A COMPARATIVE STUDY OF THE ACHIEVEMENTS

OF FIRST YEAR ALGEBRA PUPILS

WITH AND WITHOUT HOME

WORK ASSIGNMENTS

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By

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PREFACE

This study was undertaken first, to satisfy the mind of the writer as to the value of assigned home work in mathematics and, second, to inform other teachers, principals, superintendents, and parents concerning this much discussed problem in education. It is hoped that the study will be of use to other algebra teachers who are in doubt as to the value of their assigned home work.

I wish to express my appreciation to the following people who helped to make this study possible:

(1) Dr. Merle Willard Glasgow, Principal of the Junior High School, Bartlesville, Oklahoma. His interest in this experiment and his releasing of the writer from extracurricular and other duties for the year made the study a pleasure.

(2) Dr. James Howard Zant, Associate Professor of Mathematics, whose suggestions and advice at the beginning of this study were indeed helpful.

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Bartlesville, Oklahoma

(7) Thelma Venice Zinn, Mathematics teacher in Junior

High School, Bartlesville, Oklahoma.

Fannie Spencer

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CHAPTER I

THE PROBLEM AND ITS SETTING

Pupils in the first year algebra classes in the Bartlesville
Junior-Senior High School during the year 1938-1939 were used for this
study. The purpose was to determine whether there is any significant
difference in achievements in algebra as measured by teacher-made tests[1]
for pupils who have been assigned home work to prepare and those who
have not been assigned home work. The assignment consisted of written
work to be handed in daily. Methods of conducting the two groups in
classes were the same with the exception of the omission of the assign-
ment of home work in one of the groups.

An attempt was made to answer the following questions:

1. Do pupils show greater achievement when assigned home work
   is required in algebra?

2. Are home-work assignments as necessary for pupils of higher
   IQ's as for those of average or low IQ's?

3. Is there any correlation between the IQ's of the individuals
   and the improvement due to assigned home work?

4. Do boys profit more or less than girls when home work is
   required?

5. Do chronological ages relate closely to the achievements
   made by pupils having assigned home work?

This study was undertaken after several years of discussion
concerning home work among the patrons and school officials of the

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1 Tests were made by the writer.

school where the writer is employed as an algebra teacher. Much of the opinion was against home work. Complaints came mostly from parents of children in the seventh grade. These children had not been accustomed to very much home work in the grade school, and the amounts assigned by the junior high school teachers together with the child's task of adjusting himself to a new school situation seemed to work a hardship on pupils as well as on parents.

The topic of home work formed the basis of discussion in several teachers' meetings. Principals suggested lessening the amounts assigned, especially in the lower junior high school grades. Some few articles for and against assigned home work were passed around among the faculty to be read, but no results of statistical studies were available. It was found that parents, teachers, principals, and superintendents elsewhere were interested in this subject not only in the United States but in other countries.

Dr. William H. Johnson, Superintendent of Chicago Schools, says that the question of home work, long one of the thorniest problems of the modern schools, can raise a heated pro and con discussion quicker than any other in education.

> "Say fathers: 'What are teachers paid for, if I must help Billy with his algebra and ancient history?'
> Say teachers: 'It is utterly impossible to cover all of the material in the course of study in the short school hours.'"[2]

The Information Service of the International Bureau of Education for Great Britian reports that the House of Commons recently agreed to a resolution moved by Mr. Rodford, member for Manchester

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2 Dr. Wm. H. Johnson, "Home Work Ho", Literary Digest, Vol. 123 (1937), No. 1, p. 31

and worded as follows:

> "That in the opinion of this house it is undesirable
> that school children should have their evening occupied
> with home work to the exclusion of rest and recreation,
> and that whenever practicable, preparations on the school
> premises should be substituted for home work."[3]

Some years ago the Scottish Education Department issued a circular on overpressure in schools, and replies to the questionnaires which were sent all over Scotland were examined by Dr. A. Morrison of the Scottish Universities. He found from the replies that his university examinations were to a considerable extent to blame. Another cause of excessive home work was the fact that in Scotland, after the age of twelve, pupils were no longer taught by one teacher all day, but went to a separate teacher for each subject, and the more zealous the teacher, the more the danger of the total amount of home work being excessive.[4]

Replying to the debate in the House of Commons the secretary of the Board of Education, Mr. Oliver Stanley, said that they were actually in the middle of a comprehensive inquiry into the whole question of home work. The chief points in the policy of the Assistant Masters' Association of Scotland are that, (1) home work is a valuable and necessary means of study free from the restrictions of class work, but that it should be strictly limited in amount and definitely apportioned among the various subjects, and (2) that home work should be regulated by staff arrangement and by time table. The

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3 J. McKeen Cattell, "Reports", School and Society, Vol. 43 (1936), No. 1120, p. 821

4 Ibid.

maximum times per evening should be one-hundred twenty minutes for pupils between fourteen and sixteen years of age and for pupils over sixteen there should not be a rigid time table but they should be encouraged to direct their own studies.[5]

The Berlin Correspondent of the Journal of the American Medical Association wrote in 1932 that the overburdening of the school child is still a subject of much discussion. The Minister of Instruction of France has appointed a commission to study the matter of overpressure which always implies too much home study. The report of the school medical officer of the London County Council for 1929 devotes two pages to the question of overpressure, and five physicians are quoted as finding many cases of nervousness and debility due to excessive home work. He concludes by saying,

> "It is the duty of school authorities to consider the result not merely upon scholastic advancement but upon health and physique in every individual case, and to insure that in every twenty-four hours, there is not only time for work, for meals, for physical exercise, and for sufficient sleep, but also healthful relaxation and recreation."[6]

In the London Times (educational supplement, April 12, 1930) a correspondent from the Irish Free State expresses the thoughts of thousands of American parents when he says, on the subject of home study in secondary schools,

> "The question gets little or no consideration from teachers as a body. It gets plenty of unwilling consideration from parents but their approval or disapproval hardly counts."[7]

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5 Ibid., p. 822

6 J.F. Rogers, M.D., "Home Study", Hygeia, Vol. 14 (1936), No. 9, p. 812

7 Ibid.

Dr. Carr, a medical officer in the Derbyshire schools remarks that the subject of home study has never received the attention it deserves.

James Frederick Rogers, M.D., consultant in Hygiene, of the United States Bureau of Education says that over a hundred articles on the subject of home work have appeared in educational journals in the past quarter century, and probably thousands in the lay press. The following are representative phrases used by these writers in approval or condemnation of the practice.

Pros	Cons
Home study results in:	Home study results in:
self reliance	reliance on others
thoroughness	waste of time
independence	cheating
responsibility	deceit
honesty	lying
neatness	slovenly work
habits of study	nervousness
accuracy	loss of sleep
obedience	injury
Home study keeps children	Home study leaves pupil no
at home	time for play
Improves home	No time to "loaf and invite
Cultivates "quiet reading	his soul"
and profitable thought"	No time for music, art, clubs
Cultivates love of home	No time for home duties and
Makes less work for teachers	pleasures
Saves money of taxpayer	Makes work for parents
Home is best place to study.	Homes are poor place to study.

Surely no teacher believes that all his pupils could be made accurate and honest by home work or that they could all be rendered slovenly or cheats. Not all children are made home lovers by home study nor are all made ill thereby. It is evident that undesirable traits in the child are sometimes brought to the surface and intensified by home study and surely this is the last thing that education should do.

"From the mere mixing of the above 'fors' and 'againsts' is obtained only a disturbance in the test tube, a bubbling, accompanied by heat but with little light."[8]

Mr. Rogers says that there can be little doubt that home study is not undesirable provided (1) that the home is healthful and reasonably quiet; (2) that the study imposed is not excessive in amount, (3) that it is not too exacting in nature, and (4) that the child knows what he is to do and how to do it. Individual differences should be provided for in home work as in class work. Home study ought never to be harmful for any but helpful and healthful for all. It should be so handled that it will not deserve to be called a "big, bad wolf" by educators, parents or pupils.[9]

The United States Bureau of Education gave the opinion that, nationally, the argument of home work vs. no home work had simmered down to a static state of compromise in that educators had come to the general agreement that some home work was good, too much bad, that it must be coordinated by the various teachers, and must be pleasant and entertaining.[10]

Mrs. Clara Savage Littledale, editor of Parents' Magazine, asked her readers this question, "Do you believe in home work?" Answers poured in from parents, teachers, superintendents, and children. A few of the letters have been copied in part below.

"Yes --- Very early in our children's lives we instilled a love of learning things. When they reached the higher grades

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8 Ibid., p. 809

9 Ibid., p. 851

10 Dr. Wm. H. Johnson, "Home Work Ho", Literary Digest, Vol. 123 (1937), No. 1, p. 32

we made school and all its interests a big part of all our
lives. We had an early dinner and the children's time was
their own to play between the letting out of school and the
dinner hour. Immediately after dinner we all, father, mother,
and children, went into a study hour. The children were
provided with a simple table with a bookcase and a drawer
that held sharpened pencils, erasers, paper and all things
needful to efficient work. Quiet prevailed during this hour
unless questions were asked or help was needed. The children
had been taught early that a happy attitude toward their work
made for quick progress in any line of study. Why the modern child
rebels against a little home study or why parents hold this time
up to him and the world as a blot against the school system,
I, as a parent, fail to see."

- Marjorie Street, Iowa

"No --- My observations, based on my past experiences as a
high school teacher, show that home study brings about, first,
poor study habits; second, discipline problems; third, dis-
sention between parents and teachers. The modern home with
its close quarters and resulting lack of a quiet, comfortable
study place, the radio, and the unthinking demands of the
parent make it impossible for a child to concentrate and to
do his work carefully. The result is, "get through with it
any old way" study habits. The student who does his work at
home misses the benefits of supervised study."

- Bermita Faye Fraser, Washington

"Yes --- Work outside of the class room seems to be necessary
as a supplement to school instruction after the first few years
of school life. The school time of pupils, except in the
early grades, is almost completely required for explanations,
recitations and tests. The knowledge gained in the class
room must be driven home and that can only be accomplished
by practice and reflection. That means supplementary work,
usually feasible only at home."

