A COMPARISON OF ARITHMETIC ACHIEVEMENT BETWEEN AN EIGHTH GRADE ALGEBRA CLASS AND AN EIGHTH GRADE ENRICHED MATHEMATICS CLASS

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ABSTRACT

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by Rebecca W. Crocker

An experimental eighth grade mathematics class of above-average students was taught Algebra I on an accelerated basis during the school year 1965-1966 at Pattengill Junior High School, Lansing, Michigan. This class began a mathematics sequence which advances the students one full year throughout their high school mathematics program and will provide time for a college-level calculus course in their senior year. The purpose of this study is to find if the study of Algebra I in the eighth grade instead of the regularly scheduled enriched eighth grade mathematics had an adverse effect on the arithmetic achievement of the students. A similarly selected class of above-average eighth graders was taught enriched eighth grade mathematics at Walter French Junior High School, Lansing, Michigan. This class was designed to act as a control class for this experimental study.

The experimental and control classes were similarly selected in the seventh grade on the basis of scores on a sixth grade testing using the California Test of Mental

Maturity and the California Arithmetic Test as well as sixth grade teacher recommendations. For the eighth grade grouping the classes were selected from seventh grade enriched mathematics classes. At the beginning of the eighth grade year both classes were given, as a pre-test, the Sequential Test of Educational Progress, Mathematics Test, Form 3A, to establish mathematics achievement at the beginning of the year. At the end of the year Form 3B of the same test was given as a post-test to establish a comparison. Also given in the eighth grade to both classes was the California Arithmetic Test, for grades 7-9, and a teacher-made test. In addition the Mooney Problem Check List was administered to both classes to establish what personal problems the students had and whether the accelerated experimental class reflected problems differently from the control class.

A chi-square test of significance was used to establish whether the two classes were significantly different on the basis of the California Test of Mental Maturity, language and non-language percentile scores; the California Arithmetic Test, sixth grade, reasoning and fundamental percentile scores; and the California Arithmetic Text, eighth grade, reasoning and fundamental percentile scores. All the chi-squares were too small to be significant. It is, therefore, established that no significant difference existed between the experimental and control classes on the basis of the California Test of Mental Maturity or the California Achievement Test at either the sixth or eighth grade levels.

On the teacher-made test and the Sequential Test of Educational Progress, Mathematics Test, pre-test and post-test, an analysis of variance was made to determine the significance of difference between the means, based on raw scores. On the teacher-made test the experimental class did significantly better than the control class. This superior performance by the experimental class is confirmed by a mean six points higher and an F-statistic of 22.0 - beyond the .005 level of significance. The analysis of variance indicated no significant difference between the two classes on the pre-test or post-test using the Sequential Test of Educational Progress, Mathematics Test, Forms 3A and 3B. The conclusion can then be drawn that the study of algebra by the eighth grade class at Pattengill Junior High School did not adversely affect their arithmetic achievement.

On the Mooney Problem Check List the two classes shared many problems which would be expected since both are above-average ability-grouped classes. The experimental class, however, had only one-half as many school-related problems as the control class which suggests that the accelerated mathematics sequence favorably affected school-related problems in this class. To investigate the underlying factors leading to the many school-related problems found in both classes might well be the purpose of another study.

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Rebecca W. Crocker

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CHAPTER I

INTRODUCTION

General Background for the Problem

An experimental accelerated mathematics sequence program was started at Pattengill Junior High School, Lansing, Michigan, during the school year 1965-66. The eighth grade class of thirty-five students began the accelerated program by taking algebra in the eighth grade instead of the customary ninth grade. This acceleration will permit these students to complete the usual college preparatory mathematics sequence in the eleventh grade and then to continue to take calculus as seniors at Lansing Community College or Michigan State University. Since the students were carefully screened on the basis of their ability and achievement and were enrolled in an enriched seventh grade arithmetic class, it is expected that they will be able to omit the regular eighth grade mathematics class without any adverse effect on their long-term mathematics achievement.

Following is an outline of the mathematics sequence to be followed by the Pattengill experimental class, as outlined by Frank S. Rogers, Consultant in Mathematics for the Lansing School District:

Year One--seventh grade. Two sections of enriched mathematics which will cover more than the typical seventh grade curriculum.

Year Two--eighth grade. One section, selected from two sections in the seventh grade, Algebra I.

Year Three--ninth grade. Same class as in eighth grade, second year algebra.

Year Four--tenth grade. Students will be scattered through eight or nine sections of geometry at Eastern High School.

Year Five--eleventh grade. Special trigonometry section in the fall, probably limited to the group completing second year algebra in the ninth grade. Analytic geometry in the second semester, mixed with two sections of seniors at Eastern High School.

Year Six--twelfth grade. Original eighth grade algebra class will take calculus at Lansing Community College or Michigan State University. For those who feel they will not go into a mathematics related curriculum in college, an extra hour will be available to take another course, e.g., third year language, physics, special government course, or typing.

Membership in the eighth grade experimental algebra class was determined in the following way. All Lansing School District classes are administered The California Test of Mental Maturity (1), which yields an intelligence measure expressed in percentiles, and The California Arithmetic

Achievement Test (2), which yields a percentile rating of arithmetic achievement. Students for two seventh grade enriched classes for Pattengill Junior High School for the school year, 1964-65, were selected on the basis of these two tests and sixth grade teacher recommendations. At the end of the seventh grade, the teacher of the seventh grade enriched classes, who was also to be the eighth grade algebra teacher, determined the membership of the eighth grade algebra class, selecting the better students from the two seventh grade enriched classes.

The textbook used for Algebra I was Modern Elementary Algebra by Eugene D. Nichols and Wagner G. Collins (3).

In 1965-66, a control class of eighth grade students, which was similarly selected in the seventh grade and continued in the eighth grade, was taught enriched arithmetic at Walter French Junior High School, Lansing. This eighth grade class of thirty-one students was the control class for this experimental study. The textbook used was Mathematics for Junior High School, Volume II, from the School Mathematics Study Group (4). This will hereafter be referred to as "SMSG materials." The control class will follow the recommended college preparatory sequence of the Lansing School District as follows:

9 b:	Algebra I	9 b:	Algebra II
10 b:	Geometry I	10 a:	Geometry II, III
11 b:	Algebra III	11 a:	Trigonometry
12 b:	Algebra IV	12 a:	Analytic geometry

Statement of the Problem

Two general hypotheses are used to state the problem:

1. Eighth grade students who study SMSG mathematics materials will not be significantly different in arithmetic skills from eighth grade students who study Algebra I from the textbook by Nichols and Collins.
2. Eighth grade students who study SMSG mathematics materials will not be significantly different in number of problems, as measured by the Mooney Problem Checklist, from eighth grade students who study Algebra I from the textbook by Nichols and Collins.

Following the general hypotheses, ten more specific hypotheses are outlined. These are dealt with in the analysis presented in Chapter III. The specific hypotheses are:

1. Eighth grade students who study SMSG mathematics materials will not be significantly different in intelligence quotient, language, as measured by the California Test of Mental Maturity, from eigth grade students who study Algebra I from the textbook by Nichols and Collins.
2. Eighth grade students who study SMSG mathematics materials will not be significantly different in intelligence quotient, non-language, as measured by the California Test of Mental Maturity, from eighth grade students who study Algebra I from the textbook by Nichols and Collins.

3. Eighth grade students who study SMSG mathematics materials will not be significantly different in arithmetic reasoning, as measured by the California Achievement Test in Arithmetic, when they were sixth grade students, from eighth grade students who study Algebra I from the textbook by Nichols and Collins.
4. Eighth grade students who study SMSG mathematics materials will not be significantly different in arithmetic fundamentals, as measured by the California Achievement Test in Arithmetic, when they were sixth grade students, from eighth grade students who study Algebra I from the textbook by Nichols and Collins.
5. Eighth grade students who study SMSG mathematics materials will not be significantly different in arithmetic reasoning, as measured by the California Achievement Test in Arithmetic, from eighth grade students who study Algebra I from the textbook by Nichols and Collins.
6. Eighth grade students who study SMSG mathematics materials will not be significantly different in arithmetic fundamentals as measured by the California Achievement Test in Arithmetic, from eighth grade students who study Algebra I from the textbook by Nichols and Collins.
7. Eighth grade students who study SMSG mathematics materials will not be significantly different in arithmetic skills, as measured by the Sequential Test of Educational Progress (5) mathematics test, given as a

pre-test, from eighth grade students who study Algebra I from a textbook by Nichols and Collins.

8. Eighth grade students who study SMSG mathematics materials will not be significantly different in arithmetic skills, as measured by the Sequential Tests of Educational Progress mathematics test, given as a post-test, from eighth grade students who study Algebra I from a textbook by Nichols and Collins.

9. Eighth grade students who study SMSG mathematics materials will not be significantly different in mathematics achievement, as measured by a teacher-made test on arithmetic and algebra topics, from eighth grade students who study Algebra I from a textbook by Nichols and Collins.

10. Eighth grade students who study SMSG materials will not be significantly different in the seven problem areas, listed below as measured by the Mooney Problem Checklist (6), from eighth grade students who study Algebra I from the textbook by Nichols and Collins. The seven separate areas for which this hypothesis should be individually considered are: (1) Health and Physical Development, (2) School, (3) Home and Family, (4) Money, Work, the Future, (5) Boy and Girl Relations, (6) Relations to People in General, and (7) Self-Centered Concerns.

Scope of the Study

This study involves first, a review of the literature related to ability grouping and to acceleration of students. Various periodicals and books were consulted to determine the opinions of leading educators and the results of research on the ability grouping and acceleration.

Chapter III explains what data were collected and how these data were used. For part of the data, a chi-square test of significance was used to compare experimental results expected on the basis of the hypotheses. Further study of the data involved an analysis of variance study. Also included in the study are the results obtained from administering the Mooney Problem Check List to both the experimental and control classes. A statement of the results of the data analysis also appears in Chapter III.

Chapter IV contains the summary of findings, the conclusions, and implication of this study for future research.

Definition of Terms

In this study, experimental class will refer to the class studying algebra in the eighth grade on a trial basis. The control class refers to the class used as a standard for comparison purposes; that is, the class studying the regular enriched curriculum planned for above-average ability groups.

Ability grouping refers to "a system of grouping in which students are separated into sections according to their general ability or their competence in a given field of study, usually determined, in academic subjects, on the basis of school marks or the results of standardized tests of intelligence and achievement, or a combination of the two, . . ." (7). For this study acceleration will mean advancement in achievement beyond the average for the individual's chronological age (8). An enriched class refers to one in which the quality and quantity of the subject matter is increased (9).

A mathematics sequence refers to a program of mathematics instruction extending over a period of several years. SMSG refers to the School Mathematics Study Group, which consists of a number of groups of educators and mathematicians who worked together for the purpose of producing improved mathematics instructional materials. These groups were financed by the National Science Foundation.

Related Studies

A search of the literature revealed a number of related studies.

William J. Hegstrom and Donald E. Riffle presented a study in which eighth grade accelerated students were taught algebra. In the eighth grade of Delray Junior High School, Delray Beach, Florida, a class was taught one month of arithmetic topics that was followed by algebra for the remainder of the year. This was an accelerated class of above-average students. A testing program was instituted for comparing eighth and ninth grade algebra achievement with the ninth grade regularly scheduled class. A complete five-year mathematics program was planned with the receiving high school, and arrangements were made for close observation of student achievement in the accelerated groups.

Test results indicated that fifteen per cent of both years' eighth grade classes had sufficient ability to accelerate. Positive correlation in results indicated some measure of success in predicting individual student achievement. Test results comparing eighth and ninth grade algebra classes indicated that the eighth grade acceleration was successful.

> Student reaction can be summed in the words of one boy who wrote, "I found algebra very challenging and requiring much more work than my other subjects. One of the most enjoyable portions of the course was the fact that everyone was above average and a problem could be cleared up in a matter of seconds while in arithmetic much time would be spent on one small process." Although some of the students candidly admitted that another course would have been much easier, all in some way indicated a sense of accomplishment (10:419-423).

David W. Wells tells of a study at Westside Community School in Nebraska in which twenty-five superior students were selected to take algebra in the eighth grade. The same final examination was given to this class as to a class of twenty-five ninth graders. Fifteen of the twenty-five highest scores were earned by eighth grade students. It was concluded that the students of the eighth grade were motivated to achieve more nearly up to their ability because they were members of the select group.

The following year the members of the class were placed in sections of second-year algebra on the basis of their achievement the previous year with no effort made to keep this group as a unit. The ninth grade second year algebra students achieved as well as students of upper grades with comparable ability.

Future plans include teaching Euclidean geometry the first semester of the sophomore year. During the second semester of the sophomore year, the students will take trigonometry and coordinate geometry. In the junior years the course topics will include trigonometric analysis, linear and quadratic functions, sequence and limits, and differentiation. The senior year program will be on an individual basis under a faculty advisor (11:181-182).

Walter Dezelle, Jr. gave as the purpose of his study the investigation, under experimental conditions, of the changes that occur in the personality of members of matched groups of academically able accelerated seventh-grade pupils in Thomas Edison Junior High School, Port Arthur, Texas.

> The following conclusions emerged from this investigation.
> 1. Adverse changes in personality were not associated with assignment to an accelerated class in mathematics.
> 2. The practice of assigning academically able seventh grade children to an accelerated class in mathematics upon entering junior high school was sound educational practice (12:4438-4439).

Dorothy L. Messler discusses an experimental program at Palmetto Junior-Senior High school, Dade County, Florida, in which two matched classes, one eighth graders and one ninth graders, were enrolled in algebra. These students were matched on the Otis Quick-Scoring Test, Beta, and the California Arithmetic Test. Instruction was duplicated in the two classes--the same materials were presented in the same way by the same teacher. A pre-test and final test were given using the Cooperative Algebra Test. Statistical results indicated that age was not determinal to achievement in elementary algebra. In addition parents and pupils of the eighth grade class both felt that the challenge of the algebra helped stimulate the students' work in other areas of study. The eighth grade students were scheduled for geometry in the ninth grade and will be accelerated one full year throughout the high school curriculum (13:561-564).

Laurence Hyman explains an experimental program started in 1960 in Cleveland, Ohio. In this accelerated program seventh and eighth grade mathematics are completed in the seventh grade. Algebra is studied in the eighth grade followed by a plane-solid geometry course in the tenth grade. The further proposed sequence will be: 10B, intermediate algebra; 10A, trigonometry; 11B, college algebra; 11A advanced mathematics I (integrating algebra, geometry and trigonometry); 12B and 12A, analytic geometry and calculus (tentative).

