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THE RELATIVE MERITS OF TEACHING SCHORLING AND CLARK MATHEMATICS WITHOUT THE AID OF DRILL, COMPARED TO TEACHING IT WITH THE AID OF TWO KINDS OF DRILL

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CHAPTER I

INTRODUCTION

The Problem

Because of the mounting cost of increased service in school work, it becomes necessary for us to be ever on the alert for ways to develop more efficiency at less cost. This means we must constantly weigh and evaluate methods and devices used in teaching to avoid duplication and waste of effort.

It is with these things in mind that the writer makes an attempt to weigh and evaluate some of the drill devices that seem to be flooding the market at the present time. Much has been said concerning the need of drill, but little has been done to determine the amount and kind of drill best suited to the learning process in arithmetic.

An examination of errors made by pupils in eighth grade arithmetic reveals a lack of accuracy in the fundamentals, caused by a lack of knowledge of the fundamentals. One outstanding proof of this is the habit among boys and girls of counting instead of adding. That is, when the pupil wants to add seven and three; instead of saying seven and three are ten, he says; seven, eight, nine, ten. This, in the opinion of the writer, is a lazy habit, which, when once formed is very hard to correct. It finally tends to hold down one's speed of computation and develops a lack of

accuracy.

Then, there is that argument by the authors of some texts, that their books contain enough drill, for the average class, in the problems offered by the text. However, this is not a claim made by the authors of the text to be studied here.

Problems of This Investigation

This study attempts two things: (1) to find if Schorling and Clark Modern Mathematics, one of the adopted texts of Kansas, provides enough drill in the eighth grade; and (2) to weigh the value of two kinds of drill, viz., a flash-card machine and a drill test book.

Similar Studies

An approach to one phase of this subject has been made by Lutes and Samuelson[1] of the University of Iowa in their development of a method of rating the drill provisions in arithmetic text books.

Schorling and Clark[2] made a study of the value of their text compared to another in an attempt to find the value of drill as arranged by their text.

Brown and Coffman[3] give the results of a study to

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[1] O. S. Lutes, and Agnes Samuelson, A Method of Rating the Drill Provisions in Arithmetic Text Books, College of Education, University of Iowa, Iowa City, Iowa, 1926.

[2] Raleigh Schorling and John R. Clark, How Should Mathematics be Taught? World Book Co. Yonkers on Hudson, N. Y.

[3] Joseph C. Brown and Lotus D. Coffman, How to Teach Arithmetic, Row, Peterson and Company, Chicago.

determine the value of a three minute drill period to establish the right habits in the fundamentals. This showed a decided advantage for the three minute drill.

CHAPTER II

DESCRIPTION OF DRILL DEVICES USED

Flash-Card-Machine

Because many pupils had the habit of "Counting" when working problems in addition and subtraction instead of knowing the combinations, the writer felt the need of a drill device that would compel them to know the combinations. With the cooperation of the late Dr. H. C. Pryor of the Kansas State Teachers College of Pittsburg, Kansas, an auto-flash-card machine was secured from the Hub City School Supply Company of Aberdeen, South Dakota.

This machine was arranged so that it would expose number combinations to the view of the pupil at varying rates of speed, from very slow up to the rate of one per second. This machine could be used in this fashion for drill in any of the arithmetic processes. Mr. Guhin, the maker of the machine, says; "Practice on the machine should be continued until students write combinations, unerringly, at the rate of one per second".

Instructional Tests in Arithmetic

Another device used for drill was, "Instructional Tests in Arithmetic", published by Schorling-Clark-Potter. This is a small book made up of sixty-nine tests, which require three minutes each, working time. The drills cover all fundamental operations in arithmetic, such as, addition,

subtraction, multiplication, division, fractions, decimals, percents, and discount.

The tests were so arranged that each pupil could travel at his own rate or speed. Each group of problems was preceded by an inventory test. If the pupil could pass the inventory test it meant that he was up to the required standard for eighth grade pupils and was allowed to skip the rest of the problems in that group and go to the next type of problems. However, if he could not pass the inventory test, he was expected to drill on that group of problems until he could pass. This arrangement gave him an opportunity to spend his time on the type of problem that gave him trouble regardless of where the class was working. Each pupil kept his own record.