- Wm. D. Cranstoun, New York

"No --- Games, fair play, family relationships and business
contacts are necessary to the growing mind. The art, and
art it has grown to be, of making a living must come right
along with book learning if the student is to be equipped
for life at the end of twelve years. Not more than one out
of ten get to complete or even start a higher educational
course. They must, to meet and know the world into which
they are going to work, have more practical training, This
they must gain after school hours and during vacation. Book
learning has its place but there are other things needed to
complete twelve years of training, that is, religious educa-
tion, home relations, legitimate recreation, apprenticeship
to business and farming, nature lore and just plain 'learnin'

folks. Let the home, church and just living have some leeway during these impressionable years."

<div align="right">- Mrs. Warren D. Morgan, Wisconsin[11]</div>

Pupils are vitally interested in the question. The composition below is one written by a junior in the Bartlesville High School and handed to her English teacher for extra work. The subject of home work had been mentioned but briefly one day in class. This understanding teacher has led her pupils to express their thoughts on topics nearest their hearts, because they know that all is received with sympathy and strictest confidence.

"Question: Home Work to be or not to be

The student weary plods his homeword way, ignoring drugstores and school chums. He enters the door, drops his armload of books and plunges into soup eating, looking neither to the right nor to the left.

The repast finished, the student begins work, first glancing longingly at the outside, the copy music, and piano. He sighs and starts on his shorthand which is assigned every day, holiday or no, and which must be done first.

Two hours later the student finishes his shorthand and thinks about misguided teachers who think the only way to get students to learn is by giving them home work every night.

Now for the term paper. The student rises in search of an apple. Baby sister and all the neighbors' baby sisters run through the room several times. Father talks in booming voice over the telephone. Big sister is practicing the violin. Mother runs the vacuum. The student gets a despairing expression on his face and wonders what would happen if he stood up in class the next day, and screamed and went into a fit. The idea is rather appealing.

'Freedom of speech is important'--concentrate, says the student's better judgment. Forget it says something else. Three hours have elapsed. The student's brain is tired. He is tired, and muses on the morrow when all must be repeated. Useless. Hopeless. No fun. No time for music. Work. Routine. Monotony.

Bed time. Student retires with whirling brain. Notes of music. Shorthand curlyques. Nightmares. He awakens still dead tired. He staggers to the breakfast table and puts his egg in his coffee cup. Ah, he miserably thinks, I may go crazy yet.

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11 Clara Savage Littledale, "Do You Believe in Homework?" Parents' Magazine, Vol. 11 (1936), No. 1, p. 14.

If there is a pleasanter side to this, let it be presented, but this student will always feel resentful toward home work. Teachers, have mercy!"[12]

→ An experiment with two classes in algebra in the University of Chicago High School by E.R. Breslich seemed to produce the following results: Section A which was assigned the usual home work but with no previous supervised study responded to a test with an average mark of 62.8, while Section B which had been taught how to study but given no home work averaged 65.5. (In the final examinations of the preceding semester the average grades of the sections were A, 81.5 and B, 79.4.) The following chapter in the algebra was covered in six lessons. For these lessons Section A worked under supervision, and Section B did home work. In the following test the average grade of the A's was 77.5 and the B's, 86.4. According to the investigator the power obtained by Section B in the preceding chapter, while working under supervision persisted and was strong enough to be helpful in the following chapter. Possibly this was the case, but the marks achieved in the second test seem to argue for home study or at least for well directed home study.[13]

M. A. Steiner of Ingram, Pennsylvania has made a study to find the effect of home-study assignments upon the standard test scores of seventh grade pupils in arithmetic and English. A class of thirty-nine pupils just entering the seventh grade of a four-year junior high school was used in this research. The experiment extended over

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12 This pupil writer is a prominent member of the orchestra and comes from a family greatly interested in music.

13 J.F. Rogers, op. cit., p. 810

the first semester of 1933-34, a period of eighteen weeks. Since a similar investigation made two years before in the same school had been limited to arithmetic and resulted in no appreciable difference, the two subjects were included in this study.

The seventh grade class in each case was divided into two equivalent groups on the basis of mental ability and achievement tests. One half of the class was given daily assignments in English and the other group had assignments in arithmetic. The same class instruction was given in each class. All home study assignments were corrected by the teacher and returned the following day for correction. The nature of the experiment was explained to the pupils and their cooperation requested. The assignments included no new material.

An analysis of the semester failures in arithmetic shows that five pupils of the home work group failed and only two of the no home work group. Five of the seven English failures belonged to the home work group. It would seem that home study assignments in neither arithmetic nor English had any effect upon a pupil's ability to pass the semester's work in either subject. The regular classroom instruction was the deciding factor in this as well as the improvement of pupils as measured by the objective tests. In this experiment the full value of home study assignments was probably not revealed because the pupils did not have the benefit of a free classroom discussion of the work done at home but had to depend upon such comments as might be written by the teacher in marking their papers.[14]

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14 M.A. Steiner, "Value of Home Study Assignments", School and Society, Vol. 40 (1934), No. 1019, pp. 21-24

In the Bulletin of High Points in the Work of the High Schools of New York City a summary is given concerning questionnaires returned by pupils of the senior class of the Manuel Training High School in regard to home study. It states that objection may be raised to this questionnaire and the findings therefrom on the ground that the questions called for mere personal opinions and estimates which are necessarily approximate at best and even erroneous, occasionally. While this is readily admitted, the writer, Harry Eisner of the Department of Mathematics, contends that the point of view of the pupils is important as the initial step in a scientific study of home work in high schools.

A second step in this project was a questionnaire submitted to the teachers to get their attitude toward the effectiveness of home work as an aid to instruction. Mr. Eisner believes that to supplement this second phase of the inquiry there should be instituted a series of scientific experiments to ascertain the optimum amount, content, and other pertinent attributes of home work in the various secondary school subjects. He says,

> "This presents a large field for research in which little has thus far been accomplished. When such experiments have been performed by qualified teachers throughout the school system and the results made available for study, we shall then be well on the road to a solution of the whole vexing problem."[15]

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15 Education Faculty of Chicago University, "Educational News and Editorial Comment-'Home Study'", The School Review, Vol. 36 (1930), No. 3, p. 175

CHAPTER II

PRESENTATION AND ANALYSIS OF DATA

All pupils who entered the five algebra classes in the Bartlesville Junior-Senior High School in the fall of 1938 were given Form A of the Otis Self-Administering Tests of Mental Ability the first week of school. On the basis of the results of this test, the grades made in arithmetic the previous year, and the class in school, it was possible to make eighty pairs from the one-hundred ninety-three pupils enrolled. This number was reduced to seventy-seven by withdrawals so that the conclusions of this experiment have been based on that number. The writer was the teacher of all of these pupils.

Table I shows the IQ's of the pupils by pairs with the average for Group 1 being 110.7 and for Group 2, 110.5. The coefficient of correlation, which shall be designated as r hereafter in this paper, was found to be almost 1. It is practically certain then that on the basis of IQ's the groups were well equated.

Table II shows that there were seventeen pairs of pupils with the same IQ's, thirty pairs with a difference of one point, fourteen pairs with a difference of two points, thirteen pairs with a difference of three points, and three pairs with a difference of four points.

The pupils' average grades in arithmetic the previous year were considered so that a pupil with an IQ of 106 and a grade of C- would not be paired with a pupil of the same IQ but with a grade of A. This in a small degree helped to indicate differences in application, interest, study habits, attendance, health, and other influences on

TABLE I

IQ'S OF PAIRS OF ALGEBRA PUPILS USED IN THE STUDY

Pairs	Group 1	Group 2	Pairs	Group 1	Group 2
1	117	119	40	109	106
2	109	110	41	117	114
3	112	111	42	118	121
4	109	111	43	109	106
5	113	116	44	124	124
6	113	111	45	121	120
7	116	117	46	120	120
8	111	111	47	120	121
9	90	89	48	120	121
10	99	96	49	120	119
11	106	109	50	118	118
12	114	114	51	104	103
13	114	115	52	104	105
14	114	114	53	105	105
15	113	111	54	105	105
16	115	115	55	106	105
17	114	113	56	122	124
18	115	115	57	119	118
19	117	117	58	99	96
20	90	86	59	96	94
21	104	107	60	97	96
22	110	109	61	98	96
23	113	113	62	106	102
24	106	109	63	101	103
25	106	104	64	102	106
26	118	118	65	107	108
27	115	112	66	119	119
28	117	117	67	104	106
29	119	119	68	115	112
30	110	109	69	128	129
31	118	116	70	90	89
32	114	115	71	115	116
33	113	112	72	121	118
34	114	113	73	106	104
35	112	110	74	116	115
36	112	112	75	114	115
37	107	108	76	115	116
38	108	109	77	96	98
39	106	107			
			Total	8529	8512
			Average	110.7	110.5

$r = 1-$

TABLE II

DIFFERENCES IN IQ'S BY PAIRS

Difference	Frequencies
0	17
1	30
2	14
3	13
4	3

Arithmetic Mean = 1.4

Standard Deviation = 1.27

school achievements. Most of these ninth grade algebra pupils had been taught in the eighth grade by two different teachers in our own school the previous year and all of them had been given the same tests so that as far as is possible with two different teachers the grades were a fairly reliable index. About six per cent of the remainder of the ninth grade pupils were new, most of them coming from rural schools. As far as was possible they were paired with each other. All of the tenth grade pupils included in the experiment were taught the previous year by one teacher in composite mathematics classes. The grades of the two groups are shown by pairs in Table III. Assigning to the grade of A the value of five points, to B, four points, to C, three points, and to D, two points, the average grade was between 3.75 and 4.00 which was interpreted as a B- average for each group.

Ninth grade pupils were paired with ninth grade pupils and tenth grade pupils with tenth grade pupils. As far as possible, pairs were formed with like sexes. Twenty-one of the ninth grade pairs were male, sixteen were female, and eighteen were pairs made with opposite sexes. Eight of the tenth grade pairs were male, three female and eight pairs of opposite sexes. One pair was made with boys from the eleventh grade who were taking algebra for the first time. All repeating algebra pupils were excluded from this study. In order to have as many pairs as possible two pairs were made with girls in the ninth grade paired with girls in the tenth grade. Figure 1 represents graphically the total number of pairs of like sexes in comparison with those of opposite sexes.