To evaluate the effectiveness of the program during the first year the Stanford Advanced Arithmetic Test was given to the experimental seventh grade groups and to all 8A pupils in the Cleveland Public Schools. The results revealed that the experimental group of seventh-grade talented pupils achieved a median grade equivalent of 11.5 while the pupils in the regular 8A classes scored a median grade equivalent of 10. The seventh grade experimental classes also demonstrated superior aptitude for algebra as shown by scores on the Iowa Algebra Aptitude Test. Results of the students enrolling in algebra in the eighth grade were not available at the time the article was written. It was observed, however, that pupils in the experimental class were stimulated to do better work in all their classes (14:38-39).

R. H. Braun and James Steffensen say that in Urbana Junior High School, Urbana, Illinois, eighty superior students were permitted to take one, two, or three ninth grade courses. The subjects were algebra, ninth-grade English, and ninth-grade general science.

In evaluating the study on achievement in algebra, students in the accelerated eighth-grade class and all the ninth grade algebra classes were administered The Cooperative Elementary Algebra Test at the completion of the course. A sample of 33 matched pairs was drawn. The eighth grade sample had a mean of 69.55 and a standard deviation of 6.02 while the ninth grade had a mean of 67.82 and a standard deviation of 8.43. Thus the eighth-grade group actually had a higher mean score than the ninth-grade group (15:305-315).

Donald G. McCloskey reports on a mathematics curriculum committee of the Madison, Wisconsin senior high school. The final plan selected for the exceptional student offered algebra in the eighth grade followed by a sequence leading to calculus in the twelfth grade (16:215).

Herbert J. Klausmeir and William Wiersma discussed experimental groups in their school. The groups completed algebra and general science as eighth graders and geometry and biology as ninth graders. The control group took the same subjects in grades nine and ten, respectively. In algebra and general science, the experimental group achieved as high as the equally bright group who had not condensed the content and were a year or more older. The experimental group, however, achieved significantly lower than the control group as tenth graders in geometry (17:5-10).

No study was found which concerned itself with the loss of arithmetic skills through acceleration to algebra in the eighth grade. This paper is, therefore, thought to be unique in the problems under consideration.

FOOTNOTES--CHAPTER I

1. Elizabeth T. Sullivan, Willis W. Clark, and Ernest W. Tiegs, _California Test of Mental Maturity_ (Monterey, California: California Test Bureau, 1957).

2. Ernest W. Tiegs and Willis W. Clark, _California Arithmetic Test_ (Los Angeles: California Test Bureau, 1957).

3. Eugene D. Nichols and Wagner G. Collins, _Modern Elementary Algebra_ (Rev. ed.; New York: Holt, Rinehart and Winston, Inc., 1965).

4. School Mathematics Study Group. _Mathematics for Junior High School_, Vol. II (Yale University, 1959).

5. _Sequential Tests of Educational Progress_ (Princeton: Educational Testing Service, 1957).

6. Ross L. Mooney, _Mooney Problem Check List_, Junior High School Form, 1950 Revision (New York: The Psychological Corporation, 1950).

7. Carter V. Good, _Dictionary of Education_ (New York: McGraw-Hill Book Company, Inc., 1959), p. 192.

8. _Ibid_., p. 4.

9. _Ibid_., p. 151.

10. William J. Hegstrom and Donald E. Ribble, "A Two-Year Study of Eighth-Grade Algebra I," _The Mathematics Teacher_, LVI (October, 1963), 419-423.

11. David W. Wells, "A Modified Curriculum for Capable Students," _The Mathematics Teacher_, LI (March, 1958), 181-182.

12. Walter Dezelle, Jr., "A Comparative Study of the Changes in Academically Able Seventh-Grade Children Assigned or Not-Assigned to an Accelerated Math Class Upon Entering Junior High School," _Dissertation Abstracts_, XXVI, 1966, 4438-4439.

13. Dorothy L. Messler, "A Study of Pupil Age and Achievement in Eighth Grade Algebra," The Mathematics Teacher, LIV (November, 1961), 561-564.

14. Laurence Hyman, "Adapting Mathematics Instruction for the Talented," Education Digest, XXVII (May, 1962), 38-39.

15. R. H. Braun and James Steffensen, "Grouping, Acceleration and Teacher Aid Experiments in Urbana Secondary Schools, Urbana, Illinois," The Bulletin of the National Association of Secondary -School Principals, XLIV (January, 1960), 305-315.

16. Donald G. McCloskey, "Proposed Revision and Acceleration of the High School Mathematics Program," School Science and Mathematics, LX (March, 1960), 214-221.

17. Herbert J. Klausmeir and William Wiersma, "Effects of Condensing Content in Mathematics and Science in Junior and Senior High School," School Science and Mathematics, LXIV (January, 1964), 5-10.

CHAPTER II

REVIEW OF THE LITERATURE AND BACKGROUND FOR THE STUDY

Ability Grouping

The two classes considered in this study are above-average ability-grouped classes. Understanding the many issues relative to ability grouping with emphasis on the above-average group, is therefore of basic importance to this study. The arguments for and against ability grouping are numerous, with outstanding educators taking various positions on the issue.

Historically, A. Harry Passow notes that many studies on ability grouping have been done, beginning in the 1920's, reaching a peak in the mid 1930's, then dwindling until the years just prior to 1960. He says:

> Even as the number of grouping studies have accumulated over the past three decades, the inconclusiveness of the research findings becomes more apparent as each reviewer couches his summary in tentative or equivocal fashion (1:285).

Reflecting the interest in ability grouping of the mid-1930's is the National Society for the Study of Education Yearbook for 1936, <u>Grouping of Pupils</u> (2).

Giving verification to the current trend, Karl A. Douglas points out that ability grouping has spread so widely that if it continues to spread at the same rate, by 1970 the school without ability grouping will be a rare one. He further says that when ability grouping has failed, it can be attributed in part to failure to identify accurately the bright or dull students, and in part to the fact that teachers were not especially prepared or especially suited. Karl further says:

> It is encouraging to note that today a fairly large number of schools are doing the following things:
>
> 1. Grouping students for particular subjects and not for all subjects.
> 2. Giving careful consideration to borderline cases.
> 3. Employing new criteria in selecting the students, i.e., not only I.Q. or M.A. but previous grades in the subject concerned and the whole file of records likely to contain data or pertinent experiences, character traits, interests and education of parents.
> 4. Giving recognition to the cultural and economic level from which the student comes, it being recognized that of two students with the same M.A. or I.Q. and somewhat the same grade average, the one that comes from the definitely lower economic and cultural level has more potential than one who comes from a more privileged environment (3:302).

Laurence O. Lobdell and William J. Van Ness give as the purpose of ability grouping the reduction of the range of abilities within a given classroom. Teaching, they say, should be more effective because of the decrease in the number of activities the teacher must plan (4:399).

J. H. Hull says that the two strongest factors that motivate ability grouping are large classes and the idea of meeting individual needs (5:129).

Writing specifically with regard to grouping for the gifted, Mary R. Pilch provides the following list of advantages of special grouping for the gifted:

> 1) The gifted can work at their own speed and within the range of their own abilities, 2) their abilities and potentialities can be challenged to a greater degree, 3) they are allowed a greater degree of intellectual stimulation without any possible side effects of over-acceleration or development of careless study skills, 4) they can explore new ideas and experiment with various media of expression without sacrificing group acceptance--gifted children tend to support each other as they work together, 5) their performance acts as a stimulus upon each other as does the richer curriculum, 6) the selection of a qualified teacher who can develop a good intellectual environment for them becomes more feasible, 7) encourages the development of a more flexible, enriched learning environment for them, 8) there are better opportunities for the intensive development of leadership qualities, 9) the average students in other groups have their own leadership potential, and 10) grouping as a technique is a tried and tested organizational and instructional method of helping schools to develop each student to his full potential.

An equally enlightening list of disadvantages is provided by Pilch as follows:

> 1) it promotes snobbery and conceit, 2) it prevents the students from having a rich school life and from participating in many activities with other, different students, 3) leadership opportunities are limited, 4) the average student, deprived of the gifted, suffers from the lack of stimulation created by them, 5) present identification limitations make it possible some gifted will be omitted or neglected in the selection, assuming that if all gifted cannot profit, then none should, 6) students may be overworked, and 7) special classes or grouping cost money (6:21).

Kenneth Mott, speaking in favor of ability grouping, says that frustration is produced when bright children are not properly challenged by their school work, as is too often the case in heterogeneous classrooms (7:6).

Expressing the negative viewpoint, Bruno Bettelheim comments:

> Because the gifted child learns easily, he acquires a feeling of security in a regular class. On the other hand if such a child is put into a special class when learning is not easy for him, where he is only average among a group of extremely gifted youngsters, he may, as often happens, come to feel that he has only average abilities which are not up to coping with difficult challenges (7:5).

Louis A. Fleigler's concern is that grouping may lead to isolation and over-competition rather than the integration and security of the student. He says, however, that it is not the grouping technique but the teacher and the feeling which he creates that determine a democratic or autocratic viewpoint among students (8:330).

Charles E. Hood points out that teachers feel that ability grouping is the answer to most of their problems. However, he says, in using ability grouping principals should be aware of problems which arise in the following areas:

> 1. screening students, 2. increasing schedule conflicts, 3. confusing subject designations, 4. going too far or too fast in ability grouping, 5. inadequate teaching methods and materials, 6. inflexible programs, 7. selecting qualified teachers (9:467).

Leonard H. Clark suggests that ability grouping and curriculum tracks are not the only possibilities open to secondary education. He advocates differentiated assignments and individualized instruction as suitable techniques for providing for the individual student in regular classes (10:70).

With regard to social aspects, Herbert Heger says:

> Ability grouping has a side effect of segregating the races almost as effectively as a planned segregation policy.

He cites some other weakness of ability grouping as follows:

1. Grouping is done on the basis of insufficient criteria.
2. Grouping is done in all subjects on the basis of ability in one subject.
3. Teacher places maximum effort on favorite high ability groups.
4. Teachers do not vary lesson plans from group to group.
5. Ability grouping ignores positive development of feelings and attitudes of the child.
6. Child knows members of his group are less socially acceptable than members of top group.
7. Low group assignment reinforces any feeling of rejection and inferiority (11:15-16).

In Perceiving, Behaving, Becoming, we find a questioning viewpoint as to ability grouping. The writers of this yearbook say that assignment to an ability group establishes the status of a child with regard to ability. Feelings of inferiority or superiority are reinforced in this manner, and this is not the way "fully-functioning people" are developed, according to the yearbook (12:170).

In summarizing research on ability grouping R. Stewart Jones says:

> Very little evidence on grouping could be described as unequivocal evidence, however, for or against this practice (13:419).

Presenting a similar viewpoint, Willard C. Olson says:

> The fact is that the results of research on grouping tend to be small, inconsistent, complicated, and difficult to interpret. On the basis of what we know now, no one plan can be considered superior for inducing growth in achievement. The major explanation for differences in achievement appear to be in the rate of the child's growth and the nurture that supports it (14:20).

We can conclude, then, that there are many points of view relative to ability grouping, that we need to be aware of the pitfalls of ability grouping, and that ability grouping is a useful instructional technique if used judiciously.

Acceleration

In a summary of the historical background of acceleration, Sidney L. Pressey says:

> Acceleration may be defined as the movement of students through an educational program in shorter time or at younger ages than has been conventional. Such efforts at educational time-saving have a long history.

He further states that attempts to bring about earlier completion of college go back to the eighties of the last century. In addition:

> Many studies were made which indicated that younger students did better academic work, were more likely to graduate, presented fewer disciplinary problems, and for the most part, were as well adjusted socially as those of average age.

He also says that in the past, elementary-school programs of seven instead of eight years have been tried, as well as pre-collegiate programs of eleven instead of twelve grades. He goes on to say:

> Selective acceleration of superior students has long been practices, and many investigations have agreed in showing that the great majority of these accelerated students have not suffered in the quality of their school work, and that most of them have also made good social adjustment to the more advanced group, though a few have had difficulty (15:26).

Referring to the war years, Henry J. Otto and Dwain M. Estes speak of the attention focused on accelerated programs during and following World War II, especially at the secondary and college levels (16:5).

Speaking of a program of acceleration in the years following World War II, a National Education Association Journal Special Feature discusses The Advanced Placement Program which was initially studied in 1951. This program for admission into college with advanced standing has grown consistently in the number of students and colleges participating. The program allows college freshman who pass examinations covering freshman college course material to proceed with work on the sophomore level (17:22).

Reference to the two definitions for acceleration as given by Carter V. Good seems necessary to clarify the further use of the term. These definitions are:

> 1. The process of completing the school grades at a rate of more than one full grade each year; thus if a pupil has completed the first 6 grades in 5 1/2 years, an acceleration of 1/2 year has taken place; and 2, advancement in mental growth or achievement beyond the average for the individual's chronological age (18:4).

Since our study is related to a class accelerated in subject matter, greater emphasis will be placed on the second definition in this review.

James F. Gallagher and William Rogge report that in reviewing research studies about acceleration, several studies were reported which generally support the finding that gifted children can be accelerated by grade level or taught accelerated materials without negative results.

> These findings agree with a large body of research that has resulted in little educational implementation (19:44).

Herbert J. Klausmeir reports that some bright children who are not admitted early to the first grade nor accelerated during elementary years may be accelerated in junior high school by having the subject matter condensed or compressed for them. He goes on to say that most acceleration accomplished in senior high school is usually through advanced college placement exams and taking additional courses while in high school. Quoting Klausmeir:

> Education will be improved when the results of educational research, including that pertaining to acceleration, are put into practice (20:140-141).

Further supporting junior high acceleration, Joseph Justman's research showed that bright students could complete the academic work of the junior high in two rather than three years without achievement loss and that there were no ill effects, personally, socially, or emotionally to the pupils who completed the junior high program in two years (21:142-150).