The authors say of the book: "The booklet idea gives satisfaction because here we have everything under one cover-inventory tests, practice tests, diagnostic tests, remedial material, record forms, nothing for the teacher to do except to start and stop the pupils. Then, too, she has the chance to walk about the room and observe study habits and see to it that records are kept in good form.

CHAPTER III

An Outline of the Procedure

In the fall of 1930 the writer secured permission of Superintendent Rees H. Hughes of the Parsons Schools to conduct the experiment in the Parsons Junior High School.

Three classes taught by the writer were chosen for the experiment. They were regular classes, no provision being made for special grouping.

Group I met at 8:30 A. M., Group II met at 1 P. M. and Group III met at 3 P. M. Groups I and II were called "Experimental" groups and Group III was called the "Control" group, against which Groups I and II could be measured.

All groups used "Schorling and Clark Modern Mathematics" as a text and followed the regular course of study.

Composition of the Groups

The three classes used were composed of eighty-five boys and girls. Group I was made up of thirty-nine pupils--thirty-two girls and seven boys. Group II was made up of twenty-eight pupils--fourteen boys and fourteen girls. Group III was made up of eighteen pupils--eleven girls and seven boys.

Experimental Factors

All three classes used "Schorling and Clark Modern Mathematics" for a text. Group I used the Flash-card machine for three minutes. Various methods were used to

motivate the interest. If a set of addition combinations were used the answers were sometimes written or perhaps an individual would be allowed to give the answers until he made a mistake, then another would be given an opportunity, etc.

All were urged to make note of and learn the combinations that gave them trouble. Addition, subtraction, multiplication, decimals, decimal equivalents and percents were drilled on this machine.

Group II used the Instructional Tests in Arithmetic for three minutes at the beginning of the recitation period. Each pupil kept his own record sheet of his progress. He traveled at his own rate of speed. If he could pass the inventory test at the beginning of a group of problems he was allowed to skip that group and attempt the next. If he could not pass the inventory test he was expected to drill on a series of drill tests until he could pass the inventory test. Pupils were urged to add and not "count" when working addition and subtraction problems.

Group III used only the text. It was presented as nearly as possible as laid out by the authors.

Time of the Experiment

The experiment was conducted during the second semester of the school year 1930-1931 and ran for a period of twelve weeks. The total time given to the experiment was sixty class periods each sixty minutes at the beginning of each

recitation period. The total class time spent in drill by Groups I and II was one hundred-eighty minutes. The remainder of the recitation period was divided, one-half to recitation and one-half to study. This, of course, gave Group II one hundred-eighty minutes more to be spent on the study of the text than the other groups.

Tests Used for Measuring the Group

Two types of tests were used in the experiment: (1) two forms of an arithmetic test to measure achievement; (2) a mental test to measure intelligence.

Schorling-Clark-Potter Arithmetic Tests, Forms A and B were used to measure the achievement of the three classes. The Schorling-Clark Potter Test is made up of a set of six tests: (1) ten addition problems, (2) ten subtraction problems, (3) seventeen multiplication problems, (4) sixteen division problems, (5) thirty-seven decimals and percents, and (6) a list of ten general problems.

The authors say of the test,

> "It not only measures skills with whole numbers, but it also involves the various steps by which skills are built up in the less frequently measured subjects of common fractions, decimals, percentage and denominate numbers".

Forty minutes working time is required for writing the test.

The above test was selected because of its ease of administering, its reliability, objectivity, validity, and the fact that it measures the processes studied during the experiment.

The Terman Group Test of Mental Ability, by Lewis M. Terman was given the three classes to determine the I. Q. of each pupil. The test is composed of ten parts: (1) information, (2) best answer, (3) word meaning, (4) logical selection, (5) arithmetic, (6) sentence meaning, (7) analogies, (8) mixed sentences, (9) classification, and (10) number series. The test is especially adapted to grades seven to twelve.

The above test was chosen because of its simplicity, reliability, objectivity, validity and ease of scoring.