Chronological age was not a factor in the pairing of the pupils for this study but the ages are shown in months by pairs in

TABLE III

AVERAGE GRADES RECEIVED IN ARITHMETIC
FOR THE PREVIOUS YEAR

Pairs	Group 1	Group 2	Pairs	Group 1	Group 2
1	B-	C/	40	D	D
2	A	A	41	B-	B
3	C	C	42	B	B
4	A	B	43	B	B
5	C	C	44	A-	A
6	C	C	45	B-	B-
7	A	A	46	A-	A
8	A	A-	47	A	A
9	C	C	48	B	B
10	B	C	49	B	B
11	C	C	50	B	B-
12	B	B	51	B	C
13	C	C	52	B-	B
14	B	B	53	C	C
15	C	C	54	C	B
16	B	B	55	A	A
17	B	B	56	A-	A-
18	B	B	57	B	B
19	B	B	58	C	C/
20	D	D	59	C	C
21	C	C	60	D	D
22	B	B	61	C	C
23	C	C	62	C	C/
24	B	B	63	C	C-
25	B	B	64	C	C
26	B	B	65	C	B-
27	B	B	66	B	A
28	C-	D	67	C/	C
29	B-	A-	68	A	B
30	B-	C	69	B	A
31	C	C	70	C	B-
32	A-	A	71	B	A-
33	B	B	72	B	B
34	B	B	73	B-	B-
35	B	C	74	B	B
36	B	B	75	C	C
37	B/	A	76	B	A-
38	B	B	77	B	B
39	C	C-			

Average - Group 1 B-

Average - Group 2 B-

Number of Pairs
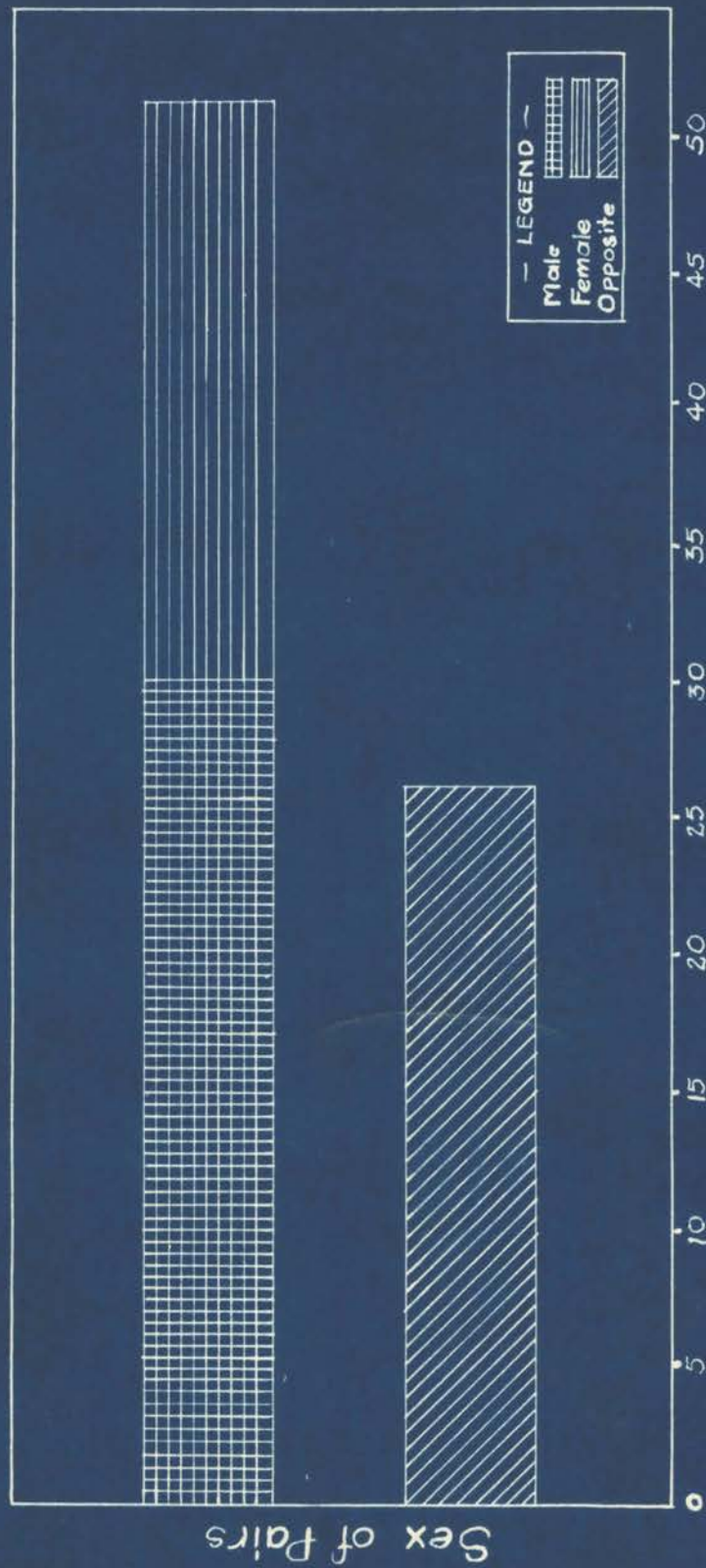
Figure 1

Sexes of Pairs of Pupils Used in the Study

Table IV so that achievement in individual cases might be studied.
It is interesting to note that the average age for Group 1 is 173.52
months and for Group 2 is 172.65 months, or a difference of only .87
month. It might be mentioned here that for the most part average
pupils and others who have made low grades in eighth grade arithmetic
are urged to take ninth grade arithmetic in preference to algebra to
satisfy the requirement for graduation. If they insist on taking
algebra they may do so in the tenth grade.

Pupils of the second and fifth period classes were used for
Group 2 and these classes were filled to capacity making forty pupils
in each class. Each of these eighty pupils was paired with some one
in one of the other three classes and these are referred to as Group 1
in the study. Left over pupils not included in the study were also
in one of these three classes. It was necessary to make several
changes in schedules during the second week of school but in this
the principals willingly cooperated and helped the writer in every
way possible.

The mathematics club which the writer had sponsored for eight
years was dropped for the period of the study in order that algebraic
achievement would not be influenced outside of the regular class in
any controllable way except by assigned home work. This extra time
given the writer after three o'clock, was used to help pupils who
had been absent to make up the work so that absences were not con-
sidered important in the results of this study, especially when they
occured early in the unit. Pupils were not informed concerning the
experiment. A normal setting was desired.

TABLE IV

CHRONOLOGICAL AGES IN MONTHS BY PAIRS

Pairs	Group 1	Group 2	Pairs	Group 1	Group 2
1	177	176	40	172	183
2	180	183	41	176	168
3	171	164	42	167	166
4	181	169	43	172	169
5	169	164	44	164	167
6	168	168	45	160	168
7	182	176	46	170	177
8	176	173	47	166	169
9	184	185	48	165	157
10	167	170	49	171	176
11	169	163	50	170	167
12	167	157	51	176	165
13	185	182	52	169	175
14	173	187	53	185	177
15	174	164	54	165	175
16	154	169	55	167	159
17	170	176	56	170	160
18	173	169	57	166	176
19	170	167	58	186	163
20	192	211	59	191	171
21	180	186	60	191	189
22	199	203	61	182	178
23	170	172	62	177	180
24	181	183	63	175	171
25	179	177	64	182	179
26	159	166	65	167	165
27	167	176	66	168	176
28	164	175	67	171	170
29	173	167	68	165	181
30	173	167	69	162	159
31	169	164	70	178	169
32	172	166	71	184	173
33	174	174	72	167	172
34	169	174	73	176	174
35	173	168	74	169	169
36	166	175	75	165	166
37	175	176	76	170	173
38	176	168	77	187	178
39	187	178			

Average - Group 1   173.52

Average - Group 2   172.65

The term "home work" is used here to mean preparation outside of the regular classroom, and without teacher supervision. In a few cases the assignment was prepared in a study hall period but most of the pupils needed to do their work at home as their daily program included a full schedule of classes. Throughout the paper the word "assigned" is to be understood when home work is mentioned. Some pupils do home work whether assigned or not. This study was for the purpose of determining whether regularly assigned home work makes a difference in the achievements of pupils when compared with pupils to whom no work was assigned but on whom no restrictions were placed.

The assignments were of the nature of a finishing-up process to complete what had been started in class and, to drill on operations already understood. No new work was included in the assignments. This study was carried on according to the purpose of home work as given in The Teaching of Mathematics by J. W. A. Young.

> The purpose of home work is (1) to drill on operations whose theory is understood, (2) to impress on the memory those few things which need to be memorized, (3) to inculcate neatness and, (4) to give opportunity for quiet thinking.[1]

> The most effective home work is that which has the character of completing the class work of the previous day, not of preparing for the next. It is not advisable to assign work unless it has been sufficiently developed in the class to enable even the dull pupils to apply their time with success and profit. The pupil should never be set to struggle with new matter except under supervision of the teacher.[2]

The course of study divides the text of first year algebra

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1 J. W. A. Young, The Teaching of Mathematics, p. 132

2 Ibid.

into eleven units. The plan of this experiment was to treat all pupils in the two groups alike on the first unit in the matter of home work. Written assignments were made when it seemed necessary to fix a certain skill, but often no work was assigned especially over a week end. On the second unit Group 1 was given no home work at any time but Group 2 had home work regularly. After the groups were treated alike on the third unit, Group 1 was given regularly assigned home work on the fourth unit while Group 2 had none. On the fifth unit the groups were treated the same again, then Group 2 had home work on unit six. This plan was followed throughout the year, making six units on which the groups were treated differently in the matter of home work. These are called the "experimental units".