Speaking somewhat negatively about acceleration, the Association for Supervision and Curriculum Development Yearbook for 1962 says:

> Acceleration--the act of speeding up, of approaching a goal faster. The danger is not so much in the speeding as in the fact that speed may become the goal. "Nine-year-oldness is not good; you must be ten." "Ten-year-oldness is not enough; rush to be eleven," and so on. And so there is great loss of time while speeding. "We will not pass this way again," said a poet in a moment of insight. The time to be, to do, to achieve what one is now ready for, is lost in the urge to speed. And this time will not return. Those feelings and understandings which were right to develop may now never come. The urge to speed may well prove the great reducer of human worth (22:232).

The implication here is that acceleration may have an adverse effect on the child's total development.

Gardner A. Swenson feels that grade acceleration is not acceptable but that subject acceleration is desirable and effective. Courses should be added to the curriculum which accelerate and enrich various subjects while students remain with their peer group. He states that there is less chance of hindering the long-range development of individual boys and girls during the age of wide variation of physical growth, emotional adjustment, and intellectual maturity, if they remain with their own age group. He recommends three years in junior high with subject acceleration (23:9-100.

R. L. Foose presents an argument favoring acceleration in which he says that:

> Acceleration for students, properly identified, seems to be good, if: 1, the work matches the normal social and physical maturation of the student; 2, it provides true stimulation and interest; and 3, it is part of a pattern which provides courses for the student to continue in a natural sequence of study (24:220).

Russell Henzie writes that a program of group accelerations in the Horace Mann Junior High School, San Diego, California, instituted in 1956, has been successful beyond their expectations. He says students and parents feel the same way. He credits the program's success to thorough screening procedures and careful planning of the acceleration program (25:151).

In discussing the disadvantages of acceleration in terms of grades and honors, Norman M. Hayes points out that grades and honors sometimes are affected by acceleration. He advocates that all permanent records and transcripts should be marked with the information that the student was in an advanced class. Accompanying the records should be an explanation of any difference this might make in grades (26:33).

J. Kendall Hoggard provides further enlightenment on the problem of grading the academically talented students in accelerated classes. He describes the solution his school system found to the problem. They assumed that a student in an accelerated class should make an "A". Students who made low grades, or even average grades, were placed in a non-accelerated class as soon as it was evident that they were unwilling or unable to earn above-average grades in an accelerated class. Grades earned in accelerated classes carried more quality point credits than non-accelerated classes. Grades earned in accelerated groups will have some label attached which would indicate to the colleges that these grades were earned in an accelerated class (27:287-288).

In an editorial in School and Society we find a discussion of a report by Abraham J. Tannenbaum, New York State Coordinator for the Gifted. The editorial says that desirable as the various acceleration plans are, they represent an easy answer to what should be offered the gifted. Quoting the editorial:

> Little account is taken of the qualitative difference in mental capacity that distinguish the gifted from the non-gifted, and that suggest the need of a program uniquely suited to these abilities rather than just a telescoped version of an existing plan designed for average students. The superior mind can probably absorb not only conventional content faster but different kinds of content as well. What these different kinds of offerings ought to be and how they can best be taught, remain as yet unanswered. In fact, acceleration offers a convenient means of dodging the question in the first place (28:434).

Jerome S. Bruner, after saying that planned carefully, acceleration is good for the student and the nation, feels that some undesirable elements exist in this connection. He is concerned with the development of a "meritocracy," involving a system of competition whereby students are moved ahead and given further opportunities on the basis of achievement. In the process, later educational opportunities and job opportunities become increasingly fixed by earlier school performance. He feels this situation may place at a disadvantage the late bloomer, the early rebel, and the child from the educationally indifferent home (29:77).

The advantages and disadvantages of acceleration are summarized by A. Harry Passow in a Special Feature of the National Education Association Journal. He says:

> The most obvious advantages of acceleration need hardly be labored: Pupils are felt to be stimulated to do work of their best quality when they are not kept in a group of less able students. Furthermore, gifted children are usually advanced in maturity as well as in academic ability. In addition, there is evidence that acceleration contributes to increased social maturity. . . .

In discussing some of the disadvantages of acceleration it is emphasized that:

> Acceleration may deny bright students the time and opportunity to think, reflect, explore, and appreciate. The pressures for rapid progress may result in a curtailment of creativity.

In summary:

> The real question seems to be: what type of acceleration is best for meeting the individual needs of each gifted child? Not all types can do all things for all students. But the evidence presented by research indicated that the principle itself is a salutory one (31:22-23).

FOOTNOTES--CHAPTER II

1. A. Harry Passow, "The Maze of Research on Ability Grouping," Education Forum, XXVI (October, 1966), 281-285.

2. National Society for the Study of Education, The Thirty-Fifth Yearbook, Part I: The Grouping of Pupils (Bloomington, Ill.: Public School Publishing Company, 1936).

3. Karl R. Douglas, "Modern Functional Adaptation to the Abler Student," Phi Delta Kappan, LXVII (February, 1966), 301-304.

4. Lawrence O. Lobdell and William Van Ness, "Grouping and Enrichment," Education, LXXXII (March, 1962), 399-402.

5. Rodney Tillman and J. H. Hull, "Is Ability Grouping Taking Schools in the Wrong Direction?" The Nation's Schools, LXXII (April, 1964), 70-71.

6. Mary M. Pilch, "Grouping for the Gifted," Minnesota Journal of Education, XLIV (April, 1964), 21.

7. Bruno Bettelhiem and Kenneth Mott, "Grouping the Gifted; Two Viewpoints," Education Digest, XXX (April, 1965), 4-7.

8. Louis A. Fleigler, "Curriculum Practices for the Gifted: U.S.A.," Concepts of Excellence in Education. The Yearbook of Education (New York: Harcourt, Brace and World, Inc., 1961), 327-343.

9. Charles E. Hood, "Do We Expect Too Much From Ability Grouping?" The Clearing House, XXXVIII (April, 1964), 467-470.

10. Leonard H. Clark, "Ability Grouping--A Third Look," The Bulletin of the National Association of Secondary-School Principals, XLVII (December, 1963), 69-71.

11. Herbert Heger, "Ability Grouping--Can It Be Justified," Ohio Schools, LXV (March, 1967), 15-16.

12. Association for Supervision and Curriculum Development, Perceiving, Behaving, Becoming, 1962 Yearbook of the Association (Washington, D. C.: ASCD, 1962), 170.

13. R. Stewart Jones, "Instructional Problems and Issues," Review of Educational Research, XXVI (October, 1966), 419-420.

14. Willard C. Olsen, "Ability Grouping: Pros and Cons," Education Digest, XXXII (October, 1966), 18-20.

15. Sidney L. Pressey, Educational Acceleration and Basic Problems (Columbus, Ohio: The Ohio State University, 1949), p. 26.

16. Henry J. Otto and Dwain M. Estes, "Accelerated and Retarded Progress," Encyclopedia of Educational Research, ed. Chester W. Harris (3rd ed.; New York: The MacMillan Company, 1960), 5.

17. "Accelerating the Academically Talented," Journal of the National Education Association, XLVIV (April, 196C), 22-23.

18. Carter V. Good, Dictionary of Education (New York: McGraw-Hill Book Company, Inc., 1959), p. 4.

19. James F. Gallagher and William Rogge, "The Gifted," Review of Educational Research, XXXVI (February, 1966), 44-45.

20. Herbert J. Klausmeir, "Research and Educational Improvement," The Teacher's College Journal, XXXIV (March, 1963), 139-141.

21. Joseph Justman, "Academic Achievement of Intellectually Gifted Accelerants and Non-Accelerants in Junior High School," School Review, LXII (March, 1954), 142-150.

22. Association for Supervision and Curriculum Development, Perceiving, Behaving, Becoming, 1962 Yearbook of the Association (Washington, D.C.: ASCD 1962), 170.

23. Gardner A. Swenson, "Acceleration Versus Enrichment," The Bulletin of the National Association of Secondary-School Principals, LXVII (October, 1963), 9-10.

24. R. L. Foose, "Enrichment or Acceleration for the Academically Talented Student," The Bulletin of the National Association of Secondary-School Principals, XLV (November, 1959), 151-153.

25. Russel Henzie, "A Junior High Program," *Education*, LXXX (November, 1959), 151-153.

26. Norman M. Hayes, "Acceleration is Here to Stay--But We Must Add Safety Features," *Ohio Schools*, XXXVIII (December, 1960), 33.

27. J. Kendall Haggard, "Grading the Accelerated Student," *Education*, LXXXIII (January, 1963), 286-288.

28. Editors, *School and Society*, LXXXVIII (November 19, 1960), 434.

29. Jerome S. Bruner, *The Process of Education* (New York: Random House, Inc., 1960), p. 77.

30. "Accelerating the Academically Talented," *Journal of the National Education Association*, XLVIV (April, 1960), 22-23.

CHAPTER III

COLLECTION AND ANALYSIS OF DATA

Design of the Study

An experimental eighth grade mathematics class of thirty-five students was taught Algebra I on an accelerated basis during the school year 1965-66 at Pattengill Junior High School, Lansing, Michigan. This class was an above-average ability group selected on the basis of intelligence quotient (hereafter designated I.Q.), achievement test scores, and teacher recommendation. A similarly selected class of above-average eighth grade students was enrolled at Walter French Junior High School, Lansing, Michigan, in an enriched mathematics class. This class of thirty-one students was designed to act as the control class for this experimental study.

Data relative to I.Q. and arithmetic achievement were collected and analyzed, using the chi-square test and analysis of variance, to test the following null hypotheses:

1. Eighth grade students who study School Mathematics Study Group (hereafter designated SMSG) mathematics materials will not be significantly different in I.Q., language, as measured by the California Test of Mental Maturity, from eighth grade students who study Algebra I from the textbook by Nichols and Collins.

2. Eighth grade students who study SMSG mathematics materials will not be significantly different in I.Q., non-language, as measured by the California Test of Mental Maturity, from eighth grade students who study Algebra I from the textbook by Nichols and Collins.
3. Eighth grade students who study SMSG mathematics materials will not be significantly different in arithmetic reasoning, as measured by the California Arithmetic Test, when they were sixth grade students, from eighth grade students who study Algebra I from the textbook by Nichols and Collins.
4. Eighth grade students who study SMSG mathematics materials will not be significantly different in arithmetic fundamentals, as measured by the California Arithmetic Test, when they were sixth grade students, from eighth grade students who study Algebra I from the textbook by Nichols and Collins.
5. Eighth grade students who study SMSG mathematics materials will not be significantly different in arithmetic reasoning, as measured by the California Arithmetic Test, from eighth grade students who study Algebra I from the textbook by Nichols and Collins.
6. Eighth grade students who study SMSG mathematics materials will not be significantly different in arithmetic fundamentals, as measured by the California Arithmetic Test, from eighth grade students who study Algebra I from the textbook by Nichols and Collins.

7. Eighth grade students who study SMSG mathematics materials will not be significantly different in arithmetic skills, as measured by the Sequential Tests of Educational Progress, mathematics test, given as a pre-test, from eighth grade students who study Algebra I from a textbook by Nichols and Collins.
8. Eighth grade students who study SMSG mathematics materials will not be significantly different in arithmetic skills, as measured by the Sequential Tests of Educational Progress, mathematics test, given as a post-test, from eighth grade students who study Algebra I from a textbook by Nichols and Collins.
9. Eighth grade students who study SMSG mathematics materials will not be significantly different in mathematics achievement, as measured by a teacher-made test on arithmetic and algebra topics, from eighth grade students who study Algebra I from a textbook by Nichols and Collins.
10. Eighth grade students who study SMSG mathematics materials will not be significantly different in the seven problem areas, listed below as measured by the Mooney Problem Check List, from eighth grade students who study Algebra I from the textbook by Nichols and Collins. The seven separate areas for which this hypothesis should be individually considered are: (1) Health and Physical Development; (2) School;

(3) Home and Family; (4) Money, Work, the Future; (5) Boy and Girl Relations; (6) Relations to People in General; and (7) Self-centered Concerns.

Faculty Involved

Teaching the experimental algebra class was Mr. Ivan Bentley, who has a B.A. in mathematics. He has twenty-four years of teaching experience with twenty years of all-mathematics teaching experience. He has taught both senior and junior high mathematics. Mrs. Marguerite Gooden, teacher of the control class, has a B.A. with a minor in mathematics and has a M.A. in sociology and anthropology. She has eleven years teaching experience in mathematics.

For a large portion of the class periods, Mr. Bentley used a method of laboratory teaching. He placed his students in groups of five or six with a captain for each group. Assignments were made and the groups worked together on the assignments during the class and independently for homework. Presentations were made to the class by group members as seemed desirable. Mr. Bentley reports that this method worked very well with this above-average class. In Mrs. Gooden's control class many supplementary materials were used to enrich the designated textbook materials.

Parent Participation

A meeting was held for parents of the experimental algebra class on September 28, 1965, to explain the experimental algebra class and the subsequent mathematics sequence.

The mathematics sequence to be followed by this experimental class has been outlined in Chapter I. Presentations at the meeting were made by Mr. Frank S. Rogers, Consultant in Mathematics in the Lansing School District, and Mr. Ivan Bentley, classroom teacher of the experimental class. The meeting was attended by about twenty parents.

A discussion period followed the presentations. In this period it was stated that grades for the accelerated class would be A's and B's and that parents would be notified if the student was not working up to his potential. Further discussion involved the question of whether being in an accelerated mathematics class would tend to steer the student to a mathematics major. There was also concern as to how the child's total personality development would be affected by being placed in an ability-grouped accelerated class. Some opposition was raised regarding calculus being offered as a college-level course to the students when they became seniors in high school.

No parents' meeting was held for the control class since the teaching of enriched classes is an established procedure in the school.

Collection of Data

As part of the regular testing program of the Lansing School District, the California Mental Maturity Test and the California Achievement Test are administered to all students in the sixth grade. The results of these measures were available in the cumulative records of the students. The I.Q., language and non-language, was given in percentiles. The California Arithmetic Test scores, which yielded a measure in fundamentals as well as one in reasoning, were also expressed in percentiles. Also made available as part of the regular testing program were eighth grade percentile test scores for fundamentals and reasoning on the California Arithmetic Test. This test was given to all eighth grade students in both schools in February, 1966. The above tests were used to establish similarity in ability and arithmetic achievement between the experimental and control classes.

In September, 1965, the two classes were administered the Sequential Test of Educational Progress, Mathematics Test, Form 3A, as a pre-test to establish the level of arithmetic achievement at the beginning of the accelerated program. On this fifty-item test, raw scores and percentiles were made available. Scoring was done by the Lansing School District data processing service. In May, 1966, Form 3B of the same test was given as a post-test and similar results made available. The post-test was designed to check the level of arithmetic achievement of the two classes at the end of the year.