Administering the Tests

All three groups were given Form A of Schorling-Clark-Potter Arithmetic Test on the first day of the experimental period. The Terman Group Test of Mental Ability was given a few days later. The Terman Group test was given in order that individuals within the three groups could be equated on the basis of their intelligence. At the end of the twelve weeks period Form B of the Schorling-Clark-Potter test was given. All of the tests were administered by the writer. The gain in achievement made by each pupil during the twelve weeks was considered as the difference between his scores on the Schorling and Clark test. The gain made by the Experimental groups was thought of as the average or mean gain made by the individuals in that group and likewise for the Control group. The individuals within the three groups were equated upon the basis of the scores

made in the Terman Group Test and the average gain achievement of pupils so equated was computed for those in each group. Similar comparisons of gains made by each group was attempted with the pupils equated on the basis of their mental age, and on the basis of scores made on Form A of the Schorling-Clark-Potter test. The average gain was found also on the entire groups.

CHAPTER IV

INTRODUCTION

Results of the Experiment

As the purpose of this study is to attempt to determine the value of drill and to evaluate two kinds of drill, it was necessary: first, to decide upon the kind of drill devices to be used; and second, to determine the value of each by trying them in a typical situation in the class room.

As, has been stated three regular classes were chosen for the experiment. Each class used the same text and covered the same amount of material in the text. All classes were taught by the same teacher and held to the same standards. The only variable in Group I was the flash-card machine which was used three minutes at the beginning of the recitation. The only variable in Group II was the Instructional Test Book used for three minutes at the beginning of the recitation period. The Control group used the regular text for a period of sixty minutes.

Evaluation of Results

In evaluating the results of the experiment it becomes necessary to answer four questions: (1) How do the average gains of the entire Experimental Groups compare with the average gain of the Control Group? (2) How do the average gains of the Experimental Groups compare with the average gain of the Control Group when the groups are equated by

the I. Q's of the members of the groups? (3) How do the average gains of the Experimental Groups compare with the average gain of Control group when the groups are equated on the basis of the mental ages of the members of the groups? (4) How do the average gains of the Experimental Groups compare with the average gain of the Control group, when the groups are equated on the basis of the scores made on Form A of the Schorling-Clark-Potter test?

A Summary of the Findings

An analysis of the results of the study shows, that the average gain made in all of the groupings, except that in which the groups were equated on the basis of the I. Q's of the members, the Control group showed the greatest gain.

Average Gain Shown by Each Group

Let us first study the scores and gains made by the entire classes as Groups I, II and III in an effort to see how the gains of the Experimental Groups I and II compare with the gains of the Control group III. Tables I, II and III give the scores made by the individuals and the average gain made by the classes.

Column (1) in each table designates the pupils by initials; column (2) in the three tables give the scores made by the pupils on Form A of Schorling-Clark-Potter Arithmetic Test at the beginning of the experiment; column (3) in the three tables give the scores made on Form B of the same test after the experiment had run twelve weeks;

column (4) in each table gives the gains made by the individuals of each class when the total score of Form A was subtracted from the total score of Form B. For example, the first pupil (BL) of Table I made a score of 83 on the initial test (Form A) and a score of 100 on the final test we find a gain of 17 points was made by this pupil. Likewise in Table II (Group II) the first pupil (EP) made a score of 79 on the initial test (Form A) and a score of 95 on the final test (Form B); subtracting we find this pupil made a gain of 16 points. In Table III, the first pupil (VE) made a score of 73 on Form A and 72 on Form B, showing a loss of 1 point.

The total gain made by Group I was 171 points; when this amount is divided by thirty-nine pupils in the group, the average gain was found to be 4.385 points or by dividing the total score (1747), made on Form A, into the total gain (171) the gain in percent is found to be 9.8%.

TABLE I

Scores and Gain Made by Individual Pupils of Group I (Experimental),[1] on Schorling-Clark-Potter Arithmetic Test, Forms A and B.