The periods between the experimental units where like treatment was given were to equate the groups again if any difference had been brought about by the home work factor. All home work assignments consisted of a certain number of exercises or problems to write and be handed in the following day. The assignments were such that on the average forty-five minutes would be ample time for the average pupil to prepare. Pupils soon learned that when work was assigned the paper must be prepared if they were to escape an hour study hall which the writer conducted after school but in which no assistance was given except to pupils who had been absent. Very seldom was it necessary to keep pupils after school except on the first day assignments had been given following a unit free from home work. It seemed to be necessary to establish the habit again. Closer attention in class was noticed by the writer when papers had

to be written outside.

The class period, approximately one hour in length, was conducted in the same manner for all pupils. Explanations, discussions, blackboard practice, workbook drills, tests, reviews, methods of study, etc., filled the hour so that it was necessary to prepare the assignments outside of class. In classes not given home work, the class was dismissed by saying, "We shall continue with this kind of work tomorrow," or "We shall begin a new unit the next hour". Occasionally, an ambitious pupil would hand in some exercises when no assignment had been made. These were always accepted by the writer but with no words of praise as might have been given under different circumstances. Generally, it was easy to believe that not many had thought about the work since leaving the class the previous day. When sent to the blackboard on the following day, the group which had prepared home work responded more quickly and readily and solved the problems in less time. The non home-work group floundered around and needed more time to remember how they were told to solve the problems in the previous class hour. Home-work classes were allowed to ask questions concerning any problem in the assignment with which they had trouble. These same problems were made a topic of discussion in the non home-work classes.

Table V shows the results of Test 1 after the two groups had been treated alike on the unit, "Positive and Negative Numbers" for a period of fourteen days with an attendance of 1,051 days for Group 1 and 1,055 days for Group 2. The range of scores for Group 1 was from 22 to 121 and for Group 2 was 26 to 123 from a possible

TABLE V

RESULTS OF TEST 1 AFTER LIKE TREATMENT OF GROUPS
UNIT: POSITIVE AND NEGATIVE NUMBERS

Scores	Frequencies	
	Group 1	Group 2
123 - 129	0	1
116 - 122	4	6
109 - 115	7	5
102 - 108	8	7
95 - 101	10	9
88 - 94	6	8
81 - 87	10	6
74 - 80	6	9
67 - 73	5	7
60 - 66	8	4
53 - 59	8	6
46 - 52	1	6
39 - 45	1	1
32 - 38	1	1
25 - 31	1	1
18 - 24	1	0

Mean 83.16   Mean 83.44

$r = .55$

$$\frac{\text{diff. sv.}}{\sigma_{\text{diff.}}} = .12\,\sigma$$

125 points. The mean for Group 1 was 83.16 and for Group 2 was 83.44, showing only .28 of a point difference. The standard error of the mean for Group 1 is 2.58 and for Group 2 is 2.63, showing that the true mean for Group 1 would be almost certain to be between the limits of 75.42 and 90.90, and Group 2 would be between 75.55 and 91.33. The difference in sigmas between the two means being .12 shows only about five per cent better than guess that Group 2 would exceed Group 1 on the same or similar tests at other times. According to agreement among workers with tests the r of .55 shows a substantial or marked relationship.

Table VI shows the results of Test 2 after Group 2 had assigned home work on the unit, "Adding and Subtracting Polynomials". The unit required a period of twelve days. Group 1 attended 890 days and Group 2 attended 863 days. The range of test scores for the home-work group was from 38 to 95 and the non home-work group was from 35 to 95. The mean for the home-work group was from 78.50 and for the non home-work group was 77.10 showing a difference of 1.40. The highest possible score on this test was 95 points. The difference in sigmas is .93 showing that in about 82% of the cases the home-work group would surpass the non home-work group. The r is .62. This degree of marked relationship between the achievements of the groups may be explained by the fact that algebra was a new subject, enthusiasm was great, interest was keen, and pupils did home work whether required to do it or not.

In explanation to pupils as to why some of the classes were given written work to hand in and others not, the writer mentioned

TABLE VI

RESULTS OF TEST 2 AFTER GROUP 2 HAD HOME WORK
UNIT: ADDING AND SUBTRACTING POLYNOMIALS

| Scores | Frequencies | |
	Group 1	Group 2
93 - 97	10	10
88 - 92	14	14
83 - 87	10	17
78 - 82	9	9
73 - 77	11	7
68 - 72	8	4
63 - 67	2	5
58 - 62	4	1
53 - 57	2	2
48 - 52	2	3
43 - 47	1	2
38 - 42	1	3
33 - 37	3	0
28 - 32	0	0

Mean 77.10   Mean 78.50

$r = .62$

$$\frac{\text{diff. av.}}{\sigma \text{ diff.}} = .93\,\sigma$$

that it was impossible to check so many papers thoroughly every day so classes would take turns in preparing papers. The experiment being in its infancy the writer made the possible mistake of telling the non home-work classes what assignment had been made to the other classes whose turn it was to hand in work. Often when the class was asked if there were a particular exercise which they would like to see solved on the board, the same one was asked for in the non home-work classes as in the home-work classes, showing that the same exercises had been tried outside of class. Also, the writer not being used to scientific methods of research, and being a conscientious teacher, found herself trying to make up to the non home-work group for what she thought that they might have lost by no assignment by crowding in a little more drill at the blackboard in class.

As the school year continued and the newness of algebra wore off, and pupils became engaged in the many activities which a school has from Christmas to the end of the year, the desire to work on algebra outside of class when not required to do so seemed to be lessened. Pupils were never told that they should not work on algebra outside of class unless a regular assignment were made as was the case in Mr. Steiner's experiment in English and Arithmetic.[3] The writer did not wish to have an artificial set-up but preferred the pupils to react in a normal situation.

The difference in sigmas between the two means of Test 2 is .93 which shows that in 82 out of 100 cases the average of the home-work

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3 M. A. Steiner, op. cit., p. 21

group would exceed the non home-work group average. Table VI indicates that the factor of home work has had but little influence upon the relative achievements of the two groups; however, what does exist is in favor of the home-work group.

Table VII shows the results of Test 3, containing 115 possible points, after like treatment of the groups on the twenty-day unit, "Multiplication and Division". Attendance for Group 1 was 1,499 days and for Group 2 was 1,484 days. The range of scores for Group 1 was from 25 to 112 and for Group 2 was from 38 to 112. The mean for Group 1 was 77.65 and for Group 2 was 78.20, showing a small difference again in favor of Group 2 on like treatment but not so great as was indicated in Test 2 when this same group was doing home work. The r of .68 indicates a marked relationship. It is about sixteen times its probable error. The .3 sigma difference between the means shows that in 62% of the cases Group 2 would exceed Group 1 which is only about 12% better than guess.

Table VIII shows the results of Test 4 after Group 1 had assigned home work on the eighteen-day unit, "Factoring". Group 1 attended 1,349 days and Group 2 attended 1,345 days. The range of scores for the home-work group was from 55 to 142, and for the non home-work group from 40 to 141, with a possible maximum score of 144. The mean for the home-work group was 104.72 and for the non home-work group was 100.17, making a difference of 4.55 points in favor of the home-work group. The r of .39 shows a low correlation. It is only about six times its probable error. The difference of 1.74 sigmas between the means of the groups indicates that in about 96% of the

TABLE VII

RESULTS OF TEST 3 AFTER LIKE TREATMENT OF GROUPS
UNIT: MULTIPLICATION AND DIVISION

Scores	Frequencies	
	Group 1	Group 2
108 - 112	3	3
103 - 107	7	7
98 - 102	8	7
93 - 97	6	4
88 - 92	4	7
83 - 87	7	6
78 - 82	6	7
73 - 77	3	4
68 - 72	9	7
63 - 67	4	5
58 - 62	7	5
53 - 57	3	9
48 - 52	4	2
43 - 47	1	1
38 - 42	0	3
33 - 37	4	0
28 - 32	0	0
23 - 27	1	0

Mean 77.65   Mean 78.20

$$r = .68$$

$$\frac{\text{diff. av.}}{\sigma_{\text{diff.}}} = .30 \ \sigma$$

TABLE VIII

RESULTS OF TEST 4 AFTER GROUP 1 HAD HOME WORK
UNIT: FACTORING

Scores	Frequencies	
	Group 1	Group 2
137 - 143	1	2
130 - 136	5	5
123 - 129	10	8
116 - 122	9	4
109 - 115	8	11
102 - 108	19	12
95 - 101	1	10
88 - 94	9	5
81 - 87	4	4
74 - 80	4	4
67 - 73	6	3
60 - 66	0	5
53 - 59	1	1
46 - 52	0	1
39 - 45	0	2

Mean 104.72   Mean 100.17

$$r = .39$$

$$\frac{\text{diff. av.}}{\sigma_{\text{diff.}}} = 1.74 \ \sigma$$

cases the home-work group would surpass the non home-work group.
Apparently as a result of the home-work factor Group 1 made a
definite improvement. This is particularly significant in that this
is the first time that home work has been assigned to Group 1, and is
also the first time that Group 1 has surpassed Group 2 when tested.

Table IX shows the results of Test 5 after like treatment of
the groups on a twenty-day unit on "Fractions". Attendance for
Group 1 was 1,505 days and for Group 2 was 1,481 days. The range
of scores for Group 1 was from 15 to 72 and for Group 2 from 9 to
78, with the mean for Group 1 being 48.70 and for Group 2 being
46.55 from a maximum possible 78 points. It will be noticed that on
the first two tests after like treatment of the groups that Group 2
showed the higher means by a small margin. In this and the next test
after like treatment, Group 1 shows a higher mean. The $\underline{r}$ of .41
shows a substantial relationship though not as high a degree as was
shown after Tests 1 and 3 after like treatment of the groups. The
sigma difference between the means, 1.07, shows that in about 86%
of the cases Group 1 would be above Group 2.

