematics is important to living. . 6
Juniors	8	0	it was a good review of arithmetic. 7
Seniors	3	0	didn't try 1
Totals	24	3	no comment 8
			other comments 5

The second part asked why. Replies indicated that the students felt a knowledge of mathematics was important to them in their adult life and that they needed to review mathematics.

CHAPTER VI

FINAL CONSIDERATIONS

The value of a good mathematical background for the student is recognized by most educators. For this reason in many states students are required to have at least one or more courses in mathematics while in high school. The characteristics of such a course may vary from area to area. In some cases a general mathematics course may be supplied for the student of lesser ability, but in other cases the slow student is required to study mathematical areas above his achievement level in mathematics.

In general, as freshmen in high school, most slow students terminate their mathematical course work; often with a mathematical ability only slightly above that of a grade school student. It has been the purpose of this study to examine the results of a second year course in general mathematics for a typical class of slow students at Olathe High School, and to evaluate the effectiveness of such a course for the students involved.

I. SUMMARY

The study involved the class, High School Mathematics, at Olathe High School for the school year 1959-1960. Two view points were taken: (1) the change in achievement level as indicated by the results of the California Achievement

Test in Mathematics and (2) the student's attitudes toward the course as indicated by the results of the inquiry form.

Comparison of the data and the results of the achievement tests indicate there was an important change in mathematical achievement, an average increase of one and four-tenths years. Correlation made between the first and second testings indicated that this change in achievement was not uniform, but that relative class achievement position was maintained. Furthermore it was found that upperclassmen showed a greater increase in achievement than sophomores, and that some correlation existed between chronological age and the increase in achievement. It may be assumed that the second year of general mathematics was largely responsible for the increase in mathematical achievement, and that it was of somewhat greater benefit to the upperclassmen.

The results of the inquiry form would indicate that in general the attitude toward the second year course in general mathematics was good. In questions concerning popularity and value the second year mathematics course rated fairly well. Many students appreciated the review of arithmetic such a course offered them. Several students indicated they were insecure in their mathematical ability, and a majority of students indicated they felt the course work had been beneficial to them.

II. CONCLUSIONS

As a result of the data presented in this study, the following general conclusions may be drawn concerning the effectiveness of a second year course in general mathematics.

1. Some students are not prepared mathematically for the traditional course in algebra, but desire to improve their mathematical achievement. Such students realize the importance of a good mathematical background and although they may lack confidence, they wish to continue study in a mathematics course. A second year course in general mathematics fulfills this need.

2. Just as remedial courses are taught in other subjects, such as English, there is also a necessity for a remedial course in mathematics in the school curriculum.

3. A second year course in general mathematics need not be an easy course, but rather can provide valuable mathematics review work. Upperclassmen, particularly, may benefit from the refresher work in mathematics.

4. It is probable that the slow student will raise his achievement level in mathematics if he continues to study this subject in a remedial high school course directed specifically toward improvement of his arithmetic weaknesses.

III. RECOMMENDATIONS

On the basis of the information presented in this study, the following recommendations are offered:

1. Additional testings should be made six months to a year after completion of the second year course in general mathematics to check the retention of the material studied and the relative differences in achievement.

2. High schools should study the possibility of providing a second year course in general mathematics for slow students.

3. There is a need for text material in remedial mathematics for use in remedial course work.

4. Research could be done concerning the feasibility of a refresher course in general mathematics for senior students who feel their mathematics preparation is weak.

BIBLIOGRAPHY

BIBLIOGRAPHY

Christofferson, H. C. "Who Said 'Simple Arithmetic'?" NEA Journal, 48:51-52, January, 1959.

Conant, James Bryant. "Diversified Studies for Diversified Students," National Parent-Teacher, 53-4-6, October, 1958.

Conant, James Bryant. "Dr. Conant Reports to American People," Scholastic Teacher (Senior Scholastic), 74:1T-4T,

Cooley, Hollis R., et.al. Introduction to Mathematics--A Survey Emphasizing Mathematical Ideas and Their Relations to Other Fields of Knowledge. Boston: Houghton Mifflin Company, 1937, 634 pp.

Courant, Richard and Herbert Robbins. What Is Mathematics? London: Oxford University Press, 1941, 521 pp.

Drucker, Peter F. "Math Even Parents Can Understand," Harper's Magazine, 216:73-75, April, 1958.

First Report of the Committee on Post-War Plans, The, "The Mathematics Teacher, 37:226-232, May, 1944.

Green, Casper D. "What Shall We Do With the Dullards?" Atlantic, 197:72-74, May, 1956.