(1) Pupil	(2) Form A	(3) Form B	(4) Gain
BL	83	100	17
BW	75	75	0
LM	75	84	4
SG	71	71	0
VS	51	52	1
ED	61	76	15
AJ	60	82	22
KK	58	71	13
MR	57	69	12
MW	57	52	-5*
CW	57	72	15
EC	54	69	15
GM	52	55	3
ML	52	40	-12
HW	51	50	-1
LC	50	61	11
VO	50	57	7
LD	49	55	6
HH	47	42	-5
JH	46	38	-8
DK	42	62	20
MH	42	47	5
JM	40	40	0
DH	39	27	-12
BW	39	47	8
MH	37	51	14
MS	37	33	-4
GM	37	35	-2
MF	35	32	-3
VL	35	39	4
IV	35	39	4
MR	33	36	3
KR	30	35	5
HF	25	25	0
GD	25	24	-1
FF	22	18	-4
MM	17	26	9
MA	11	14	3
AF	10	17	7
Totals	1747	1918	171
Average Gain 4.385		Percent Gain 9.8%	

[1]This group used the flash-card machine.

*-5 indicates a loss of five points.

The total gain on Group II, in Table II, another experimental group, was found to be 142; when this gain was divided by twenty-eight, the average gain was found to be 5.072 or by dividing 142 by the total of Form A (1394) the gain percent was found to be 10.2%.

TABLE II

Scores and Gain Made by Individual Pupils of Group II (Experimental),* on Schorling-Clark-Potter Arithmetic Test, Forms A and B.

(1) Pupil	(2) Form A	(3) Form B	(4) Gain
EP	79	95	16
SL	77	90	13
DV	74	87	13
EC	68	83	15
EM	66	80	14
MS	66	77	11
CW	65	88	23
HH	64	62	-2
GC	59	70	11
PW	59	50	-9
GA	57	70	13
ES	56	66	10
AN	53	55	2
VT	50	51	1
LP	47	32	-15
JC	46	42	-4
EP	46	53	7
PS	41	32	-9
PS	36	32	-4
MC	36	38	2
NR	35	34	-1
MG	35	41	6
MW	34	41	7
BS	33	31	-2
NR	31	28	-3
MS	30	30	0
CM	26	30	4
AH	25	48	23
Totals	1394	1536	142
Average Gain 5.072		Percent Gain 10.2%	

*This group used the "Instructional Tests in Arithmetic".

The total gain on Group III (Table III) the Control group, was found to be 96; dividing this by 18 the number in the group, the average gain was found to be 5.333 or by dividing 96 by the total of Form A (744) the percent gain was found to be 12.8%.

TABLE III

Scores and Gain Made by Individual Pupils of Group III (Control), on Schorling-Clark-Potter Arithmetic Test, Forms A and B.

(1) Pupil	(2) Form A	(3) Form B	(4) Gain
VE	73	72	-1
MD	58	71	13
BC	55	53	-2
WF	54	47	-7
JH	54	65	11
VD	51	66	15
ME	50	54	4
VD	46	64	18
PB	46	42	-4
NN	42	54	12
TR	39	57	18
CB	38	30	-8
FH	35	53	18
RS	31	34	3
BB	29	33	4
FO	20	19	-1
MM	13	14	1
SL	10	12	2
Totals	744	840	96
Average Gain 5.333		Percent Gain 12.8%	

It may be seen that the average gain made by Group III (the Control group) exceeded the average gain made by Group II ("Experimental") group that used the Instructional Tests) .261 points, and the gain of Group I (An "Experimental" group that used the flash-card machine) .948 points.

The Gains with Intelligence Equated

Now let us study the scores and gains made by the groups when equated by their I. Q's as determined by the Terman Group Test of Mental Ability.

Tables IV, V and VI give the mental ages and I. Q's of all of the pupils in Groups I, II and III. Column (1) in each table designates the pupils by initials; column (2) in each table gives the mental ages, and in column (3) will be found the I. Q's.

TABLE IV

I. Q's and Mental Ages of Individual Pupils in Group I, as Determined by the Terman Group Test of Mental Ability.

(1) Pupil	(2) M. A.	(3) I. Q.
MW	201	131
CW	185	116
HW	160	105
BW	193	118
IV	168	110
ML	176	116
VS	169	101
SG	160	102
MH	196	132
MM	146	89
VO	180	118
MR	166	89
KR	151	83
MR	195	121
GM	188	118
MS	168	107
JM	177	111
LM	193	121
MT	154	92
VL	140	81
DK	163	94
KK	188	118
AJ	197	126
MA	152	86
HF	157	96
BS	211	134
BW	191	126
MH	174	115
LD	179	121
EC	182	119
GD	153	103
ED	179	111
DH	165	109
GM	188	109
AF	149	92
FF	160	85
HH	166	91
JH	153	80