Table X gives the results of Test 6 after Group 2 had assigned
home work on a seven-day unit, "Trigonometry". Group 1 had an
attendance of 526 days and Group 2 of 519 days. The range of scores
for the non home-work group was from 25 to 108 and of the home-work
group from 25 to 108 with a maximum of 108 possible points. The
mean for the non home-work group was 79.00 and for the home-work
group was 81.70. Again a difference of a few points was shown in
favor of the home-work group. The $\underline{r}$ of .25 shows a negligible or

TABLE IX

RESULTS OF TEST 5 AFTER LIKE TREATMENT OF GROUPS
UNIT: FRACTIONS

| Scores | Frequencies | |
	Group 1	Group 2
74 - 80	0	1
73 - 77	0	2
68 - 72	11	8
63 - 67	10	7
58 - 62	4	7
53 - 57	8	6
48 - 52	10	9
43 - 47	4	2
38 - 42	8	7
33 - 37	12	9
28 - 32	3	5
23 - 27	4	8
18 - 22	0	4
13 - 17	2	1
8 - 12	1	1

Mean 48.70   Mean 46.55

$r = .41$

$$\frac{\text{diff. av.}}{\sigma_{\text{diff.}}} = 1.07 \, \sigma$$

TABLE X

RESULTS OF TEST 6 AFTER GROUP 2 HAD HOME WORK
UNIT: TRIGONOMETRY

Scores	Frequencies	
	Group 1	Group 2
108 - 112	1	3
103 - 107	4	3
98 - 102	7	4
93 - 97	8	11
88 - 92	7	7
83 - 87	11	16
78 - 82	9	7
73 - 77	5	10
68 - 72	7	1
63 - 67	4	4
58 - 62	3	6
53 - 57	1	2
48 - 52	5	0
43 - 47	3	1
38 - 42	0	0
33 - 37	1	0
28 - 32	0	1
23 - 27	1	1

Mean 79.00   Mean 81.70

$$r = .25$$

$$\frac{\text{diff. av.}}{\sigma \text{ diff.}} = 1.10 \, \sigma$$

low degree of correlation. It is only three times its probable error. 1.10 sigmas difference between the means shows that in about 86% of the cases the home-work group would surpass the non home-work group. This may be extra significant in that in the unit just prior to this one, where both were treated alike, Group 1 surpassed Group 2.

Table XI gives the results of Test 7 after another like treatment of the groups on a thirteen-day unit, "Graphs". Group 1 attended 968 days and Group 2 attended 943 days. The range of scores for Group 1 was from 38 to 98 and for Group 2 was from 30 to 100 with the means being 72.60 and 71.50, respectively. The maximum possible score was 100 points. The r of .40 is about the same as that for Test 5 after like treatment of the groups. A difference of .54 sigma between the means of the two groups indicates that in 71% of the cases the mean of Group 2 would not exceed that of Group 1, or the mean of Group 1 would not fall below that of Group 2. This is not half way between a guess and complete reliability. Up to this time Group 1 has exceeded Group 2 twice in the mean score, and Group 2 has exceeded Group 1 twice in the like treatment tests.

Table XII shows the results of Test 8 after Group 1 had assigned home work on an eleven-day unit, "Equations in Two Unknowns". Group 1 attended 834 days and Group 2 attended 830 days. The range in scores for the home-work group was from 20 to 102 and for the non home-work group from 11 to 104. The mean for the former group was 74.65 and for the latter group 69.35. The

TABLE XI

RESULTS OF TEST 7 AFTER LIKE TREATMENT OF GROUPS
UNIT: GRAPHS

Scores	Frequencies	
	Group 1	Group 2
98 - 102	2	2
93 - 97	5	5
88 - 92	9	8
83 - 87	9	7
78 - 82	10	9
73 - 77	8	6
68 - 72	9	11
63 - 67	2	7
58 - 62	4	6
53 - 57	6	6
48 - 52	8	4
43 - 47	2	3
38 - 42	3	0
33 - 37	0	1
28 - 32	0	2

Mean 72.60   Mean 71.50

$$r = .40$$

$$\frac{\text{diff. av.}}{\sigma \text{ diff.}} = .54 \ \sigma$$

TABLE XII

RESULTS OF TEST 8 AFTER GROUP 1 HAD HOME WORK
UNIT: EQUATIONS IN TWO UNKNOWNS

Scores	Frequencies	
	Group 1	Group 2
103 - 107	0	1
98 - 102	4	2
93 - 97	1	4
88 - 92	13	4
83 - 87	10	10
78 - 82	10	9
73 - 77	7	8
68 - 72	12	8
63 - 67	9	6
58 - 62	3	8
53 - 57	1	3
48 - 52	2	3
43 - 47	0	4
38 - 42	0	2
33 - 37	2	1
28 - 32	2	1
23 - 27	0	1
18 - 20	1	1
13 - 17	0	0
8 - 12	0	1

Mean 74.65   Mean 69.35

$$r = .28$$

$$\frac{\text{diff. av.}}{\sigma \text{ diff.}} = 2.18 \ \sigma$$

difference of 5.30 points was again in favor of the home-work group.
The r of .28 is about four times its probable error and again
indicates very low correlation. The sigma difference between the
means is 2.18 showing that it is quite probable (98$\frac{1}{2}$ chances in 100)
that the non home-work group would not exceed the home-work group
in achievement on a similar test. This is the nearest approach to
absolute certainty in any test thus far.

At this point in the study after each group had had the same
number of units of assigned home work and the same number of units
of no assigned home work, as well as the same number of units of like
treatment, the writer thought that it might be well to give a stand-
ardized algebra test to see whether the two groups were equal.
Accordingly, Form 1 B of the Columbia Research Bureau Algebra Test
was given to all pupils included in the study. This test has two
parts requiring forty minutes for each part. There are thirty-nine
possible points to be made on the "Mechanics" of Part 1 and twenty-
four possible points on the "Problems" in Part 2. Figure 2 shows
the number of pupils in each group making each score from 17 to 39
on the mechanics of Part 1. The mean score for Group 1 is 29.28 and
for Group 2 is 29.99. Figure 3 shows the frequencies of each score
from 4 to 24 for the groups on the verbal problems of Part 2. The
mean for Group 1 is 15.9 and for Group 2 is 16.7. From the total of
69 points were found the means 45.18 and 46.69 for Groups 1 and 2,
respectively. Figure 4 is a frequency distribution and histograms
of the total scores for Groups 1 and 2 on the Columbia Research Test.
Again the r of .61 shows a marked relationship. The reliability
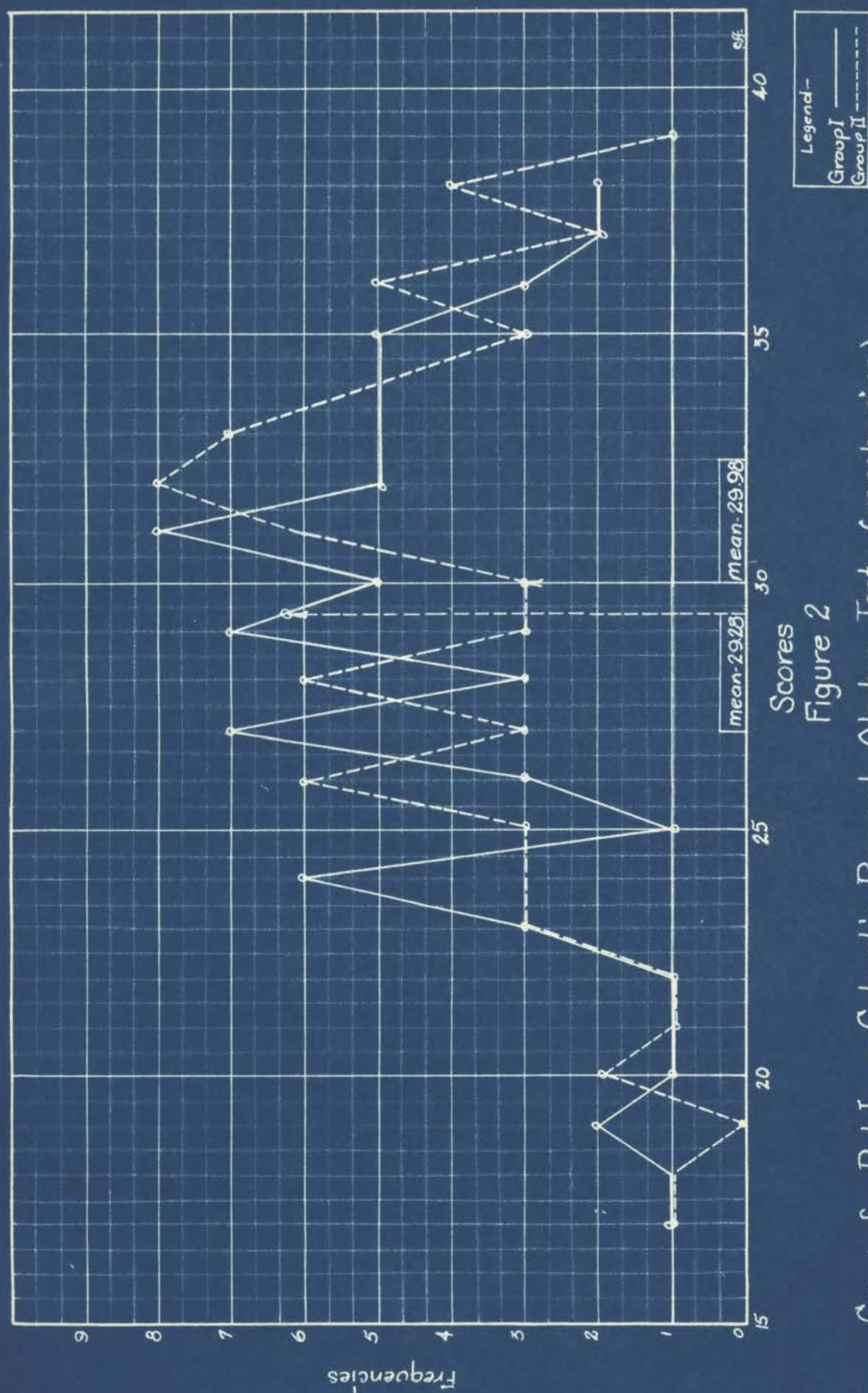
Curves for Part I – Columbia Research Algebra Test (mechanics)
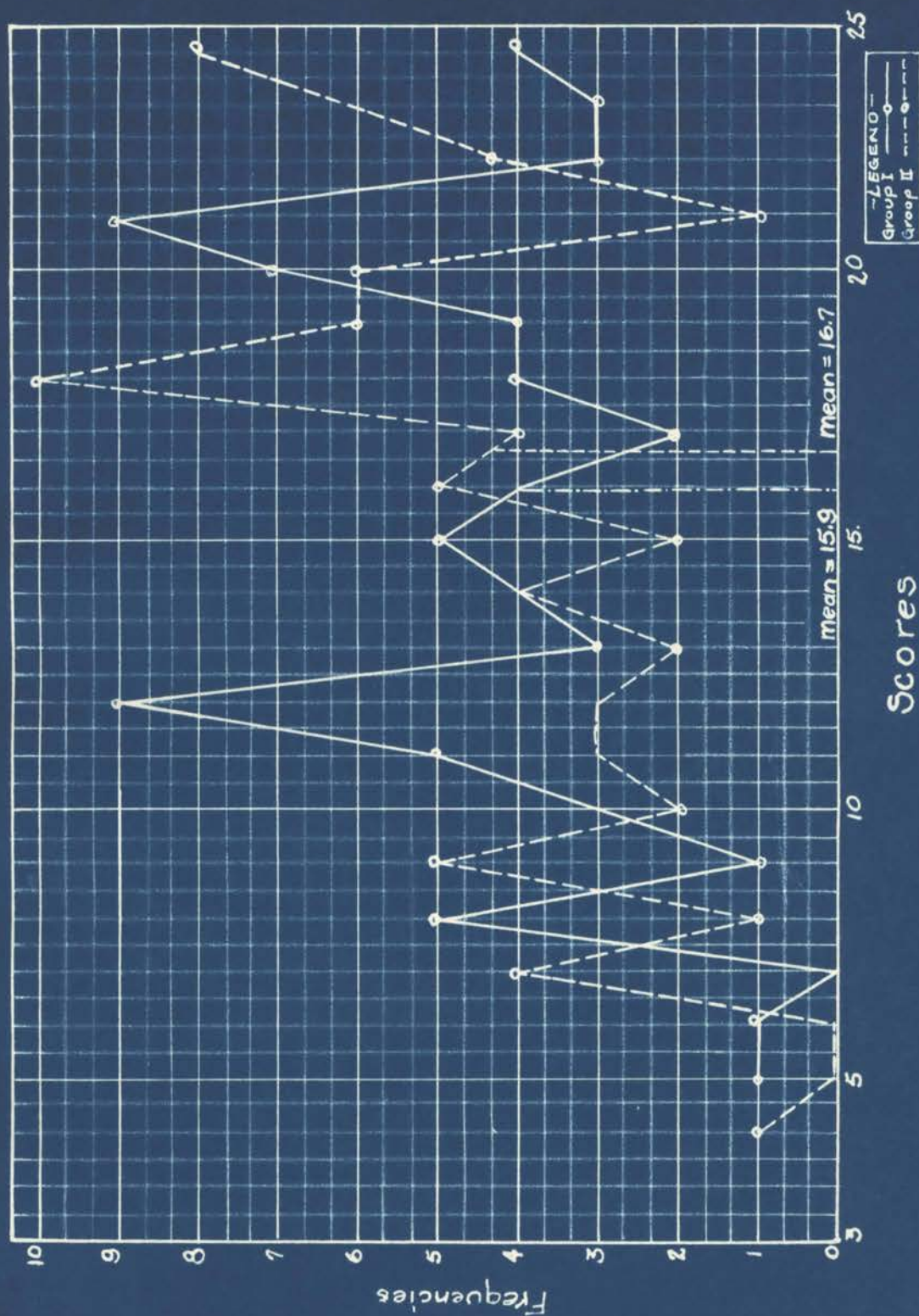
Scores
Figure 2