A teacher-made test, compiled by Frank S. Rogers and this writer, was also given in May, 1966. This test included twenty arithmetic-oriented items and thirty algebra-oriented items. Scoring was done by the Michigan State University scoring service. Results were available in raw scores.

Also in May, 1966, the Mooney Problem Check List was given both classes to establish what personal problems the students had and whether the accelerated experimental class reflected any problem differently from the control class. Scoring was done by the Michigan State University scoring service.

Analysis of Data and Findings

To test the first six hypotheses, the chi-square test was used. The chi-square test may be used to determine the significance of differences between two independent groups. The data were split at the fiftieth percentile so that not less than five scores would be in each cell of the contingency table. Separating the data into a larger number of cells would likely give less than five per cell, which according to Sidney Siegel gives questionable results (1:104-111).

Using a program of the Michigan State University Computer Laboratory, chi-squares were computed and are shown in Appendix A (2).

All the chi-squares were too small to be significant. It is therefore established that on this basis, the first six null hypotheses could not be rejected. It is established then that no significant difference existed between the experimental and control classes on the basis of the

California Test of Mental Maturity or the California Arithmetic Test at either the sixth or eighth grade levels.

Visual comparison of the two classes may be made by observing the graphs in Appendix B.

For the Sequential Tests of Educational Progress, pre-test and post-test, and the teacher-made test, an analysis of variance permits a determination of the significance of the difference between the means (3:276-295).

Using a program of the Michigan State University Computer, the analysis of variance was made and is presented in Table 1 through Table 6 (4).

On the teacher-made test, which included twenty arithmetic-oriented items and thirty algebra-oriented items, the experimental class did significantly better than the control class. This superior performance by the experimental class is confirmed by a mean six points higher and an F statistic of 22.0 at the .005 level of significance as shown in Tables 1 and 2, respectively.

The difference of the means on the Sequential Test of Educational Progress, Form 3A, was less than three points with the control class, the higher-scoring class averaging 35.1 points. The analysis of variance indicated no significant difference between the two classes on the Sequential Test of Educational Progress, Form 3A. For details, reference should be made to Tables 3 and 4.

TABLE 1

MEASURES OF CENTRAL TENDENCY OF TEACHER-MADE TEST OF FIFTY ITEMS

Group	Number	Mean	Standard Deviation
Experimental	35	36.1	4.6
Control	31	30.3	5.5

TABLE 2

ANALYSIS OF VARIANCE FOR TEACHER-MADE TEST

Source of Variance	Sum of Squares	Mean Squares	F	Significance Probability of F
Between groups	569	569	22.0	.005
Within groups	1654	26		

TABLE 3

MEASURES OF CENTRAL TENDENCY OF FIFTY ITEMS

Sequential Test of Educational Progress, Mathematics Test, Form 3A			
Group	Number	Mean	Standard Deviation
Experimental	35	32.4	7.3
Control	31	35.1	6.1

TABLE 4

ANALYSIS OF VARIANCE

Sequential Test of Educational Progress, Mathematics Test, Form 3A

Source of Variance	Sum of Squares	Mean Squares	F	Significance Probablilty of F
Between groups	125	125	2.7	0.10
Within groups	2938	46		

TABLE 5

MEASURES OF CENTRAL TENDENCY OF FIFTY ITEMS

Sequential Test of Educational Progress, Mathematics Test, Form 3B

Group	Number	Mean	Standard Deviation
Experimental	35	42.7	5.2
Control	31	41.2	4.5

TABLE 6

ANALYSIS OF VARIANCE

Sequential Test of Educational Progress Mathematics Test, Form 3B

Source of Variance	Sum of Squares	Mean Squares	F	Significance Probability of F
Between groups	36	36	1.6	0.22
Within groups	1503	23		

The difference of the means on the Sequential Test of Educational Progress, Form 3B, was less than one point with the experimental class, the higher-scoring class, averaging 42.7 points. The analysis of variance indicated no significant difference between the two classes on the Sequential Test of Educational Progress, Form 3B. For details, reference should be made to Tables 5 and 6.

Visual comparison of the two classes on these measures may be made by observing the graphs in Appendix B.

The Form 3A results indicate no significant difference between the two classes in arithmetic achievement at the beginning of the year. The null hypothesis that no significant difference exists in the arithmetic achievement of the two classes at the end of the year could not be rejected by the analysis of variance of Form 3B.

The conclusion can then be made that the study of algebra by the eighth grade class at Pattengill Junior High School has not adversely affected their arithmetic achievement.

The Junior High School Form of the Mooney Problem Check List was administered to both the experimental and control classes. The Junior High School Form includes two hundred and ten items (problems), thirty in each of the following areas: I, Health and Physical Development; II, School; III, Home and Family; IV, Money, Work, the Future; V, Boy and Girl Relations; VI, Relations to People in General; and VII, Self-centered Concerns.

The purpose of giving the Check List was to appraise the major concerns of the two classes and to locate the most prevalent problems of the students. In adapting curricular offering school personnel need to know the problems of individual students and those problems characteristic of the group. An analysis of problems by classes, and also for the combined classes, is made in the tables and text which follow.

In Table 7, the summary of problems for the experimental class is presented. Sixty-three per cent of this class was concerned with the problem, "Don't get enough sleep." This problem may be due partly to poorly organized study habits in which the student either waits too late to start studying or tries to combine studying with watching television, listening to the radio, or telephoning friends. Also, this problem may be due to irregular homework assignments from the various classes, which results in too much homework for one particular night. The conscientous, above-average student attempts to complete all assignments. Another possible cause is that extra-curricular activities may consume too much time. Also it is possible that a home situation exists which is not conducive to a suitable bedtime.

"Being afraid of making mistakes" also concerned sixty-three per cent of this class. Above-average students are very keen competitors for grades and for teacher and parental approval. To them making a mistake is synonomous

TABLE 7

SUMMARY OF PROBLEMS FROM THE MOONEY PROBLEM CHECK LIST FOR THE EXPERIMENTAL CLASS OF THIRTY-FIVE STUDENTS SHOWING PROBLEMS CHECKED BY 25% OR MORE OF THE CLASS.

Problem	No. Yes Answers	% of Yes Answers	Problem Area
1. Don't get enough sleep.	22	63	Health and Physical Develop.
2. Being afraid of making mistakes.	22	63	Self-centered Concerns
3. Don't like to study.	17	49	School
4. Wanting to earn some of my own money.	14	40	Money, Work, the Future
5. Deciding what to take in high school	14	40	Money, Work, the Future
6. Wanting to know more about college.	14	40	Money, Work, the Future
7. Dull classes.	12	34	School
8. Being nervous.	11	31	Boy and Girl Relations
9. Bashful.	11	31	Relations to People in General
10. Can't keep my mind on my studies.	11	31	School
11. Daydreaming.	11	31	Self-centered Concerns
12. Forgetting things.	11	31	Self-centered Concerns
13. Trouble with oral reports.	10	29	School
14. Needing to decide on an occupation.	10	29	Money, Work, the Future
15. Being stubborn.	10	29	Relations to People in General
16. Not interested in certain subjects.	10	29	School
17. Wondering what becomes of people when they die.	10	29	Money, Work, the Future

18.	Spending money foolishly.	9	26	Money, Work, the Future
19.	Wishing people liked me better	9	26	Relations to People in General
20.	Taking things too seriously	9	26	Self-centered Concerns
21.	Too little spending money.	9	26	Money, Work, the Future
22.	Trying to stop a bad habit.	9	26	Self-centered Concerns
23.	Sometimes not being as honest as I should be.	9	26	Self-centered Concerns
24.	Giving in to temptations.	9	26	Self-centered Concerns
25.	Overweight.	9	26	Health and Physical Development
26.	Too much school work to do at home.	9	26	School
27.	Wanting a more pleasing personality.	9	26	Relations to People in General
28.	Unable to discuss certain problems at home.	9	26	Home and Family
29.	Being disliked by someone.	9	26	Boy and Girl Relations

with being a failure. Desire of peer approval is a reason for "Being afraid of making mistakes." Above-average students tend to set high standards for themselves with regard to doing outstanding school work and to performing correctly in social situations. They are, therefore, very concerned with "Being afraid of making mistakes." If individual students show excessive concern, parents and teachersshould make some effort to relieve this pressure.

"Don't like to study" was a problem with forty-nine per cent of the experimental class. These students are perhaps expressing dislike for homework which conflicts with their many other after-school interests. Motivation to study,which may be achieved through the use of more challenging teaching methods and materials, is needed. The students are possibly showing rebellion against the authority of parents and teachers who require them to do homework when they wish to pursue their own activities. Students, at the junior high age, often do not know how to study. They often procrastinate in doing their work which tends to create a feeling of distaste for the work which must eventually be done. Study requires that they discipline themselves with regard to their use of time, which is difficult for the immature student to do. Counseling with regard to good study habits should prove helpful.

Forty per cent checked "Wanting to earn my own money." This concern shows a desire for maturity and independence.

To be able to make purchases with their own money gives the students a feeling of importance and personal worth and is a status symbol with their peers. Employment opportunities are wanted by the above-average student. Parents and school officials need to give consideration to this expressed desire of the above-average student.

"Deciding what to take in high school" and "Wanting to know more about college" were problems checked by forty per cent of the class. These problems indicate a serious attitude toward their academic future and also their vocations. Most of the above-average students plan to attend college and are intensely interested in their preparation for college. Teachers and counselors need to provide guidance and continued inspiration toward these goals.

Twenty-three other problems checked by between twenty-five and thirty-nine per cent of the experimental class are shown in Table 7.

Table 8 summarizes the problems checked by the experimental class by problem areas. For the twenty-nine problems checked by more than twenty-five per cent of the experimental class, the totals show one problem checked for Health and Physical Development; six problems checked for School; one problem checked for Home and Family; seven problems checked for Money, Work, the Future; two problems checked for Boy and Girl Relations; four problems checked for Relations to People in General; and seven problems checked for Self-centered Concerns.

TABLE 8

SUMMARY OF PROBLEMS FROM THE MOONEY PROBLEM CHECK LIST BY PROBLEM AREAS FOR THE EXPERIMENTAL CLASS

	Problem Area	40% or Above	25% to 39%	Total
I.	Health and Physical Development	1	0	1
II.	School	1	5	6
III.	Home and Family	0	1	1
IV.	Money, Work, the Future	3	4	7
V.	Boy and Girl Relations	0	2	2
VI.	Relations to People in General	0	4	4
VII.	Self-centered Concerns	1	6	7
	TOTAL	6	23	29

In Table 9, the summary for the control class is presented. "Don't like to study" was the problem checked by the highest number of students, fifty-eight per cent. As previously discussed with regard to the experimental class, these students are expressing dislike for homework and are evidencing the possibility that they have poor study habits. Teachers and parents need to promote good study habits and to provide greater motivation for study through the use of improved teaching methods and materials.

TABLE 9

SUMMARY OF PROBLEMS FROM THE MOONEY PROBLEM CHECK LIST FOR THE CONTROL CLASS OF THIRTY-ONE STUDENTS SHOWING PROBLEMS CHECKED BY 25% OR MORE OF THE CLASS.

	Problem	No. of Yes Answers	% of Yes Answers	Problem Area
1.	Don't like to study.	18	58	School
2.	Not spending enough time in study.	17	55	School
3.	Dull classes.	16	52	School
4.	Not interested in certain subjects.	15	48	School
5.	Don't get enough sleep.	14	45	Health and Physical Development
6.	Can't keep my mind on studies.	14	45	School
7.	Worried about grades.	13	42	School
8.	Being lazy.	13	42	Self-centered Concerns
9.	Sometimes not being as honest as I should be.	13	42	Self-centered Concerns
10.	Poor complexion or skin trouble.	12	39	Health and Physical Development
11.	Trouble with arithmetic.	12	39	School
12.	Sometimes lying without meaning to.	12	39	Self-centered Concerns
13.	Afraid of tests.	11	35	School
14.	Trying to stop a bad habit.	11	35	Self-centered Concerns
15.	Too much school work to do at home.	11	35	School
16.	Wanting a more pleasing personality.	11	35	Relations to People in General
17.	So often feel restless in class.	11	35	School
18.	Teachers not practicing what they preach.	11	35	School

13.	A[illegible]	11	35	Self-centered Concerns
14.	Trying to stop a bad habit.	11	35	School
15.	Too much school work to do at home.	11	35	Relations to People in General
16.	Wanting a more pleasing personality.	11	35	School
17.	So often feel restless in class.	11	35	School
18.	Teachers not practicing what they preach.	11	35	School
19.	Daydreaming.	11	35	Self-centered Concerns
20.	Losing my temper.	11	35	Relations to People in General
21.	Can't forget some mistakes I've made.	11	35	Self-centered Concerns
22.	Taking things too seriously.	10	32	Self-centered Concerns
23.	Giving in to temptations.	10	32	Self-centered Concerns
24.	Feeling ashamed of something I've done	10	32	Self-centered Concerns
25.	Not good-looking	9	29	Health and Physical Development
26.	Wanting to earn some of my own money.	9	29	Money, Work, the Future
27.	Choosing best subjects to take next term.	9	29	Money, Work, the Future
28.	Not eating the right food.	8	26	Health and Physical Development
29.	Worrying.	8	26	Self-centered Concerns
30.	Lacking self-confidence.	8	26	Self-centered Concerns
31.	Wanting to know more about college.	8	26	Money, Work, the Future
32.	Ill at ease at social affairs.	8	26	Boy and Girl Relations
33.	Trouble in keeping a conversation going.	8	26	Boy and Girl Relations
34.	Awkward in meeting people.	8	26	Relations to People in General
35.	Missing someone very much.	8	26	Relations to People in General
36.	Trouble with oral reports.	8	26	School
37.	Not getting along with a brother or sister.	8	26	Home and Family
38.	Not knowing what I really want.	8	26	Money, Work, the Future
39.	Wondering if I'll ever get married.	8	26	Money, Work, the Future
40.	Disliking someone.	8	26	Relations to People in General

The second highest problem of the control group was "Not spending enough time in study" with fifty-five per cent. These students give evidence of a feeling of guilt for not spending more time studying. They appreciate the value of time spent in studying. These above-average students are serious students who indicate a desire and felt need to do more studying. Assistance in organizing study time and guidance in using the study time is needed from parents and teachers.