TABLE V

I. Q's and Mental Ages of Individual Pupils in Group II, as Determined by the Terman Group Test of Mental Ability.

(1) Pupil	(2) M. A.	(3) I. Q.
CM	150	85
GA	187	115
NR	166	101
JC	190	104
MC	160	90
GC	175	106
EC	179	113
NR	155	100
EP	205	127
SL	196	117
HH	169	89
AD	143	79
EM	171	103
EP	190	128
ES	179	113
MS	175	109
PB	155	90
PS	161	90
VT	167	99
CW	205	124
BS	163	92
AN	161	100
PS	151	103
DV	207	132
MS	157	101
MW	143	81

TABLE VI

I. Q.'s and Mental Ages of Individual Pupils in Group III, as Determined by the Terman Group Test of Mental Ability.

(1) Pupil	(2) M. A.	(3) I. Q.
MM	156	93
VE	198	122
BF	153	91
ME	190	117
PB	161	100
BC	188	126
CB	162	106
MD	153	94
JH	187	113
FC	153	79
NN	173	107
TR	169	106
FH	140	83
VD	166	99
WT	182	109
RS	169	104
SL	159	94
VD	159	83

Tables VII, VIII and IX is an attempt to compare those pupils in the groups who have approximately the same mental ability, as indicated by their I. Q's. It may be seen that pupils with corresepponding numbers in the three tables, have approximately the same I. Q. For exemple; No. 16 in Table VII has an I. Q. of 103; No. 16 in Table VIII has an I. Q. of 103 and No. 16 of Table IX has an I. Q. of 104. Since there were only eighteen pupils in Group III it was necessary to use only eighteen of approximately equal I. Q's in the other groups in order to make the groups equal.

The group in Table VII is the "Experimental" group that used the flash-card machine for drill. The group that is described in table VIII is also an "Experimental" group. It used the Instructional Test Book for drill. The group in Table IX is the "Control" group that used no supplementary drill in connection with the text. Table VII shows a total gain of sixty points. This number divided by eighteen gives an average gain of 3.333 points, or divided by the total of Form A (741) gives a percent increase of 8.09%. Table VIII shows a total gain of 124 points, an average gain of 6.889 points or 13.5% gain. Table IX shows a total gain of 96 points, an average of 5.333 points or 12.8% gain.

TABLE VII

I. Q's, Scores and Gain Made by Eighteen Pupils of Group I (Experimental),* on Schorling-Clark-Potter Arithmetic Test, when Equated on the Basis of Their I. Q's, Forms A and B.

(1) Pupil	(2) I. Q.	(3) Form A	(4) Form B	(5) Gain
(1) MF	92	35	32	-3
(2) MR	121	57	69	12
(3) HH	91	47	42	-5
(4) CW	116	57	72	15
(5) VS	101	51	52	1
(6) AJ	126	60	82	22
(7) EW	103	51	50	-1
(8) DK	95	42	62	20
(9) MH	115	42	47	5
(10) JH	80	46	38	-8
(11) MS	107	37	33	-4
(12) GM	109	52	55	3
(13) KR	83	30	35	5
(14) HF	96	25	25	0
(15) DH	109	39	27	-12
(16) GD	103	25	24	-1
(17) AF	92	10	17	7
(18) VL	81	35	39	4
Totals		741	801	60

Average Gain 3.333 Percent Gain 8.09%

*This group used the flash-card machine.

TABLE VIII

I. Q's, Scores and Gain Made by Eighteen Pupils of Group II (Experimental),* on Schorling-Clark-Potter Arithmetic Test, when Equated on the Basis of Their I. Q's, Forms A and B

(1) Pupil	(2) I. Q.	(3) Form A	(4) Form B	(5) Gain
(1) PW	90	59	50	-9
(2) CW	124	65	88	23
(3) MC	90	36	38	2
(4) SL	117	77	90	13
(5) NR	100	31	28	-3
(6) EP	127	79	95	16
(7) GC	106	59	70	11
(8) PS	90	41	32	-9
(9) ES	113	56	66	10
(10) AH	79	25	48	23
(11) MS	109	66	77	11
(12) JC	104	46	42	-4
(13) MW	81	34	41	7
(14) AN	100	53	55	2
(15) EC	113	68	83	15
(16) EM	103	66	80	14
(17) BS	92	33	31	-2
(18) CM	85	26	30	4
Totals		900	1044	124
Average Gain 6.889			Percent Gain 13.5%	

*This group used the "Instructional Tests in Arithmetic.