Curves for Part II – Columbia Research Bureau – Algebra Test (Verbal Problems)
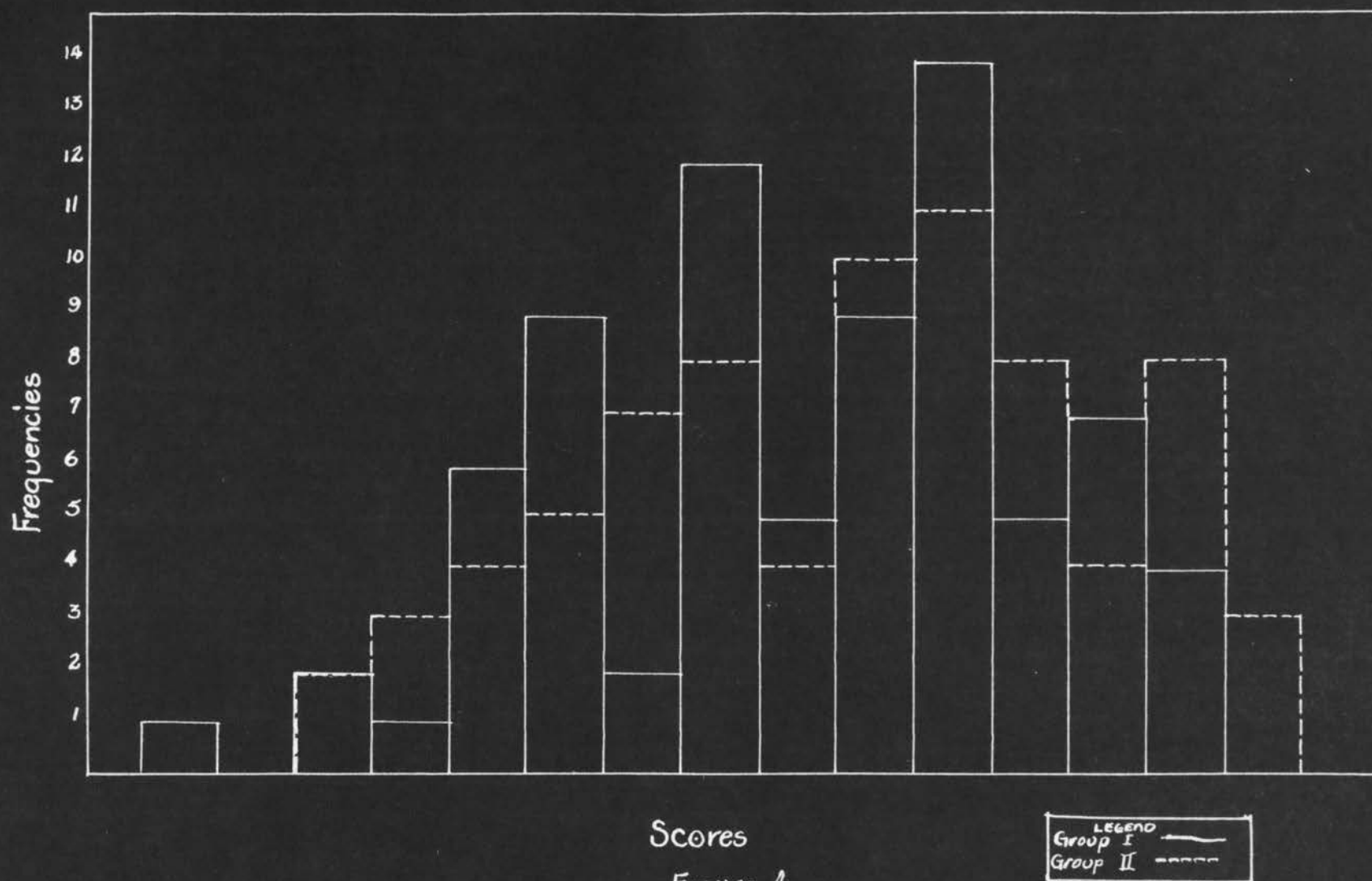
Figure 4

Frequency Distribution and Histogram of Scores for Group I and II on the
Columbia Research Bureau Algebra Test

coefficient between the two forms of the Columbia Research Test is is given as .87.

The writer checked the reliability of her test of one hundred points given after like treatment of the groups on the unit of graphs by checking the correctly answered even numbered questions against the odd numbered ones. The scatter diagram in Figure 5 shows the distribution of scores for this test. Below the diagram is the solution of r which was found to be .91. Table XI above gave the mean for Group 1 to be 1.10 points higher than for Group 2, while the standardized test gave a difference in the means of 1.51 in favor of Group 2. The writer feels that the two groups were as nearly equated as the factors considered would permit.

Table XIII shows the results of Test 9 after like treatment of the groups on the five-day unit of verbal problems. Each group attended 370 days. The range of scores for Group 1 was 17 to 104 and for Group 2 from 18 to 104 out of a possible score of 104. The mean for the former was 55.07 and for the latter was 58.30. The r of .75 shows a high degree of relationship. This was the only test during the year that was wholly thought problems.

Table XIV shows the results of Test 10 after Group 2 had assigned home work on the nine-day unit, "Square Roots and Radicals". Group 1 attended 665 days and Group 2 attended 673 days. The range in scores for the non home-work group was 47 to 181 and for the home work group from 61 to 178 out of a possible score of 181. The mean for the non home-work group was 126 and for the home work group was 145.5 with a difference of 19.5 points in favor of the home work group. The r of .43 shows a substantial relationship but the sigma

odd / even	12	15	18	21	24	27	30	33	36	39	42	45	48	51
51										1		1	1	2
48										4	1	1	7	
45				1				1	2	2	3	3	4	
42							1	3	2	8	4	4	4	1
39									4	3	5	4	1	1
36					1	3		5	6	2				
33					2	1		5	3	5			2	
30			1	3	3	2		1	2					
27			1	3	2	6	2	1						
24	1			1	1	2		3						
21		1			3									
18				1	1									
15		1	1											

N = 158

Figure 5

Even (y) ———— Reliability of Test 7 ———— Odd (x)