"Dull classes" was a problem checked by fifty-two per cent of the control class. Above-average students are evidently bored in many of their junior high classes. This is a challenge to teachers to make their classes more interesting to the above-average student, even though most of the classes are heterogeneous in composition. It is interesting to compare the experimental and control class percentages on this problem. The experimental class had thirty-four per cent who checked this problem as compared to fifty-two per cent in the control class. The study of algebra by the experimental class may have provided a stimulus to their curriculum.

Forty-eight per cent of the control class checked "Not interested in certain subjects." The indication here is that as early as junior high school students begin to have specific interests even though their choice of subjects is limited. It points to the wisdom of allowing students more choice in their subject selections. Of course, teachers should make all subjects as interesting as possible. Forty-five per cent checked "Don't get enough sleep." This compares with sixty-three per cent in the experimental class. "Can't keep my mind on my studies" was checked by forty-five per cent of the control class. This problem shows that students are easily distracted from their studies by something else that interests them. The studies are not holding their interest against other forces that compete for their attention. Being basically good students, checking this problem indicates that they are trying to overcome these distractions.

For forty-two per cent "Worried about grades" was a problem checked. Making good grades is a very important consideration to above-average students because of the effect grades have on future academic placement and on college entrance. Parents of above-average students often place much emphasis on grades. Forty-two per cent also checked "Sometimes not being as honest as I should be." Many students copy homework or obtain help from others in a way that is not entirely honest. Also in matters of personal and social relations strict honesty is not practiced. The conscientous student is aware of these deviations and would like to improve. Also checked by forty-two per cent of the class was "Being lazy." Students are frequently called "lazy" by parents and teachers. In reality, they are lazy about projects they do not wish to do so the laziness may be interpreted as lack of motivation.

Perhaps uninteresting chores are assigned to them. Teachers often suggest extra-credit projects for the above-average students, which the students may not be motivated to do. Evidently these students feel they are not performing their duties as faithfully as they should.

Thirty-one other problems checked by between twenty-five and thirty-nine per cent of the control class are shown in Table 9.

TTable 10 summarizes the problems checked by the control class by problem areas. For the forty problems checked by more than twenty-five per cent of the control class, the totals show four problems checked for Health and Physical Development; twelve problems checked for School; five problems checked for Money, Work, the Future; two problems checked for Boy and Girl Relations; five problems checked for Relations to People in General; and eleven problems checked for Self-centered Concerns.

In comparing Tables 8 and 10, it should be noted that six out of nine of the problems checked by more than forty per cent of the control class were school-related problems. This compares with one school-related problem out of six problems checked by more than forty per cent of the experimental class. Also the total of twelve school-related problems for the control class compares with six school-related problems for the experimental class. The control class has eleven Self-centered Concerns as compared with

TABLE 10

SUMMARY OF PROBLEMS FROM THE MOONEY PROBLEM CHECK LIST BY PROBLEM AREAS FOR THE CONTROL CLASS

	Problem Area	40% or Above	25% to 39%	Total
I.	Health and Physical Development	1	3	4
II.	School	6	6	12
III.	Home and Family	0	1	1
IV.	Money, Work, the Future	0	5	5
V.	Boy and Girl Relations	0	2	2
VI.	Relations to People in General	0	5	5
VII.	Self-centered Concerns	2	9	11
	TOTAL	9	31	40

seven for the experimental class. Other problem areas are similar in the number checked by the two classes.

The two classes are different in the school-related problem area. To explain this difference, it should be considered that the experimental class had a school stimulus in the accelerated algebra class, while the control class had no such stimulus. It seems feasible to conclude then that the reduction in school-related problems is an additional benefit of the accelerated algebra class. It suggests also that the large number of problems of the control class may result from a failure to meet their intellectual needs.

In Table 11, a summary is presented of the problems checked by both classes at the twenty-five per cent level or above. Fourteen items, selected from the possible two hundred and ten, were checked by both classes. Seven of these fourteen have previously been discussed. They are: "Don't get enough sleep," "Don't like to study," "Wanting to earn some of my own money," "Wanting to know more about college," "Dull classes," "Can't keep my mind on my studies," and "Not interested in certain subjects." Five of these are school-related problems.

"Daydreaming" concerned both classes, which indicates that various problems exist which affect the students' concentration on the immediate subject. It should be remembered by teachers that daydreaming is common in the classroom when boredom is allowed to exist. "Trouble with oral reports," a concern of both classes, point to student self-consciousness about appearing before an audience. The inclusion of a speech course in the curriculum should aid this problem as well as the increased use of oral reports in regular classes. "Taking things too seriously" reflects a tendency to worry on the part of students of both classes. As confidence in their own performance is gained, this problem should be modified. "Trying to stop a bad habit" shows seriousness on the part of the student for improving themselves. "Giving in to temptations" further confirms the student's desire to improve in personal habits and attitudes. "Too much school work to be done at home"

TABLE 11

SUMMARY OF PROBLEMS FROM THE MOONEY PROBLEM CHECK LIST CHECKED BY MORE THAN 25% OF BOTH THE EXPERIMENTAL AND CONTROL CLASSES

	Problem	Experimental Class %	Control Class %	Problem Area
1.	Don't get enough sleep.	63	45	Health and Physical Development
2.	Don't like to study	49	58	School
3.	Wanting to earn some of my own money.	40	29	Money, Work, the Future
4.	Wanting to know more about college.	40	26	Money, Work, the Future
5.	Dull classes.	34	52	School
6.	Can't keep my mind on my studies.	31	45	School
7.	Daydreaming.	31	35	Self-centered Concerns
8.	Trouble with oral reports.	29	26	School
9.	Not interested in certain subjects.	29	48	School
10.	Taking things too seriously.	26	32	Self-centered Concerns
11.	Trying to stop a bad habit.	26	35	Self-centered Concerns
12.	Giving in to temptations.	26	32	Self-centered Concerns
13.	Too much school work to be done at home	26	35	School
14.	Wanting a more pleasing personality.	26	35	Relations to People in General

raises again the controversial question of homework assignments. Teachers and counselors should be aware of the demands on student's time and work toward a reasonable approach to the problem of homework. The final concern of above twenty-five per cent of the two classes was "Wanting a more pleasing personality," which is a commendable problem for the maturing teen-ager and shows sincere interest in getting along with other people and in developing into a mature, socially-acceptable individual.

Awareness of these problem areas by teachers, counselors, and school administrators should influence the curriculum of the schools as related to the above-average ability-grouped classes. The experimental and control classes shared many problems, which we would expect since both are above-average ability-grouped classes. The large number of school-related problems of these above-average students, who should be better adjusted to schoolwork than the average or below-average student, indicates lack of success on the part of the schools in completely meeting their needs. It is perhaps the purpose of another study to investigate the underlying factors leading to these problems. The fact that the experimental class had only one-half as many school-related problems as the control class suggests that the accelerated mathematics sequence favorably affected school-related problems in the experimental class.

Summary

On the basis of the chi-square tests, using data from the California Mental Maturity Test and the California Arithmetic Test, the two classes were established to be no different in I.Q. or arithmetic skills at the beginning of the experimental study. On the basis of the analysis of variance of pre-test and post-test data, using the Sequential Test of Educational Progress, the two classes were found to be no different in arithmetic skills at the beginning or the end of the experiment. On the teacher-made test the experimental class did significantly better beyond the .005 level. It is concluded, then, that the study of algebra instead of arithmetic in the eighth grade did not adversely affect the arithmetic skills of the experimental class.

The Mooney Problem Check List furnished clues to problems concerning members of the two classes. Although fourteen problems checked by the two classes were similar, problems checked by the experimental class were different in one area from those of the control class. Twelve school-related problems were checked by twenty-five per cent or more of the control class compared to six problems checked by the experimental class. Of the twelve problems of the control class, six were above the forty per cent level while in the experimental class only one problem was above the forty per cent level. The study of algebra in the eighth grade seems, therefore, to have a favorable effect on the school-related problems of the experimental class.

The large number of school-related problems of these above-average students in both classes should be a matter of concern to educators. To investigate the underlying factors leading to these school-related problems might well be the purpose of another study.

FOOTNOTES--CHAPTER III

1. Sidney Siegel, Nonparametric Statistics for the Behavioral Sciences (New York: McGraw-Hill Book Company, Inc.), pp. 104-111.

2. F. M. Sims, L. C. Widmayer, and S. M. Lesgold, "Analysis of Contingency Tables (ACT) for the CDC 3600" (Computer Institute for Social Science Research, Michigan State University, 1965), pp. 1-19 (mimeographed).

3. Henry E. Garrett, Statistics in Psychology and Education, (New York: Longman, Green and Co.), pp. 276-295.

4. William Ruble, Donald F. Kiel, and Mary E. Rafter, "One-Way Analysis of Variance with Unequal Number of Replications Permitted," (Agricultural Experiment Station, Michigan State University, 1966), pp. 1-23 (Mimeographed).

CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

On the basis of research cited in Chapter I and Chapter II, it appears that considerations relative to ability grouping, accelerated classes, and in particular, accelerated mathematics classes, have been the subjects for investigations in many studies. Both ability grouping and acceleration in subject matter are accepted educational devices for dealing with the academically talented, although both are subject to controversial points of view. Literature reviewed in Chapter I and Chapter II clarifies the controversial aspects of ability grouping and acceleration in subject matter. Chapter I reviews some studies more closely related to the experimental study presented in this paper, of acceleration of algebra in the eighth grade.

This experimental study compares two ability-grouped eighth grade mathematics classes with regard to their arithmetic achievement. One class studied Algebra I; the other class studied enriched arithmetic. Their arithmetic achievement was measured at the beginning and at the end of the school year and suitable comparisons made using the chi-square test and analysis of variance. A study was also made of the two classes using the Mooney Problem Check List.

Statistical analysis shows that the two classes were similar in ability and achievement initially. Also shown by statistical analysis is that the arithmetic achievement of the two classes is not significantly different at the end of the year's study. It should be recalled that one class studied algebra while the other class studied arithmetic. It appears then that the study of algebra in the eighth grade by academically talented students is a successful venture which can be undertaken without loss of arithmetic skills. The instructor of the accelerated algebra class attests to their success in the study of algebra.

Conclusions

Ten hypotheses were tested to establish the comparison between the two classes. By combining several of the hypotheses, the following conclusions can be summarized:

1. The two classes were found to be not significantly different in I.Q., language and non-language, as measured by the California Test of Mental Maturity in the sixth grade.
2. The two classes were found to be not significantly different in arithmetic skills, fundamentals and reasoning, as measured in the sixth grade, on the California Arithmetic Test.
3. The two classes were found to be not significantly different in arithmetic skills, fundamentals and

reasoning, as measured in the eighth grade, on the California Arithmetic Test.

4. The two classes were found to be not significantly different in arithmetic achievement on the pre-test, using the mathematics test of the Sequential Test of Educational Progress, Form 3A.
5. The two classes were found to be not significantly different in arithmetic achievement on the post-test, using the mathematics test of the Sequential Test of Educational Progress, Form 3B.
6. The two classes were found to have some similar and some dissimilar problems on the Mooney Problem Check List. The experimental class had only one-half as many school-related problems as the control class, which suggests that the accelerated mathematics sequence favorably affected school-related problems in the experimental class. The large number of school-related problems in both classes points to a need for further research relative to the causes of these school-related problems.

Tables and text in Chapter III present the details of the above conclusions.

Recommendations

Chapter II shows the need for more conclusive evidence regarding ability grouping and acceleration with regard to subject matter.

Further curriculum studies need to be made to provide information on mathematics sequences used in various school systems throughout the country.

Experimental studies similar to the one presented need to be done, using larger numbers of students, to establish the feasibility of condensing arithmetic content and teaching more advanced mathematics at an earlier age to the academically talented.

The effects of ability grouping and acceleration on the total personality of the child and on his mental health need to be studied further and suitable recognition of these effects should be considered in making curriculum changes.

BIBLIOGRAPHY

BIBLIOGRAPHY

"Accelerating the Academically Talented," Journal of the National Education Association, XLVIV (April, 1960), 22-23.

Association for Supervision and Curriculum Development. Perceiving, Behaving, Becoming. 1962 Yearbook of the Association. Washington, D.C.: ASCD, 1962.

Bettelhiem, Bruno, and Mott, Kenneth. "Grouping the Gifted: Two Viewpoints," Education Digest, XXX (April, 1965), 4-7.

Braun, R. H., and Steffensen, James. "Grouping, Acceleration and Teacher Aid Experiments in Urbana Secondary Schools, Urbana, Illinois," The Bulletin of the National Association of Secondary-School Principals, XLIV (January, 1960), 305-315.

Bruner, Jerome S. The Process of Education. New York: Random House, Inc., 1960.

Clark, Leonard H. "Ability Grouping--A Third Look," The Bulletin of the National Association of Secondary-School Principals, XLVII (December, 1963), 69-71.

Dezelle, Walter, Jr. "A Comparative Study of the Changes in Academically Able Seventh Grade Children Assigned or Non-Assigned to an Accelerated Math Class Upon Entering Junior High School," Dissertation Abstracts, XXVI (1966), 4438-4439.

Douglas, Karl R. "Modern Functional Adaptation to the Abler Student," Phi Delta Kappan, LXVII (February, 1966), 301-304.

Editors. School and Society, LXXXVIII (November 19, 1960), 434.

Educational Testing Service. Sequential Tests of Educational Progress. Princeton, N.J.: Educational Testing Service, 1957.

Fleigler, Louis A. "Curriculum Practices for the Gifted: U.S.A.," Concepts of Excellence in Education. The Yearbook of Education. New York: Harcourt, Brace and World, Inc., 1961.

Foose, R. L. "Enrichment or Acceleration for the Academically Talented Student," The Bulletin of the National Association of Secondary-School Principals, XLV (November, 1959), 151-153.

Gallagher, James F., and Rogge, William. "The Gifted," Review of Educational Research, XXXVI (February, 1966), 44-45.

Garrett, Henry, E. Statistics in Psychology and Education. New York: Longman, Green and Co., 1958.

Good, Carter V. Dictionary of Education. New York: McGraw-Hill Book Company, Inc., 1959.