TABLE IX

I. Q's, Scores and Gain Made by Eighteen Pupils of Group III (Control), on Schorling-Clark-Potter Arithmetic Test, when Equated on the Basis of Their I. Q's, Forms A and B.

(1) Pupil	(2) I. Q.	(3) Form A	(4) Form B	(5) Gain
(1) MM	93	13	14	1
(2) VE	122	73	72	-1
(3) BB	91	29	33	4
(4) ME	117	50	54	4
(5) PB	100	46	42	-4
(6) BC	126	55	53	-2
(7) CB	106	38	30	-8
(8) MD	94	58	71	13
(9) JH	113	54	65	11
(10) FO	79	20	19	-1
(11) NN	107	42	54	12
(12) TR	106	39	57	18
(13) FH	83	35	53	18
(14) VD	99	51	66	15
(15) WF	109	54	47	-7
(16) PS	104	31	34	3
(17) SL	94	10	12	2
(18) VD	83	46	64	18
Totals		744	839	96
Average Gain 5.333			Percent Gain 12.8%	

It may be seen that the average gain of the "Experimental" group which used the Instructional Test Book exceeded the average gain of the group which used the flash-card machine by 3.556 points and exceeded the average gain of the Control group 1.556 points.

Equation on the Basis of Mental Age

In Tables IV, V and VI may be found the mental ages as determined by Terman Group Test of Mental Ability. Tables X, XI and XII show a comparison of the groups when equated on the basis of the mental ages of the pupils. In column (1) of each table will be found the mental ages of the pupils. In column (2) will be found the scores of Schorling-Clark-Potter Arithmetic Test, Form A, column (3) shows the scores made on Form B of the same test and column (5) shows the gains made on the test during the experimental period.

The class represented by Table X used the flash-card machine. The class represented by Table XI used the Instructional Tests and the class represented by Table XII is the "Control" group that used no supplementary drill in connection with the text.

TABLE X

Mental Ages, Scores and Gain Made by Eighteen Pupils of Group I (Experimental),* on Schorling-Clark-Potter Arithmetic Test, when Equated on the Basis of Their Mental Ages, Forms A and B

(1) Pupil	(2) M. A.	(3) Form A	(4) Form B	(5) Gain
HF	157	25	25	0
AJ	197	60	82	22
GD	153	25	24	-1
BW	191	75	75	0
SG	160	71	71	0
KK	188	58	71	13
DK	163	42	62	20
JH	153	46	38	-8
GM	168	52	55	3
MA	152	11	14	3
MH	174	42	47	5
VS	169	51	52	1
VL	140	35	39	4
MR	166	33	36	3
EC	182	54	69	15
IV	168	35	39	4
HW	160	51	50	-1
FF	160	22	18	-4
Totals		788	867	79

Average Gain 4.388 Percent Gain 10%

*This group used the flash-card machine.

TABLE XI

Mental Ages, Scores and Gains Made by Eighteen Pupils of Group II (Experimental,* on Schorling-Clark-Potter Arithmetic Test, when Equated on the Basis of Their Mental Ages, Forms A and B.

(1) Pupil	(2) M. A.	(3) Form A	(4) Form B	(5) Gain
MR	155	31	28	-3
SL	196	77	90	13
PB	155	59	50	-9
JC	190	46	42	-4
PS	161	41	32	-9
GA	187	57	70	13
AN	161	53	55	2
PS	151	36	32	-4
EP	190	46	53	7
CN	150	26	30	4
GC	175	59	70	11
HH	169	64	62	-2
AD	143	25	48	23
NR	166	55	54	-1
EC	179	68	83	14
EM	171	66	80	14
MC	160	36	38	2
MS	157	30	30	0
Totals		855	927	72
Average Gain 4			Percent Gain 8.4%	

* This group used the "Instructional Tests in Arithmetic.