Guest, Lester. Beginning Statistics. New York: Thomas P. Crowell Company, 1957, 255 pp.

Halmos, Paul R. "Innovation in Mathematics," Scientific American, 199:66-73, September, 1958.

"High Schools . . . U. S. A." Senior Scholastic, 74:12-13, February 13, 1959.

Howard, Homer. Mathematics Teachers Views on Certain Issues in the Teaching of Mathematics. Bureau of Publications. New York: Teachers College, Columbia University, 1951, 134 pp.

Mallory, Virgil S. The Relative Difficulty of Certain Topics in Mathematics for Slow-Moving Ninth Grade Pupils. Bureau of Publications. (New York: Teachers College, Columbia University, 1959, 179 pp.

Morton, Robert Lee. Teaching Children Arithmetic. New York: Silver Burdett Company, 1953, 566 pp.

Morton, Robert Lee. _Teaching Children Arithmetic_. New York: Silver Burdett Company, 1953, 566 pp.

Norris, Ruby. "General Mathematics or Algebra for the Ninth Grade?" _Workshop in High School Mathematics_. Emporia, Kansas: Kansas State Teachers College, 1955, 62 pp.

Ogle, Esther. "The Slow Learner," _Workshop in High School Mathematics_. Emporia, Kansas: Kansas State Teachers College, 1958, pp. 92.

Reeve, William David. _Mathematics For the Secondary School_. Henry Holt and Company, 1954, 547 pp.

Sausen, Inez I. "A Study of Corrective Mathematics For Ninth Grade Pupils in Mathematics," Unpublished Master's thesis, Kansas State Teachers College, Emporia, Kansas, 1956, 56 pp.

School Mathematics Study Group. _Mathematics For High School --First Course in Algebra_. New Haven: Yale University Press, 1959.

Thompson, William H. "This 'Thang' Called Algebra," _Workshop in High School Mathematics_. Emporia, Kansas: Kansas State Teachers College, 1955, 62 pp.

Tiegs, Ernest W. and Willis W. Clark, _Manual, California Achievement Tests_. Los Angeles: California Test Bureau, 1957.

Wilson, Guy M., Mildred B. Stone, and Charles O. Dalrymple. _Teaching the New Arithmetic_. New York: McGraw-Hill Book Company, Inc., 1939, pp.458.

________, _et al_. (eds.). _Webster's New World Dictionary of the American Language_. Cleveland: The World Publishing Company, 1954, 1724 pp.

APPENDIX

HIGH SCHOOL MATHEMATICS QUESTIONAIRE NAME

Directions: The following questionaire is designed to measure the importance of this course to the school curriculum, and to help in analyzing possible changes which could be made toward improvement of the course. Please answer each question fully and honestly.

1. List the subjects you have taken this school year.

   ________ ________ ________ ________ ________

2. Which subject that you have taken this school year did you like best? ________

3. Which subject that you have taken this school year did you like second best? ________

4. Which subject that you have taken this school year did you like least? ________

5. Which subject that you have taken this school year did you think the most useful and valuable to you? ________

6. Check the statement which expresses your feeling about the course you have taken in high school arithmetic this year:

   ___ I have liked it very much.
   ___ I have liked it slightly.
   ___ I do not care much about it either way.
   ___ I have disliked it slightly.
   ___ I have disliked it very much.

7. Check the following statements which express reasons you enjoyed the High School Mathematics course. (Check as many as apply.)

   ___ It was interesting to do.
   ___ It was useful.
   ___ It was easy to do.

___ I liked the other class members.
___ I liked the teacher.
___ I liked the way the class was taught.
___ It was review work.
___ Other reasons: (Please state them.)

____

8. Check the following statements which express reasons you did not enjoy the High School Mathematics course. (Check as many as apply.)

___ It was not interesting to do.
___ It was too hard.
___ I disliked the teacher.
___ There was too much repetition.
___ It was not useful.
___ I am not good at mathematics.
___ I disliked the method of teaching.
___ I disliked the other class members.
___ Other reasons: (Please state them.)

____

9. Check the study areas you liked.

___ history
___ the number system
___ fundamental operations
___ fractions
___ decimals
___ percents
___ sets

10. Which of these study areas did you like best? ________

11. Check the study areas you disliked.

___ history
___ the number system
___ fundamental operations
___ fractions
___ decimals
___ percents
___ sets

12. Which of these study areas did you like least? ________

13. Do you feel the High School Mathematics course has been beneficial to you?

___ yes ___ no

Below please state briefly your reasons for making this choice.