Hager, Herbert. "Ability Grouping--Can It Be Justified," Ohio Schools, LXV (March, 1967), 15-16.

Haggard, J. Kendall. "Grading the Accelerated Student," Education, LXXXIII (January, 1963), 286-288.

Hayes, Norman M. "Acceleration Is Here to Stay--But We Must Add Safety Features," Ohio Schools, XXXVIII (December, 1960), 33.

Hegstrom, William J., and Ribble, Donald E. "A Two-Year Study of Eighth-Grade Algebra I," The Mathematics Teacher, LVI (October, 1963), 419-423.

Henzie, Russel. "A Junior High Program," Education, LXXX (November, 1959), 151-153.

Hood, Charles E. "Do We Expect Too Much From Ability Grouping?" The Clearing House, XXXVIII (April, 1964), 467-470.

Hyman, Laurence. "Adapting Mathematics Instruction for the Talented," Education Digest, XXVII (May, 1962), 38-39.

Jones, R. Stewart. "Instructional Problems and Issues," Review of Educational Research, XXVI (October, 1966), 419-420.

Justman, Joseph. "Academic Achievement of Intellectually Gifted Accelerants and Non-Accelerants in Junior High School," School Review, LXII (March, 1954), 142-150.

Klausmeir, Herbert J. "Research and Educational Improvement," The Teacher's College Journal, XXXIV (March, 1963), 139-141.

Klausmeir, Herbert J., and Wiersma, William. "Effects of Condensing Content in Mathematics and Science in Junior and Senior High School," School Science and Mathematics, LXIV (January, 1964), 5-10.

Lobdell, Lawrence O., and Van Ness, William. "Grouping and Enrichment," Education, LXXII (March, 1962), 399-402.

McCloskey, Donald G. "Proposed Revision and Acceleration of the High School Mathematics Program," School Science and Mathematics, LX (March, 1960), 214-221.

Messler, Dorothy L. "A Study of Pupil Age and Achievement in Eighth Grade Algebra," The Mathematics Teacher, LIV (November, 1961), 561-564.

Mooney, Ross L. Mooney Problem Check List. Junior High Form, 1950 Revision. New York: The Psychological Corporation, 1950.

National Society for the Study of Education. The Thirty-Fifth Yearbook, Part I: The Grouping of Pupils. Bloomington, Ill.: Public School Publishing Company, 1936.

Nichols, Eugene D., and Collins, Wagner G. Modern Elementary Algebra. Rev. ed. New York: Holt, Rinehart and Winston, Inc., 1965.

Olsen, Willard C. "Ability Grouping: Pros and Cons," Education Digest, XXXII (October, 1966), 18-20.

Otto, Henry J. and Estes, Dwain M. "Accelerated and Retarded Progress," Encyclopedia of Educational Research. 3rd ed. Ed. Chester W. Harris. New York: The Macmillan Company, 1960.

Passow, A. Harry. "The Maze of Research on Ability Grouping," Education Forum, XXVI (October, 1966), 281-285.

Pilch, Mary M. "Grouping for the Gifted," Minnesota Journal of Education, XLIV (April, 1964), 21.

Pressey, Sidney L. Educational Acceleration and Basic Problems. Columbus, Ohio: The Ohio State University, 1949.

Ruble, William, Kiel, Donald F., and Rafter, Mary E. "One-Way Analysis of Variance With Unequal Number of Replications Permitted." Agricultural Experiment Station, Michigan State University, 1966. (Mimeographed.)

School Mathematics Study Group. Mathematics for Junior High School. Vol. II. Yale University, 1959.

Siegel, Sidney. Nonparametric Statistics for the Behavioral Sciences. New York: McGraw-Hill Book Company, Inc., 1956.

Sims, F. M., Widmayer, L. C., and Lesgold, S. M. "Analysis of Contingency Tables (ACT) for the CDC 3600." Computer Institute for Social Science Research, Michigan State University, 1965. (Mimeographed.)

Sullivan, Elizabeth T., Clark, Willis W., and Tiegs, Ernest W. California Test of Mental Maturity. Monterey, Calif.: California Test Bureau, 1957.

Swenson, Gardner A. "Acceleration Versus Enrichment," The Bulletin of the National Association of Secondary-School Principals," XLVII (October, 1963), 9-10.

Tiegs, Ernest W., and Clark, Willis W. California Arithmetic Test. Los Angeles, Calif." California Test Bureau, 1957.

Tillman, Rodney, and Hull, J. H. "Is Ability Grouping Taking Schools in the Wrong Direction?" The Nation's Schools, LXXIII (April, 1964), 70-71.

Wells, David W. "A Modified Curriculum for Capable Students," The Mathematics Teacher, LI (March, 1958), 181-182.

APPENDICES

APPENDIX A

CHI-SQUARE VALUES FOR I.Q. AND ARITHMETIC ACHIEVEMENT

Tests	Chi-square
I.Q., language	1.146
I.Q., non-language	0.000
Arithmetic reasoning, sixth grade	0.000
Arithmetic fundamentals, sixth grade	0.000
Arithmetic reasoning, eighth grade	0.778
Arithmetic fundamentals, eighth grade	0.308

APPENDIX B

GRAPHS OF TEST DATA

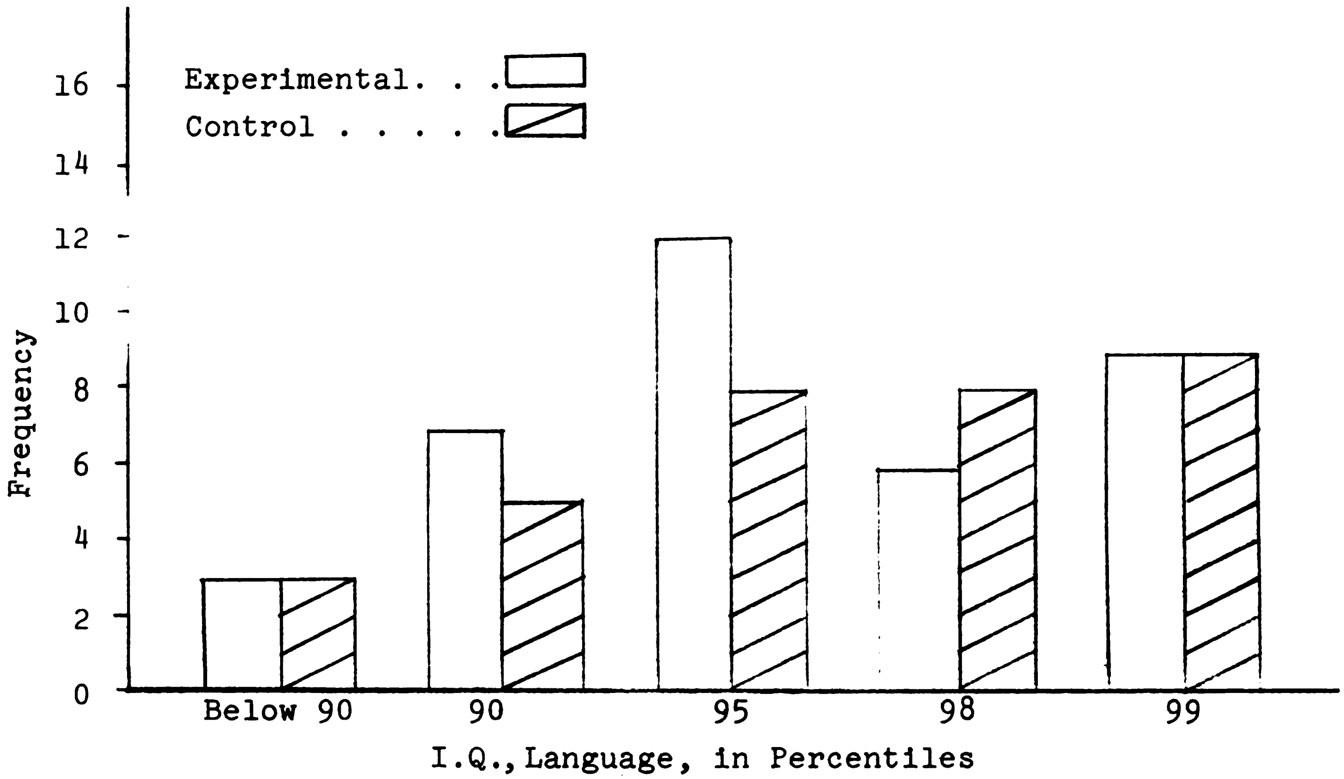

Figure 1.--I. Q., language, expressed in percentiles, for the experimental and control classes from the California Test of Mental Maturity, sixth grade testing. N = 35 for experimental class. N = 31 for the control class.

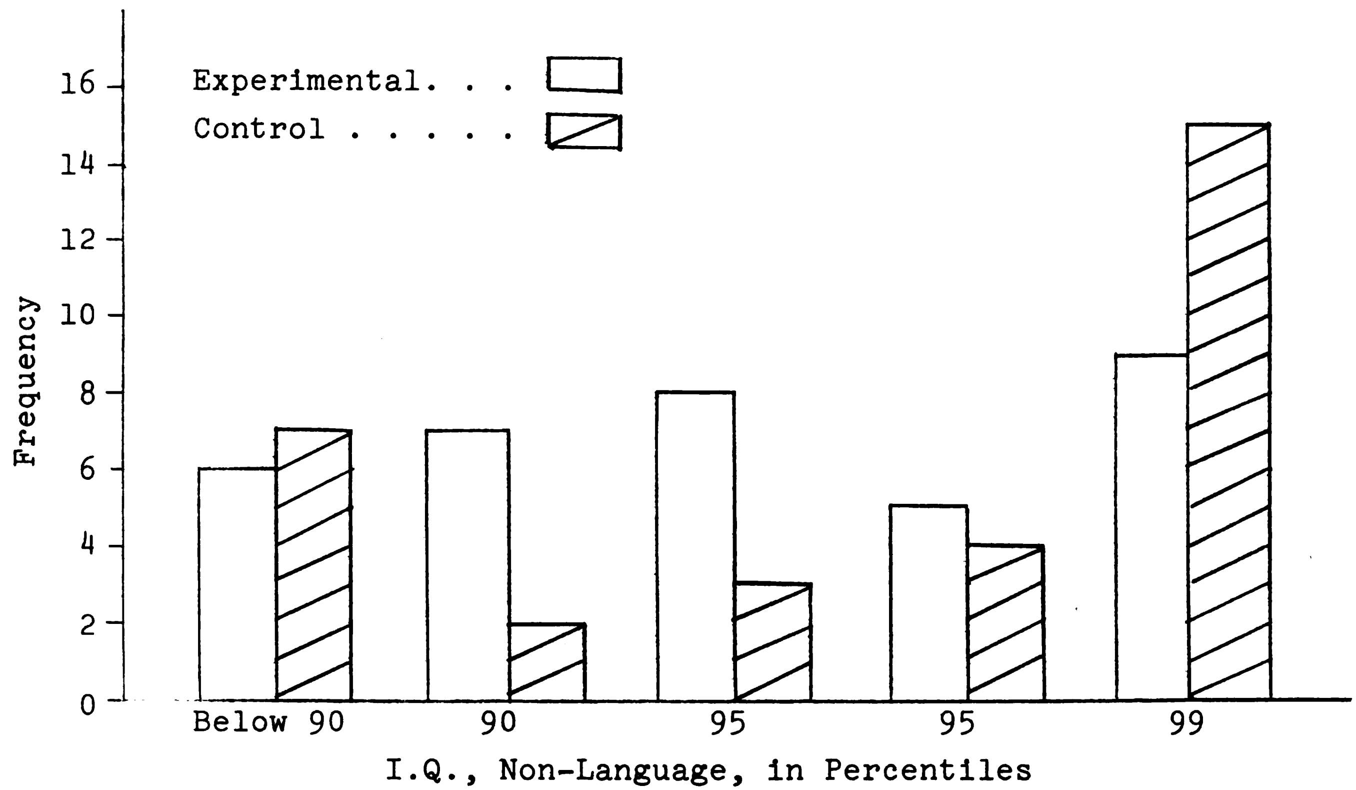

Figure 2.--I.Q., non-language, expressed in percentiles for the experimental and control classes from the California Test of Mental Maturity, sixth grade testing. N = 35 for the experimental class. N = 31 for the control class.

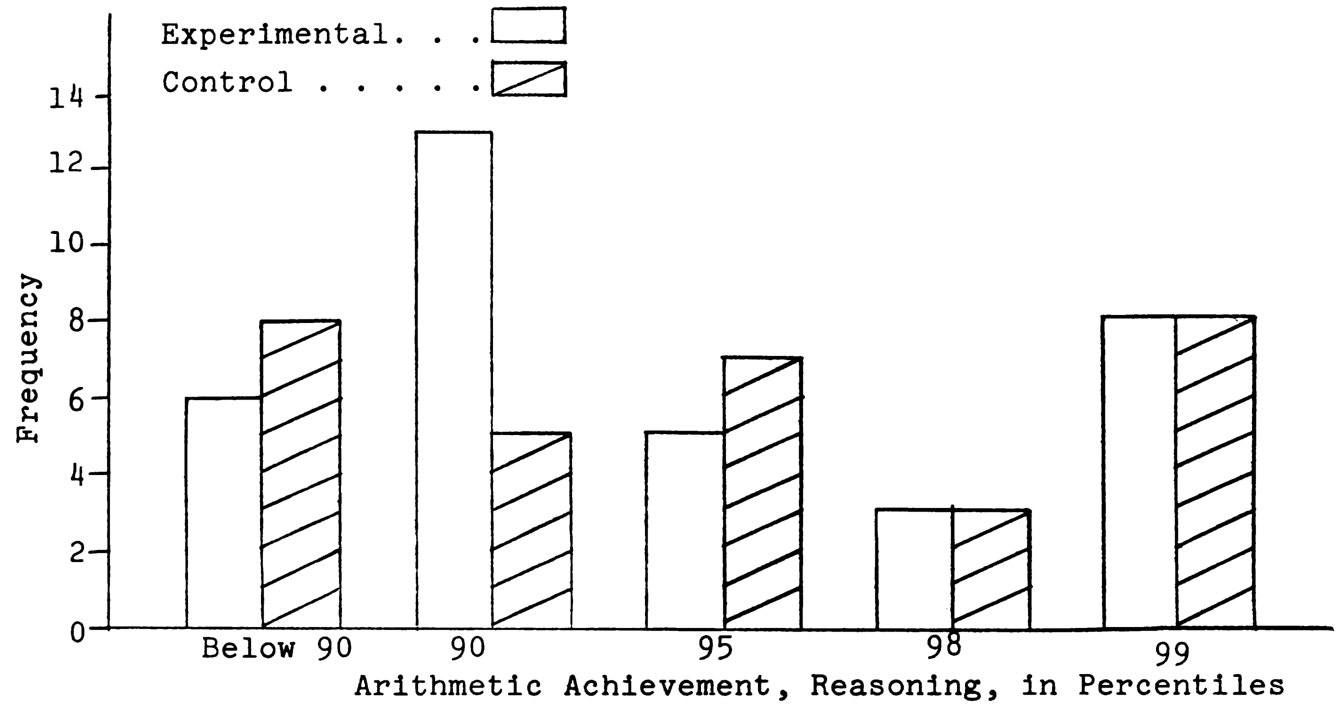

Figure 3.--Arithmetic achievement, reasoning, expressed in percentiles, for the experimental and control classes from the California Arithmetic Test, sixth grade testing. N = 35 for the experimental class. N = 31 for the control class.