TABLE XII

Mental Ages, Scores and Gains Made by the Pupils of Group XIX (Control), on Schorling-Clark-Potter Arithmetic Test, when Equated on the Basis of their Mental Ages, Forms A and B

(1) Pupil	(2) M. A.	(3) Form A	(4) Form B	(5) Gain
MM	156	13	14	1
VE	198	73	72	-1
BB	153	29	33	4
ME	190	50	54	4
PB	161	46	42	-4
BC	188	55	53	-2
CB	162	38	30	-8
MD	153	58	71	13
JH	187	54	65	11
FO	153	20	19	-1
NN	173	42	54	12
TR	169	39	57	18
FH	140	35	53	18
VD	166	51	66	15
WF	182	54	47	-7
RS	169	31	34	3
SL	159	10	12	2
VD	159	46	64	18
Totals		744	840	96

Average Gain 5.333 Percent Gain 12.8%

Table X shows an average gain of 4.388 or 10% for the flash-card machine. Table XI shows an average gain of 4 points or 8.4%, for the Instructional Test Book and Table XII shows an average gain of 5.333 points or 12.8% gain for the "Control" group.

It will be seen from these tables that the average gain of the "Control" group exceeds the average gain of the "Experimental" flash-card group by .945 points and exceeds the average gain of the group that used the Instructional Test Book, 1.333 points.

Equation on the Basis of Scores Made on Form A of Schorling-Clark-Potter Arithmetic Test

Another comparison of the groups has been attempted in Tables XIII, XIV and XV. Table XIII represents the class that used the flash-card machine, Table XIV represents the class that used the Instructional Test Book, and Table XV represents the "Control" group that used no supplementary test material in connection with the text. Eighteen members of each class were chosen that had approximately the same scores on Form A of the Schorling-Clark-Potter Test. For example the first pupils in the three tables made scores on Form A, of 75, 74 and 73 respectively.

TABLE XIII

Scores and Gain Made by Eighteen Pupils of Group I (Experimental),* on Schorling-Clark-Potter Arithmetic Test, when Equated on the Basis of Scores Made on Form A

(1) Pupil	(2) Form A	(3) Form B	(4) Gain
LM	75	84	9
KK	58	71	13
EC	54	69	15
CM	52	55	3
ML	52	40	-12
JW	51	50	-1
LC	50	61	11
JH	46	38	-8
DK	42	62	20
MH	42	47	5
BW	39	47	8
MH	37	51	14
VL	35	39	4
MR	33	36	3
KR	30	35	5
FF	22	18	-4
MA	11	14	3
AF	10	17	7
Totals	739	834	95
Average Gain 5.277		Percent Gain 12.8%	

* This group used the flash-card machine.

TABLE XIV

Scores and Gains Made by Eighteen Pupils of Group II (Experimental),* on Schorling-Clark-Potter Arithmetic Test, when Equated on the Basis of Scores Made on Form A

(1) Pupil	(2) Form A	(3) Form B	(4) Gain
DV	74	87	13
GC	59	70	11
GA	57	70	13
ES	56	66	10
AN	53	55	2
VT	50	51	1
LP	47	32	-15
JC	46	42	-4
EP	46	53	7
PS	41	32	-9
PS	36	32	-4
MC	36	38	2
NR	35	34	-1
NR	31	28	-3
MS	30	30	0
CM	26	30	4
AD	25	48	23
MG	35	41	6
Totals	783	839	56
Average Gain 3.111		Percent Gain 7.2	

* This group used the "Instructional Tests in Arithmetic."

TABLE XV

Scores and Gain Made by Pupils in Group III (Control), on the Schorling-Clark-Potter Arithmetic Test, when Equated on the Basis of Scores Made on Form A.

(1) Pupil	(2) Form A	(3) Form B	(4) Gain
VE	73	72	-1
MD	58	71	13
BC	55	53	-2
WF	54	47	-7
JH	54	65	11
VD	51	66	15
ME	50	54	4
VD	46	64	18
PB	46	42	-4
MN	42	54	12
TR	39	57	18
CB	38	30	-8
FH	35	53	18
RS	31	34	3
BB	29	33	4
FA	20	19	-1
MM	13	14	1
SL	10	12	2
Totals	744	840	96
Average Gain 5.333		Percent Gain 12.8%	

Table XIII shows that the flash-card group made an average gain of 5.277 points or 12.8%; Table XIV shows that the Instructional Test group made an average gain of 3.111 points or 7.2%, and Table XV shows that the "Control" group made an average gain of 5.333 points or 12.8%.