Even (y)	Odd (x)
$C = -.8$	$C = .06$
$C^2 = .64$	$C^2 = .004$
$C = 3 \times (-8) = -2.4$	$C = .18$
Av. = 36.6	Av = 36.2
$\sigma = 2.75$	$\sigma = 2.81$

$$\Sigma xy = 1006$$

$$r = \frac{\frac{1006}{158} - (-.8)(.06)}{(2.75)(2.81)} = .83$$

for half of test

$$r = \frac{(2)(.83)}{1 + (2-1) \cdot (.83)} = .91$$

for complete test

TABLE XIII

RESULTS OF TEST 9 AFTER LIKE TREATMENT OF GROUPS
UNIT: VERBAL PROBLEMS

Scores	Frequencies	
	Group 1	Group 2
103 - 107	2	1
98 - 102	2	6
93 - 97	2	2
88 - 92	3	1
83 - 87	4	5
78 - 82	1	4
73 - 77	2	5
68 - 72	6	3
63 - 67	9	6
58 - 62	5	2
53 - 57	4	10
48 - 52	9	4
43 - 47	3	2
38 - 42	1	7
33 - 37	6	7
28 - 32	6	3
23 - 27	5	6
18 - 20	6	3
13 - 17	1	0

Mean 55.07   Mean 58.30

$$r = .75$$

$$\frac{\text{diff. av.}}{\sigma_{\text{diff.}}} = 1.70 \ \sigma$$

TABLE XIV

RESULTS OF TEST 10 AFTER GROUP 2 HAD HOME WORK
UNIT: SQUARE ROOTS AND RADICALS

| Scores | Frequencies | |
	Group 1	Group 2
179 - 185	1	0
172 - 178	2	6
165 - 171	9	11
158 - 164	6	8
151 - 157	13	7
144 - 150	1	6
137 - 143	5	5
130 - 136	1	5
123 - 129	4	4
116 - 122	5	5
109 - 115	5	6
102 - 108	2	4
95 - 101	5	4
88 - 94	3	0
81 - 87	3	1
74 - 80	4	2
67 - 73	4	1
60 - 66	3	2
53 - 59	0	0
46 - 52	1	0

Mean 126.0   Mean 145.5

$$r = .43$$

$$\frac{\text{diff. av.}}{\sigma \text{ diff.}} = 4.87 \ \sigma$$

difference between the means of 4.87 shows absolute certainty that the home-work group would surpass the non home-work group in the classes taught by the writer. This surpassing of Group 1 by Group 2 is significant in that in the previous experiment where Group 1 was assigned home work, the number of chances (98½%) in their favor was almost as great as are now in favor of Group 2.

Before the last experimental unit, a unit where like treatment was given the groups, was omitted in order to see whether any different results would be obtained when home work was assigned to one group. Table XV shows the results of Test 11 after Group 1 had assigned home work on the seven-day unit, "Quadratic Equations". Both groups had been treated alike on solving quadratic equations by the method of factoring several weeks previously when the chapter on factoring was completed. This later unit reviewed that method and included the two other methods--completing the square and by the formula. No assigned home work was given to Group 2 on these last two methods named but all three methods were included in the test at the end of the unit. Group 1 attended 519 days and Group 2 attended 517 days. The range of scores for the non home-work group was from 16 to 81 and for the home-work group from 24 to 81. The highest possible score was 81 points. The mean for the non home-work group was 52.20 and for the home-work group was 57.70. Again a noticeable difference of 5.50 is in favor of the home-work group (Group 1). On the previous unit Group 1 which did not have assigned home work was far surpassed by Group 2. The sigma difference of 2.86 is again absolute certainty that the group having home work would surpass the non home-work group but this difference is not as great as on the previous test where a difference of 4.87 sigmas

TABLE XV

RESULTS OF TEST 11 AFTER GROUP 1 HAD HOME WORK
UNIT: QUADRATIC EQUATIONS

Scores	Frequencies	
	Group 1	Group 2
78 - 82	3	3
73 - 77	12	6
68 - 72	12	8
63 - 67	6	5
58 - 62	10	5
53 - 57	9	11
48 - 52	4	9
43 - 47	4	7
38 - 42	9	9
33 - 37	2	4
28 - 32	3	7
23 - 27	3	2
18 - 20	0	0
13 - 17	0	1

Mean 47.70   Mean 52.20

$$r = .39$$

$$\frac{\text{diff. av.}}{\sigma_{\text{diff.}}} = 2.86 \ \sigma$$

was shown in favor of the home-work group. This might be explained by the fact that about 20% of this test was on the factoring method of solving quadratic equations and this method had been handled similarly in each group prior to this unit.

Table XVI gives a summary of the means for the two groups when turns were taken in the matter of assigned home work on the six experimental units scattered throughout the school year. Differences between the means of the groups ranged from 1.40 to 19.5 points, each time being in favor of the group having assigned home work.

Table XVII gives a summary of the means for the two groups when like treatment was given on five intermittent units. The range of differences is from .28 to 3.23 points, sometimes in favor of Group 1 and sometimes in favor of Group 2.

Table XVIII gives the standard differences between the means as measured on the base line. In each case the difference found for the experimental unit was greater than that found in the immediately preceding like treatment unit. It would seem that the home-work factor brought about this greater difference in the achievements of the groups. As the year continued there seemed to be an increasingly greater difference between the achievements of the groups as home work was assigned. This may have been due to the fact that the newness of the subject as well as the early fall school enthusiasm wore off until finally only the required home work was being done in algebra. Another cause might have been that easy material is given in the beginning of the course and this could be achieved without much additional class work but such difficult topics as

TABLE XVI

COMPARISON OF MEANS ON THE SIX EXPERIMENTAL UNITS
FOR GROUPS 1 AND 2

Test No.	Group 1 Mean	Group 2 Mean
1	No home work - 77.10	Home work - - - 78.50
2	Home work - - 104.72	No home work - 100.17
3	No home work - 79.00	Home work - • - 81.70
4	Home work - - 74.65	No home work - 69.35
5	No home work - 126.00	Home work - - 145.50
6	Home work - - 52.20	No home work - 57.70

TABLE XVII

COMPARISON OF MEANS ON THE FIVE INTERMITTENT UNITS
OF LIKE TREATMENT

Test No.	Group 1	Group 2
1	83.16	83.44
2	77.65	78.20
3	48.70	46.55
4	72.60	71.50
5	55.07	58.30

TABLE XVIII

SIGMA DIFFERENCES BETWEEN THE MEANS OF THE
GROUPS ON TESTS AFTER THE APPLICATION
OF HOME WORK AND AFTER
LIKE TREATMENT

Test Number	Experimental Units	Like Treatment
1	.93 σ	.12 σ
2	1.74 σ	.30 σ
3	1.10 σ	1.07 σ
4	2.18 σ	.54 σ
5	4.87 σ	1.70 σ
6	2.86 σ	

factoring, fractions, and quadratics coming later in the course need much more practice. Finally, the many activities of the school as well as outside activities later in the year claim a large per cent of the pupils' time so that less and less time is available for home work and if not required, it is likely not to be done.

Table XIX gives the average z scores of the seventy-seven pairs of pupils included in this study. The individual scores made on the tests following the six experimental units were changed to z scores for the purpose of studying individual cases. Each pupil's average position was found on the three unit tests on which he was not given home-work assignments, then again on the three unit tests on which he did have assignments. These figures are given in the first two columns and his net gain in the third column. Positive scores are those above the mean of his group and negative scores are those below the mean of his group. For example the first pupil in Group 1 made an average z score of .722 when he had no home work and .766 when he had home-work assignments. His net gain was .044 showing a higher position after the home-work units. Pupil No. 7 in Group 2 changed his position from -.247 to $\not{+}$.279 when he did home work. His net gain was .526. Pupil No. 56 in Group 2 was able to achieve a higher position when no home work was given. This was probably due to the fact that he is a conscientious pupil of high IQ and he studied whether he had assigned home work or not. He may not have really done any better work on the non home-work units but his relative position was improved because the mean of his group slipped down in the non home-work units.

TABLE XIX

AVERAGE Z SCORES OF THE PAIRS ON THE THREE TESTS FOLLOWING ASSIGNED HOME WORK AND THE THREE TESTS FOLLOWING NO ASSIGN- ED HOME WORK

Pairs	Group 1 H.W.	No H.W.	Net Gain	Group 2 H.W.	No H.W.	Net Gain
1	.766	.722	.044	.211	.624	-.413
2	-.381	.120	-.501	.312	.034	.346
3	-.294	-1.885	1.591	-1.611	.137	-1.748
4	.824	.970	-.146	.703	1.174	-.471
5	.049	-.094	.143	-.875	-.256	-.619
6	-.645	-1.775	1.130	-1.685	-1.205	-.480
7	1.020	.628	.392	.279	-.247	.526
8	.969	.631	.338	.284	.686	-.402
9	-.425	-1.033	.608	-.637	-.897	.260
10	.246	-.930	1.176	-1.002	.153	-1.155
11	.411	.382	.029	-.548	.211	-.759
12	.386	.686	-.300	-.116	-.365	.249
13	-.979	-.431	.548	-.815	-.025	-.790
14	.465	1.046	-.581	-.104	-.691	-.795
15	.814	.771	.043	.430	-1.171	1.601
16	-.172	-.184	.012	.311	.893	-.582
17	.506	.084	.422	.309	.505	-.196
18	.176	.099	.077	.585	.944	-.359
19	-.246	.086	-.332	.037	-.805	.842
20	-.866	-1.662	.796	-1.223	-1.075	-.148
21	-.242	-1.183	.941	.238	-.410	.648
22	.288	.630	-.342	-.359	-.832	.473
23	-.292	-.513	.221	-.402	-.894	.492
24	.216	.123	.093	.693	-1.168	.475
25	.691	.794	-.103	.140	.328	-.188
26	.597	.452	.145	-.162	-.892	.710
27	-.199	-.254	.055	.606	1.137	-.531
28	-1.375	-1.527	.152	-1.228	-.855	-.373
29	.417	.994	-.577	.656	1.362	-.706
30	-.096	-.525	.429	-.293	.017	-.310
31	.101	-.092	.193	-.721	-.489	-.232
32	-.629	.760	.869	.989	.973	.016
33	.235	.451	-.216	.271	.093	.178
34	.552	.239	.313	.784	.256	.528
35	-.216	-1.471	1.255	-1.701	-.825	-.876
36	1.456	.962	.494	.359	.331	.028
37	.235	.324	-.089	.691	1.030	-.339
38	-.292	-.131	-.161	-1.007	-.699	-.308
39	-.729	-.988	.259	-.187	.343	-.530
40	-1.239	-.507	-.732	1.063	-1.588	.480

TABLE XIX
(continued)