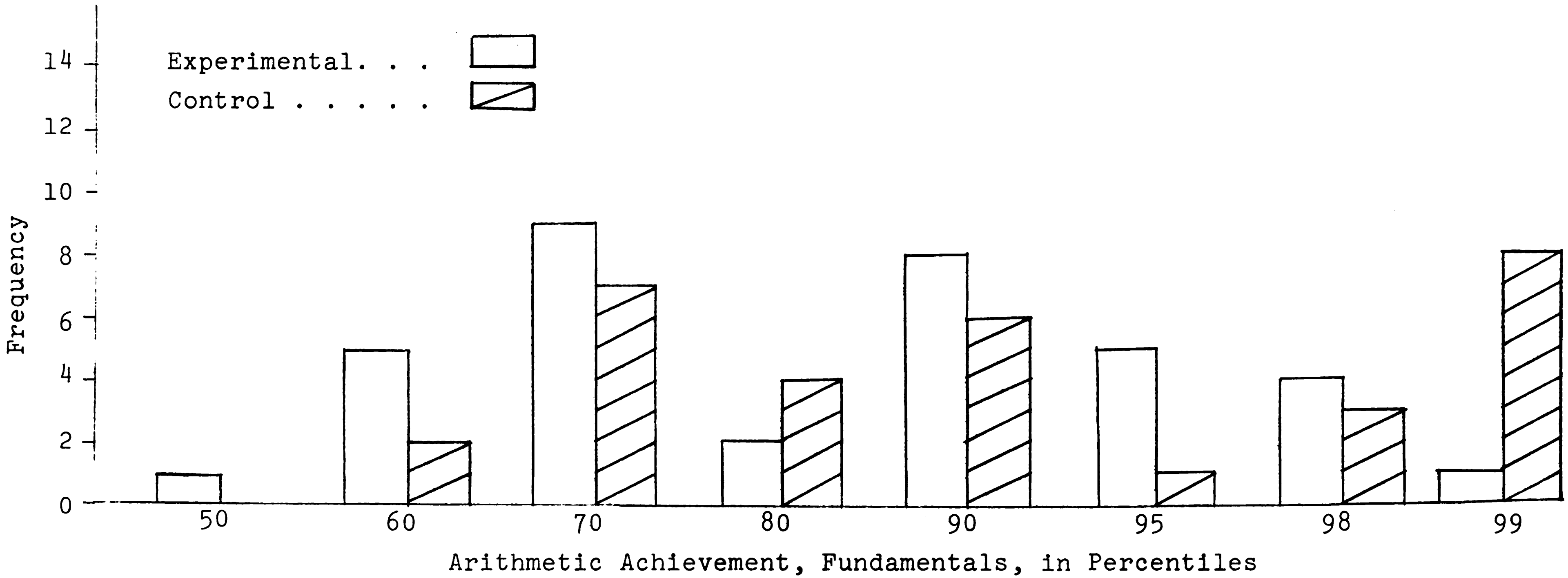

Figure 4.--Arithmetic achievement, fundamentals, expressed in percentiles, for the experimental and control classes from the California Arithmetic Test, sixth grade testing. N = 35 for the experimental class. N = 31 for the control class.

Figure 5.--Arithmetic achievement, reasoning, expressed in percentiles, for the experimental and control classes from the California Arithmetic Test, eighth grade testing. N = 35 for the experimental class. N = 31 for the control class.

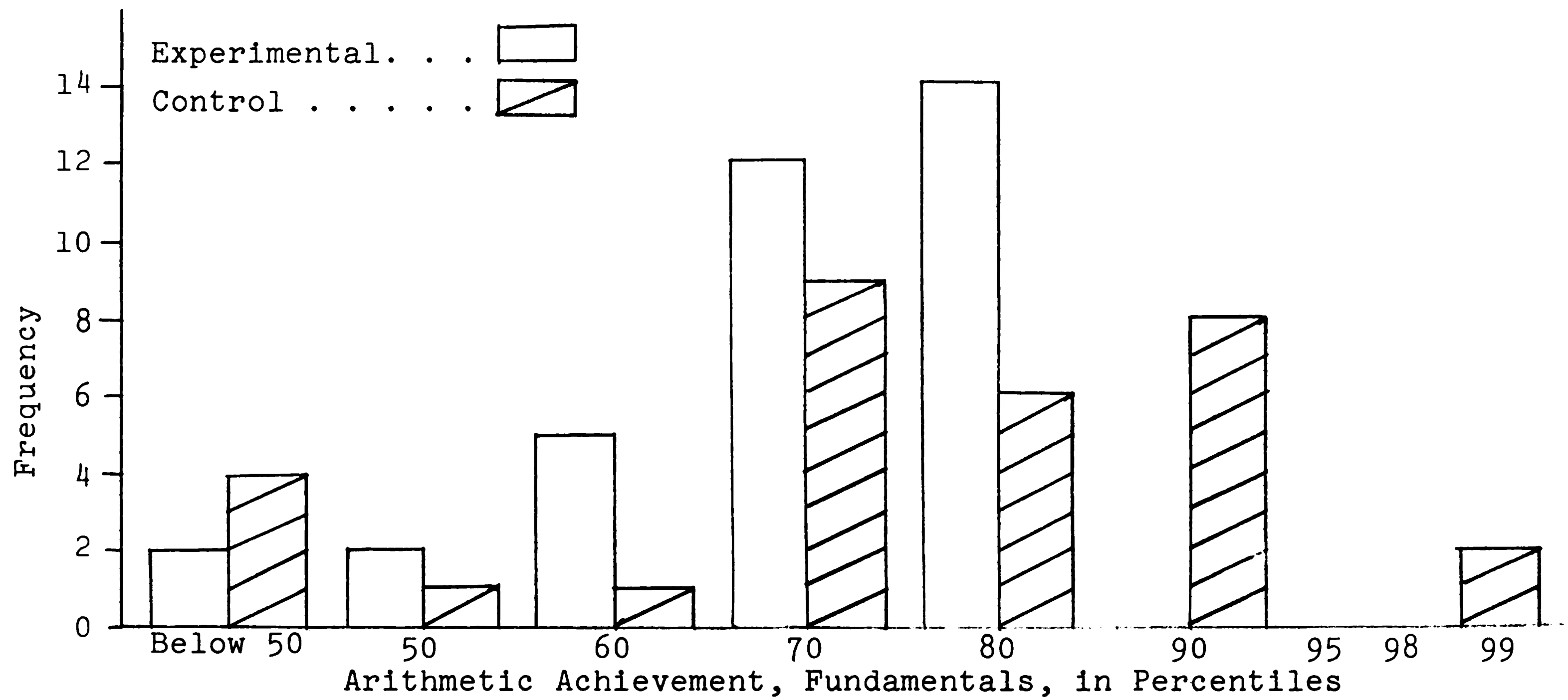

Figure 6.--Arithmetic achievement, fundamentals, expressed in percentiles, for the experimental and control classes from the California Arithmetic Test, eighth grade testing. N = 35 for the experimental class. N = 31 for the control class.

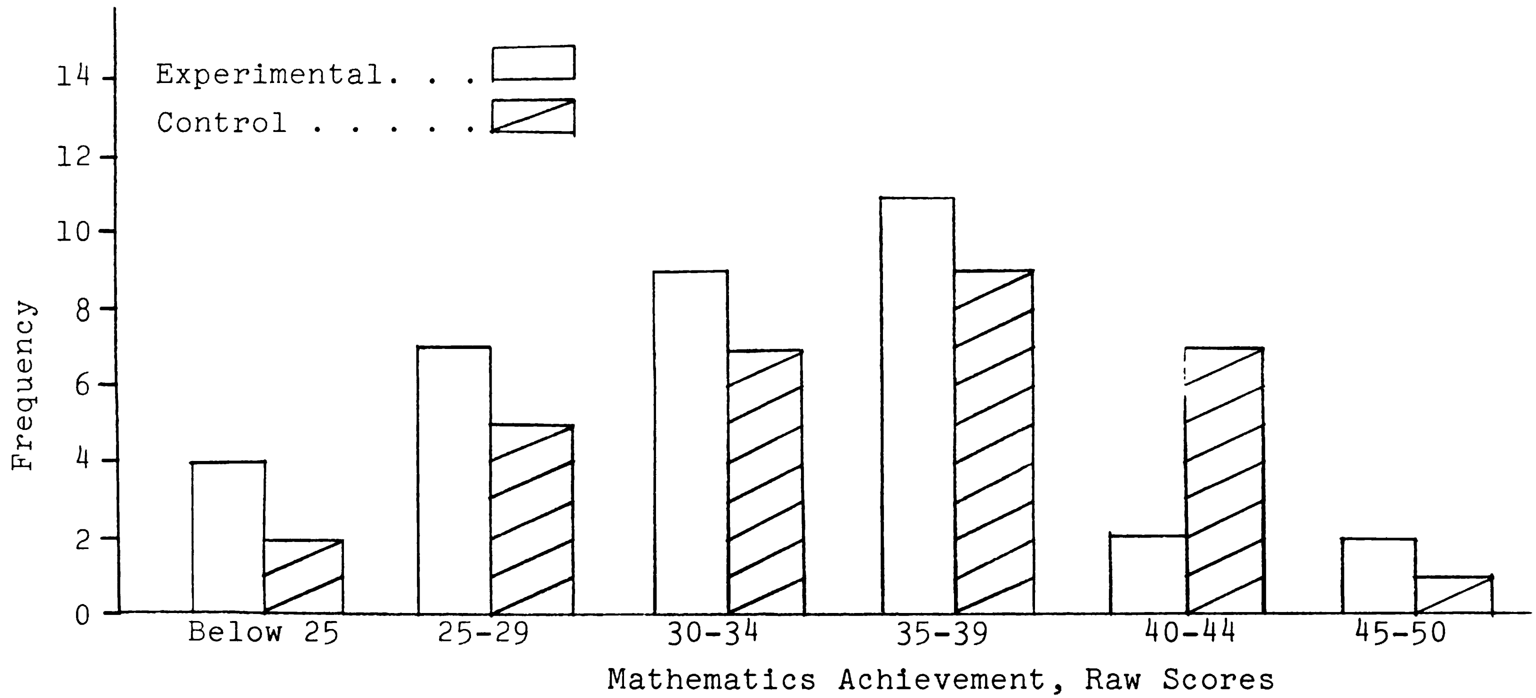

Figure 7.--Mathematics achievement, expressed in raw scores, for the experimental and control classes from the Sequential Test of Educational Progress, Mathematics Text, Form 3A. N = 35 for the experimental class. N = 31 for the control class.

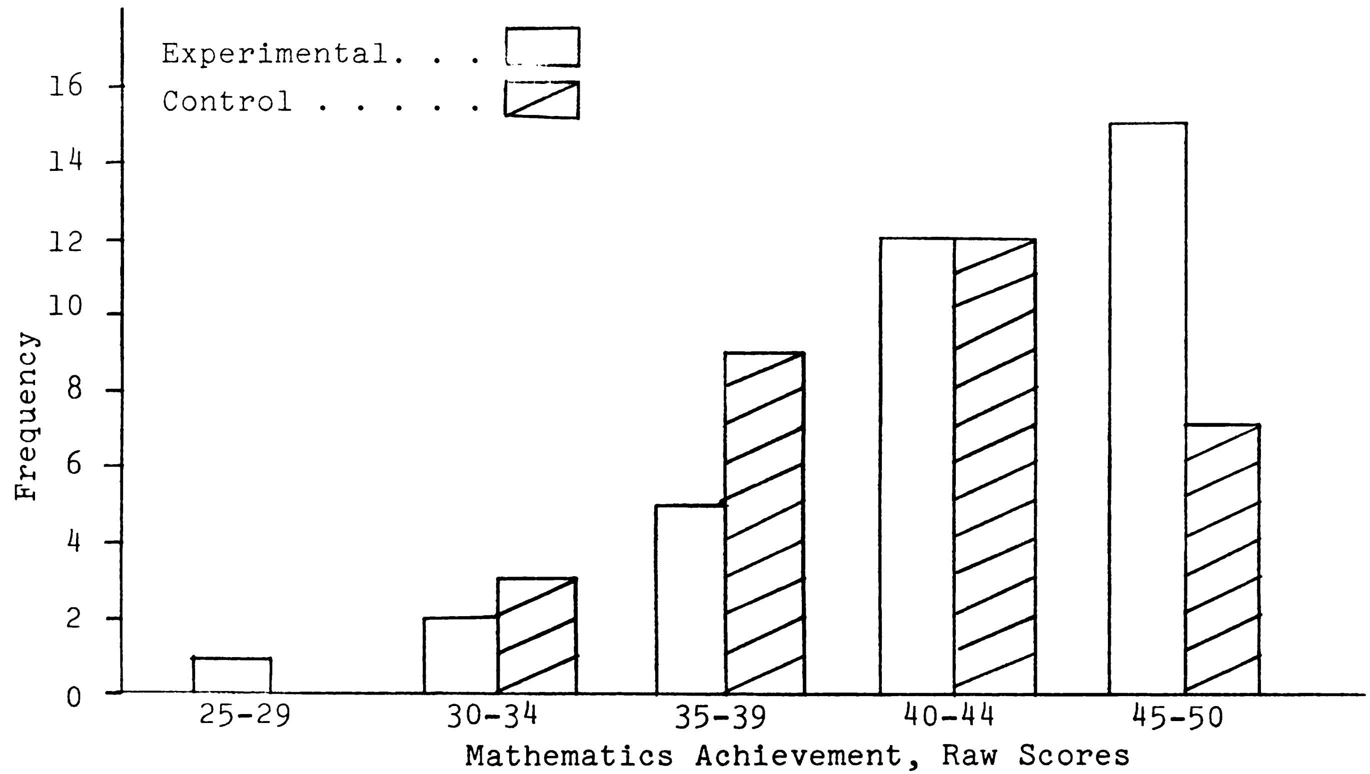

Figure 8.--Mathematics achievement, expressed in raw scores, for the experimental and control classes from the Sequential Test of Educational Progress, Mathematics Test, Form 3B. N = 35 for the experimental class. N = 31 for the control class.