It will be seen that the average gain of the "Control" group exceeds average gain of the flash-card group by .056 points, and exceeds the average gain of the Instructional Test group by 2.222 points.

Final Summary of Findings

The "Control" group made the greatest average gain in all groupings except, when they were grouped on the basis of intelligence. The Instructional Tests furnished the next greatest gain, with the flash-card group last.

An average of the averages, gives the "Control" group an average gain of 5.333 points, the Instructional Test Experimental group an average gain of 4.768 points, and the flash-card Experimental group an average gain of 4.345 points.

Summary of the Factors Involved

The writer endeavored to keep all factors equal in three classes used in carrying out the experiment, with the exception of supplementary drill which was the variable factor.

The factors which the writer tried to keep equal throughout the experiment were: all groups had the same teacher; the same assignments, test, textbook, and the same type of recitation. The experimental group had less time for actual study on the text, during the twelve weeks because of the three minute drill period and probably two minutes making their records.

The time for the experiment was too brief. Pupils had fixed habits and the emphasis, in the Experimental groups, of proper methods, such as knowing the combinations instead of counting them up, probably had a tendency to slow up

their speed. The one hundred-eighty minutes did not furnish enough time for them to change the habit and acquire any degree of speed with the new habit. This probably explains the loss in scores made by many. Another indication that would seem to make this true, is that the flash-card machine in nearly all cases made the least showable gains, and offered the least opportunities for bad methods of computation.

CHAPTER V

FINDINGS AND CONCLUSION

Findings of the Study

The findings of the study are as follows:

1. The average gain of the "Control" group exceeded the average gain of the "Experimental groups when the gains of the entire classes were averaged.

2. The average gain of the "Experimental" group, that used the Instructional Tests, exceeded the average gain of other "Experimental" group and the gain of the "Control" group when grouped on the basis of I. Q's.

3. The average gain of the "Control" group exceeded the average gain of the "Experimental" groups when grouped on the basis of the mental ages of the pupils.

4. The average gain of "Control" group exceeded the average gain of the "Experimental" group when grouped on the basis of the scores made on the initial Schorling-Clark-Potter Arithmetic Test.

5. When the averages of all of the groups were averaged it was found that the gain of the "Control" group exceeded the gains of the "Experimental" groups, and that the gain of the group which used the Instructional Test exceeded the gain of the group that used the flash-card machine.

Conclusions

The results of the study seem to justify the following conclusions:

1. In the opinion of the writer, the number of pupils used was too small for the results to be considered conclusive.

2. The time used was too short to allow the pupils to change from old habits to new and develop any amount of speed and accuracy.

3. The results indicate that the "Instructional Tests in Arithmetic" is a better drill device than the "auto-flash-card" machine.

4. The results indicate that drill has been sufficiently provided for, in "Schorling and Clark Modern Mathematics".

5. The results would seem to indicate that the time of day has very little, if any, effect upon a pupil's ability to work arithmetic.

6. The fact that the average gain of the "Control" group exceeded the average gains of the "Experimental" groups is, at least, evidence that more study should be made of Supplementary drill in connection with the teaching of arithmetic.

TERMAN GROUP TEST OF MENTAL ABILITY

For Grades 7 to 12

Prepared by Lewis M. Terman, Stanford University, California

EXAMINATION: FORM A

1. Name ..... (First name / Last name)
2. Boy or girl .....Grade .....High or Low .....
3. Age last birthday .....Date of birthday ..... (Month / Day / Year)
4. Name of city (or county) .....
5. Name of school .....
6. Name of teacher .....
7. Date of this examination .....19..... (Month / Day / Year)

Do not turn the page until you are told to.

Test	Score	Remarks or Further Data
1. Information		
2. Best Answer		
3. Word Meaning		
4. Logical Selection		
5. Arithmetic		
6. Sentence Meaning		
7. Analogies		
8. Mixed Sentences		
9. Classification		
10. Number Series		
Total		