Pairs	Group 1			Group 2		
	H.W.	No H.W.	Net Gain	H.W.	No H.W.	Net Gain
41	.113	.402	-.289	.837	1.115	-.278
42	-.497	-.349	-.148	.036	.800	-.764
43	-1.108	-1.579	.471	-.397	.071	-.468
44	1.656	.975	.681	1.149	1.538	-.389
45	.181	.399	-.218	.746	.602	.144
46	.937	1.139	-.202	1.006	1.227	-.221
47	.959	1.138	-.179	1.091	1.273	-.182
48	.763	.805	.042	.660	.543	.117
49	.981	1.032	-.051	1.078	.837	.241
50	.259	.528	-.269	-.463	-1.336	.873
51	.415	.096	.319	-.429	.064	-.493
52	.303	.075	.226	-.099	.558	-.657
53	-1.378	-1.232	-.146	.671	-.034	.705
54	-.288	-.762	.474	.009	.285	.275
55	-.621	-.259	-.362	.984	-1.597	.613
56	1.203	1.148	.055	.897	1.167	-.270
57	-.475	-.103	-.372	.067	-.699	.632
58	-1.592	-1.200	-.392	-.928	-.117	-.811
59	-1.216	-.414	-.802	-2.383	-1.795	-.588
60	-1.973	-.822	-1.151	-.286	-.923	.637
61	.138	.077	.061	.093	-.022	.115
62	-1.898	-.816	-.082	.425	.169	.256
63	-1.631	-.913	-.718	-.708	-.614	-.094
64	-.646	-.118	-.528	-.091	-.477	.386
65	.392	.524	-.132	-1.149	-.878	-.271
66	1.768	.902	.866	.612	1.576	.866
67	.195	.682	-.487	-.475	-.166	-.309
68	.667	.598	.069	.345	.573	-.228
69	.528	1.047	-.519	1.039	1.414	-.375
70	-.565	-1.209	.644	-2.758	-1.487	-1.271
71	.871	1.004	-.133	.623	.816	-.193
72	-.382	.314	-.696	-.253	-.450	.197
73	-1.861	-1.948	.087	-1.327	-1.113	-.214
74	1.395	1.258	.137	.012	.303	-.291
75	.332	.595	-.273	-.153	-.735	.582
76	.830	.456	.374	.932	.388	.544
77	-.455	-.557	.102	.326	.625	-.299

Seventy-one pupils had a higher z score average when home work was assigned, while the other eighty-three were able to raise their relative position when no work was assigned. This might be explained similarly to the above case of pupil No. 56 in Group 2.

Of the total of one hundred fifty-four pupils, eighteen improved consistently on each test following the assignment of home work when compared with the immediately preceding non home-work test.[4] Their IQ's are listed below.

IQ	No. of Pupils	IQ	No. of Pupils	IQ	No. of Pupils
119	1	114	1	102	1
118	1	113	2	99	1
117	1	112	2	92	1
116	2	111	2	90	1
115	1	104	1		

Of the total number of pupils in this study forty-eight raised their standings on two out of the three home-work tests[5] when compared with the immediately preceding non home-work tests. Their IQ's are listed below.

IQ	No. of Pupils	IQ	No. of Pupils	IQ	No. of Pupils
124	1	112	2	96	2
120	1	111	1	90	1
119	1	110	2		
118	5	109	4		
117	2	107	1		
116	2	106	7		
115	5	105	3		
114	4	104	1		
113	2	103	1		

Fifty-seven of the total number of pupils showed improvement on one of the home-work tests in comparison with the immediately

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4 A test given after no assigned home work on the unit.

5 A test given after assigned home work on the unit.

preceding non home-work tests. Their IQ's are listed below.

IQ	No. of Pupils	IQ	No. of Pupils	IQ	No. of Pupils
128	1	114	2	105	3
124	1	113	4	104	4
122	1	112	2	102	1
121	3	111	1	99	1
120	3	110	1	98	2
119	1	109	5	96	1
118	2	108	2	94	1
117	3	107	2	89	1
115	6	106	2	86	1

Thirty-one of the total number of pupils showed no improvement on any home-work test in comparison with the previous non home-work test. In fact, their average z scores were higher on the non home-work tests. Their IQ's are as follows:

IQ	No. of Pupils	IQ	No. of Pupils	IQ	No. of Pupils
129	1	114	3	103	1
124	1	112	1	101	1
121	2	111	1	97	1
120	2	110	1	96	3
119	4	108	1	89	1
117	1	107	1		
116	2	106	2		

Summarizing the above information it seems that with the pupils of higher IQ's[6] that assigned home work is less effective. In the first group above[7] there is only one pupil above an IQ of 118, and this is an IQ of 119. In the second group[8] there are three pupils from 118 to 124 IQ's. In the third group[9] there were ten pupils

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6 IQ's above 118.

7 The group which improved consistently on each home-work test

8 The group which improved two out of three times

9 The group which improved one out of three times

from 118 to 128 IQ's and in the fourth group[10] there are ten pupils from 118 to 129 IQ's. The IQ's at the lower end of the scale shows no consistency.

Table XX shows the IQ's of the seventy-one pupils who had higher z score averages on the three home-work tests in comparison with the eighty-three who had a higher average on the non home-work tests. The IQ has no effect on the achievements of the group when home-work is assigned as shown by the r of .03 which is negligible, but it can be seen in the table that in the former group there are six pupils above 118 IQ while in the latter group there are eighteen above 118 IQ which might be a slight indication that home work is needed less by the pupils of higher IQ's.

A correlation coefficient was found to determine whether the age effected the achievement of pupils given assigned home work. An r of .004 showed no relationship to exist among the pupils of this group whose ages ranged from 154 months to 211 months.

A study of the number of boys who improved when home work was assigned was compared with the number of girls who improved with home work to determine whether that factor effected the work of boys or girls more. Forty-one of the seventy-one pupils who made a higher z score average on the home-work tests were boys but a larger number of boys were included in the experiment than girls. Altogether there were eighty-six boys and sixty-eight girls who made up the total one

10 The group which had a higher relative position without the home-work factor

TABLE XX

COMPARISON OF IQ'S OF PUPILS WHO HAD A
HIGHER z SCORE AVERAGE ON THE
HOME-WORK TESTS WITH THOSE
WHO HAD A HIGHER
AVERAGE ON NON
HOME-WORK
TESTS

	Higher Home-Work Average		Higher Non Home-Work Average
IQ	Number of Pupils	IQ	Number of Pupils
129		129	1
128		128	1
127		127	
126		126	
125		125	
124	1	124	2
123		123	
122	1	122	
121	1	121	4
120	1	120	5
119	2	119	5
118	6	118	2
117	4	117	3
116	3	116	3
115	7	115	5
114	4	114	6
113	6	113	2
112	5	112	2
111	2	111	4
110	2	110	2
109	3	109	5
108		108	3
107	1	107	3
106	6	106	5
105	3	105	3
104	3	104	3
103		103	2
102	1	102	1
101		101	1
100		100	
99	1	99	1
98	1	98	1
97		97	1
96	3	96	3
95		95	
94		94	1
93		93	
92	1	92	
91		91	
90	2	90	1
89	1	89	1
88		88	
87		87	
86		86	1
Total	71 pupils	Total	83 pupils

hundred fifty-four pupils in this study. The per cent of boys
having a higher average in the tests was about $3\frac{1}{2}\%$ higher than
that for the girls. Since girls are supposed to do better in
school than boys, this per cent might have been greater with an
average group. Table I showed the average IQ of this group to
be about 10 points above the general average. A more extensive
study might show that boys profit more by written home-work assign-
ments than girls.

Table XXI gives a summary of the statistics used in the inter-
pretation of the results of the eleven tests used in this study.

TABLE XXI

SUMMARY OF STATISTICAL COMPUTATIONS
USED IN THE STUDY

Tests	Group 1 Sigma	Group 2 Sigma	Group 1 Mean	Group 2 Mean	r	Group 1 Sigma av.	Group 2 Sigma av.	σ diff.	diff. be-tween means	diff. av. σ diff.
1.	3.24	3.30	83.16	83.44	.55	2.58	2.63	2.26	.28	.12
2.	3.08	3.00	77.10	78.50	.62	1.75	1.71	1.50	1.40	.93
3.	4.20	3.86	77.65	78.20	.68	2.40	2.20	1.85	.55	.30
4.	2.73	3.33	104.72	100.17	.39	2.18	2.65	2.69	4.55	1.74
5.	3.10	3.45	48.70	46.55	.41	1.76	1.94	2.00	2.15	1.07
6.	3.65	3.32	79.00	81.70	.25	2.08	1.89	2.44	2.70	1.10
7.	3.23	3.27	72.60	71.50	.40	1.84	1.86	2.02	1.10	.54
8.	3.29	3.81	74.65	69.35	.28	1.87	2.17	2.43	5.30	2.18
9.	4.76	4.79	55.07	58.30	.75	2.71	2.73	1.92	3.23	1.70
10.	5.09	4.23	126.00	145.50	.43	4.06	3.37	4.00	19.50	4.87
11.	3.02	3.09	57.70	52.20	.39	1.72	1.76	1.92	5.50	2.86

CHAPTER III

CONCLUSIONS

The results of the six experimental units, which were chosen from the algebra course of study for the Bartlesville Junior-Senior High School and carried out by the writer, suggest the following conclusions:

1. Daily home-work assignments in algebra had a positive effect on the achievements of these groups of pupils as a whole.

2. The factor of home work seemed to be of increasingly greater effectiveness as the year progressed.

3. Since the daily home-work assignments were planned to keep a pupil of average ability busy for only about forty-five minutes, they were not excessively burdensome on the pupils in proportion to the benefits obtained. Many pupils prepared their assignments in about twenty minutes as the average IQ of the group was relatively high.

4. The IQ is not closely related to the effect of the factor of assigned home work of these algebra pupils.

5. The factor of assigned home work seems to be of less importance for the achievements of pupils of IQ's above 118.

6. The chronological age has no effect on the achievements of pupils when considering the home-work factor.

7. A small margin in per cent is in favor of the boys improving their rating when home work is assigned more than the girls.

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