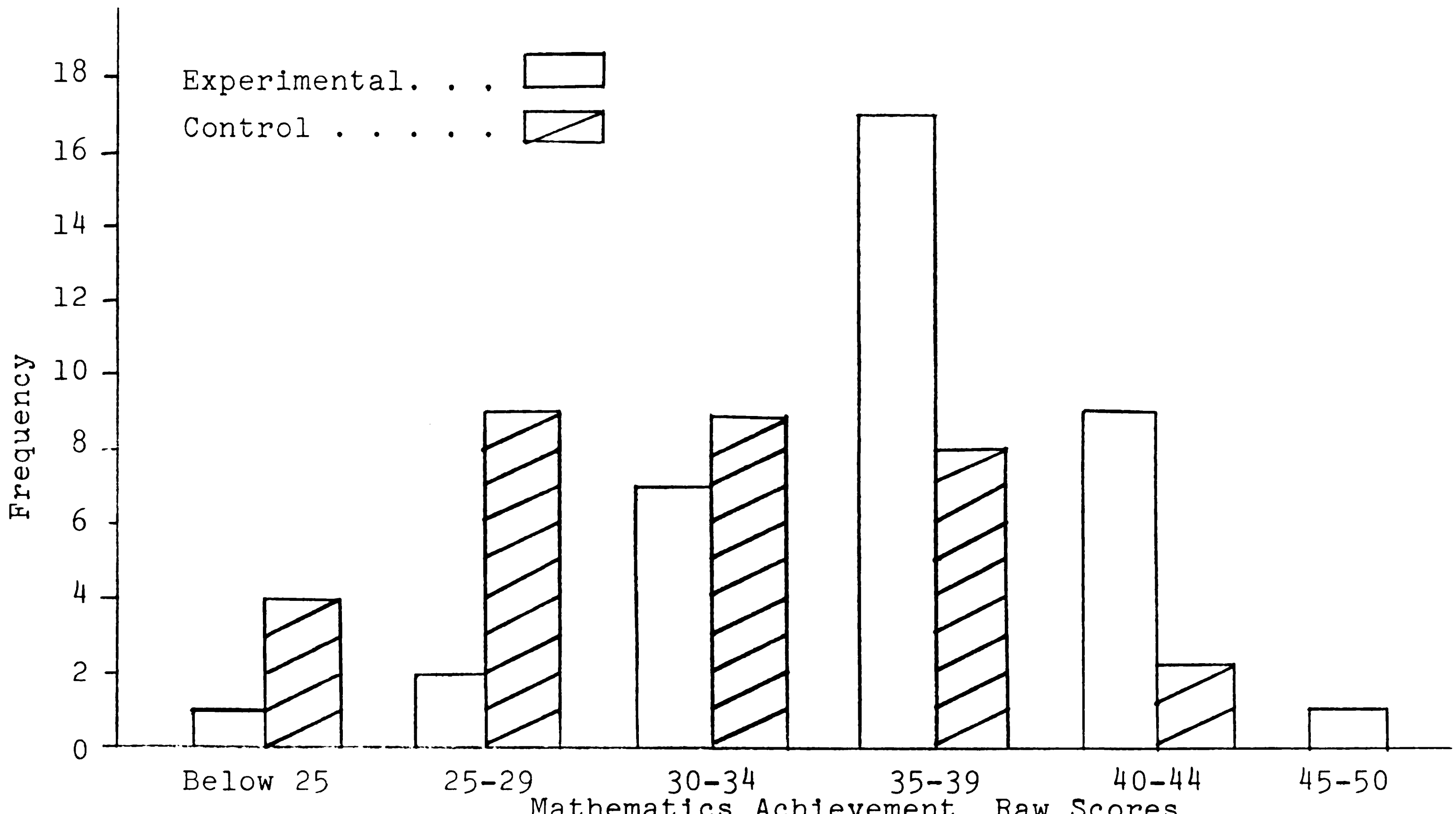

Figure 9.--Mathematics achievement, expressed in raw scores, for the experimental and control classes from the teacher-made test. N = 35 for the experimental class. N = 31 for the control class.

APPENDIX C

TEACHER-MADE MATHEMATICS TEST

__________ school   __________ name

Directions: Solve each of the following problems and place the letter of the correct answer in the blank at the left of the problem. Answer every question. There will be no penalty for incorrect answers.

____1. 13 in base five, expressed as a base ten numeral is

a) 4   b) 5   c) 8   d) 10   e) none of these

____2. 2^4 equals

a) 6   b) 8   c) 12   d) 16   e) none of these

____3. The next prime number after 7 is

a) 9   b) 10   c) 11   d) 12   e) none of these

____4. The least common multiple of 6, 8, and 18 is

a) 144   b) 72   c) 48   d) 96   e) none of these

____5. $\frac{4}{7} - \frac{9}{14} =$

a) $\frac{13}{21}$ b) $\frac{13}{14}$ c) $\frac{-5}{7}$ d) $\frac{1}{14}$ e) none of these

____6. $\frac{5}{8} - \frac{3}{5} =$

a) $\frac{2}{3}$ b) $\frac{3}{40}$ c) $\frac{1}{8}$ d) $\frac{1}{5}$ e) none of these

____ 7. $\frac{5}{8} \times \frac{4}{5} =$

a) $\frac{1}{2}$ c) $\frac{1}{8}$ e) none of these

b) $\frac{1}{4}$ d) $\frac{1}{10}$

____ 8. $(\frac{3}{5} \times \frac{1}{2}) \div \frac{3}{5} =$

a) $\frac{1}{2}$ c) $\frac{1}{5}$ e) none of these

b) $\frac{1}{3}$ d) $\frac{9}{50}$

____ 9. 36.07 - 2.3 =

a) 36.30 c) 38.37 e) none of these

b) 38.20 d) 59.07

____10. The perimeter of a triangle is 18.26 inches. One side of the triangle measures 4.81 inches and another side measures 6.172 inches. How long is the third side of the triangle?

a) 7.278 c) 19.242 e) none of these

b) 8.278 d) 20.242

____11. 7.4 x 0.38 =

a) 7.78 c) 28.12 e) none of these

b) 2.812 d) 2.912

____12. 1.008 - 0.36 =

a) .28 c) .38 e) none of these

b) .29 d) .49

____13. If the length of a rectangle is 8 inches and the width is 9 inches, the perimeter is

a) 17 in. c) 34 sq. in. e) none of these

b) 34 in. d) 72 sq. in.

____14. If the base of a triangle is 10 inches and the height is 14 inches, the area is

a) 12 in. c) 70 in. e) none of these

b) 24 sq. in. d) 70 sq. in.

____15. The circumference of a circle with diameter of 10 inches is (assume that $\pi = 3.14$)

a) 3.14 in. c) 3140 sq. in. e) none of these

b) 3.14 sq. in. d) 3140 in.

____16. If the length is 7 in., the width is 8 in., and the height is 10 in., the volume of a rectangular prism is

a) 280 in. c) 560 sq. in. e) none of these

b) 280 cu. in. d) 560 cu. in.

____17. The ratio of the width of a certain rectangle to its length is 3 to 5. The length of the rectangle is 45 in. How wide is the rectangle?

a) 15 in. c) 27 in. e) none of these

b) 21 in. d) 30 in.

____18. 28 is what per cent of 140?

a) 15% c) 23% e) none of these

b) 20% d) 40%

____19. 32 is 40% of what number?

a) 80 c) 90 e) none of these

b) 85 d) 95

____20. 19% of 38 is

a) 2 c) 20 e) none of these

b) 200 d) .5

____21. In a right triangle if one side is 6 in. and the other side is 8 in., the hypotenuse is

a) 12 in. c) 16 in. e) none of these

b) 14 in. d) 18 in.

____22. The number of subsets of the set {s, t, u} is

a) 3 c) 8 e) none of these

b) 6 d) 10

____23. The value of $5 \cdot (7+6)$ is

a) 35 c) 30 e) none of these

b) 65 d) 210

____24. The statement that $8 + (6 + 5) = (8 + 6) + 5$ is an example of

a) The commutative principle
b) The associative principle
c) The distributive principle
d) The identity principle
e) None of these

____25. $a \times b = b \times a$, by the

a) The commutative principle
b) The associative principle
c) The distributive principle
d) The identity principle
e) None of these

____26. $3(a + 6) = 3a + 3(6)$ is an example of

a) The commutative principle
b) The associative principle
c) The distributive principle
d) The identity principle
e) None of these

____27. The product of $(^{-}10)(^{+}6)$ is

a) $^{-}4$ c) $^{+}60$ e) none of these

b) $^{+}4$ d) $^{-}60$

____28. The sum of $^{-}6 + {}^{+}4 + {}^{-}10$ is

a) $^{-}12$ c) $^{-}20$ e) none of these

b) $^{+}20$ d) $^{+}12$

____29. The missing factor in the problem $^{-}13 \cdot (\quad) = {}^{-}65$ is

a) $^{-}52$ c) $^{+}5$ e) none of these

b) $^{-}5$ d) $^{+}52$

____30. The solution for $|\Delta| = |^{+}7| - |^{-}4|$ is

a) 3 c) $^{-}11$ e) none of these

b) 11 d) $^{-}3$

____31. The value of $|^{+}2 \cdot {}^{-}3|$ is

a) $^{+}6$ c) $^{-}1$ e) none of these

b) $^{-}6$ d) $^{-}5$

____32. The value of $^{-}150 \cdot 0$ is

a) $^{-}150$ c) $^{+}1500$ e) none of these

b) $^{+}150$ d) $^{-}1500$

For Problems 33, 34, and 35, the universal set will be $\{1, 2, 3, 4, 5, ---, 9\}$.

____33. The solution set for $x + {}^{-}1 \geq 4$ is

a) $\{6,7,8,9\}$ c) $\{1,2,3,4,5\}$ e) none of these

b) $\{5,6,7,8,9\}$ d) $\{1,2,3,4\}$

____34. The solution set for $2x + {}^{-}4 < 6$ is

a) $\{1,2,3,4\}$ c) $\{1\}$

b) $\{1,2,3,4,5\}$ d) $\{5,6,7,8,9\}$

____35. The solution set for $x^2 < 16$ is

a) {4,5,6,7,8,9} c) {1,2,3,4,5,6,7} e) none of these

b) {1,2,3,4} d) {1,2,3}

____36. A girl is two times as tall as her brother. If the girl is 64" tall, how tall is her brother?

a) 66" c) 62" e) none of these

b) 32" d) 128"

____37. Bob has $1.25 in nickels and dimes. He has three times as many nickels as dimes. How many dimes has he?

a) 15 c) 8 e) none of these

b) 10 d) 5

____38. Find a number such that one-half of the number is equal to the number plus 5.

a) 3 c) 2 e) none of these

b) $^{+}10$ d) $^{-}10$

____39. In a clock arithmetic system having a "five-hour" clock, (Mod 5 system) $2 \cdot 3 =$

a) 4 c) 3 e) none of these

b) 2 d) 1

____40 $\frac{(a-b)^3}{a-b} =$

a) $a^2 - b^2$ c) $a^2 + b^2$ e) none of these

b) $2a - 2b$ d) $a^2 - 2ab + b^2$

____41. A simpler equivalent expression for $-x-3x-5x+7x-2x$ is

a) $^{-}4x$ c) $2x$ e) none of these

b) $^{+}4x$ d) $^{-}3x$

____42. A simpler equivalent expression for $\frac{x/y}{r/s}$ is

a) $\frac{sx}{ry}$ c) $\frac{rx}{sy}$ e) none of these

b) $\frac{sr}{xy}$ d) $\frac{rs}{xy}$

____43. A simpler expression for $\frac{2x}{3} - \frac{7y}{4}$ is

a) $\frac{8x - 21y}{7}$ c) $\frac{21y - 8x}{12}$ e) none of these

b) $\frac{8x - 21y}{12}$ d) $\frac{21y - 8x}{7}$

____44. A simpler expression for $\frac{r + \frac{s}{t}}{r - \frac{s}{t}}$ is

a) $^{-}1$ c) $\frac{rt + s}{rt - s}$ e) none of these

b) $\frac{-t}{s}$ d) $\frac{rt - s}{rt + s}$

____45. A simpler expression for $(q + u)(3u - q)$ is

a) $4u$ c) $3u^2 + 2qu - q^2$ e) none of these

b) $3u^2 + 4qu - q^2$ d) $3u^2 + 2qu + q^2$

____46. The solution for $f - \frac{2}{7} = \frac{-1}{3}$ is

a) $\frac{1}{21}$ c) $2\frac{7}{1}$ e) none of these

b) $\frac{6}{21}$ d) $1\frac{1}{6}$

____47. The solution for $\frac{7}{8}n = \frac{^-1}{2}$ is

a) $\frac{^-7}{16}$ c) $\frac{3}{8}$ e) none of these

b) $\frac{^-4}{7}$ d) $^-2\ \frac{2}{3}$

____48. The solution for $0.07y = 8.4$ is

a) 1.2 c) 120 e) none of these

b) 12 d) 7.7

____49. The solution for $\frac{y}{y-6} = \frac{7}{3}$ is

a) 6 c) $^-10\ \frac{1}{2}$ e) none of these

b) 7 d) $10\ \frac{1}{2}$

____50. The solution for x, in the two equations $\frac{x + y}{3} = 2$, and $\frac{x - y}{2} = {}^-1$ is

a) 4 c) 2 e) none of these

b) 3 d) 1

R.W.Crocker. I967.
M.A.