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Study in corrective arithmetic in grades four, six, and eight

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Thesis

A STUDY IN CORRECTIVE ARITHMETIC IN GRADES IV, VI, AND VIII

Submitted by

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A STUDY IN CORRECTIVE ARITHMETIC IN GRADES IV, VI, AND VIII

INTRODUCTION

Statement of the Problem

The purpose of this study is to determine the need for corrective arithmetic in grades IV, VI, and VIII in the public schools of Newport, Rhode Island. More specifically, its purpose is:

1. To discover how many children in grades IV, VI, and VIII need corrective work in addition, subtraction, and multiplication when viewed from the standpoint of 100% accuracy and a reasonable time limit.

2. To discover the frequencies of certain of the most common errors.

3. With the aid of the teachers, to discover to what degree these errors may be eliminated after regular stress on corrective work over a five month period.

4. To compare corrective procedures and results in a fourth grade group and an eighth grade group.

5. To discover the difference, if any, in the results of the retests between children who have been worked with correctively and those who have had merely regular class work with no stress on corrective work.

The Need for Corrective Arithmetic

That there is a need in the schools today for corrective arithmetic is a fact that everyone admits. J. M. Rice, working before the turn of the present century, produced data that made it clear that in many schools where a great deal of time was being devoted to arithmetic results were no more satisfactory than in schools which were giving much less time to the subject.[1] He wrote, "There is extreme variation in results under the same appropriation of time."[2] Wilson says that arithmetic takes one-sixth of all school time in the grades.[3] Klapper says, "There are few complaints against current education that come with greater frequency than those directed by business men who find the school graduate unable to measure up in arithmetic to the demands of commercial life. It is charged that he is inaccurate, unduly slow in his calculations, and unable to meet a new arithmetic situation, however slightly it is changed from the type."[4]

Writing along the same line, Williams and Whitaker say, "The large number of failures resulting from arithmetic deficiency is not only a serious item of expense to the schools and the pupils, but the prospective employer and the general public adopt a very

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1 J. M. Rice, "E ducational Research," Forum, XXXIV (July - September, 1902), p. 123.

2 J. M. Rice, "Educational Research, A Test in Arithmetic," Forum, XXXIV (October - December, 1902), p. 293.

3 Guy M. Wilson, "Paying for Useless Arithmetic," Education, LV (March, 1935), p. 429.

4 Paul Klapper, The Teaching of Arithmetic, p. 45

critical attitude at times concerning these unsatisfactory results."[1] Wilson writes, "The taxpayer is constantly disturbed over the inability of the school graduate to do simple tool work in arithmetic," and draws the inescapable conclusion, "The schools have failed to give accuracy in the fundamentals."[2]

In 1914 Brown and Coffman write, "A larger percentage of children fail in arithmetic than in any other subject."[3] In 1925 Buswell brings the same charge against arithmetic.[4] In 1930 the identical charge is again brought against arithmetic by Wilson who says, "Arithmetic has caused more of failure and grief than any other subject in the grades, and the final results have been poor,"[5] and by Brueckner who says, "Surveys of instruction have shown that one of the chief causes of non-promotion in the elementary school is failure in the subject of arithmetic."[6]

In 1934 Myers writes to teachers, "You will be astonished to find how large a number of pupils even in the sixth grade have

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1 Claude L. Williams, and Ruth L. Whitaker, "Diagnosis of Arithmetic Difficulties," Elementary School Journal, XXXVII (April, 1937), p. 592.

2 Guy M. Wilson, "Arithmetic and the Taxpayer," Journal of the National Education Association, XX (1931), p. 221.

3 Joseph C. Brown, and L. D. Coffman, How To Teach Arithmetic, p. 43.

4 Guy Thomas Buswell, and Charles H. Judd, Summary of Educational Investigations Relating to Arithmetic, p. 7.

5 Guy M. Wilson, "New Standards in Arithmetic: A Controlled Experiment in Supervision," Journal of Educational Research, XXII (December, 1930), p. 352.

6 Leo J. Brueckner, Diagnostic and Remedial Teaching in Arithmetic, p. 2.

never mastered the most elemental skills."[1] Writing in the same year Nygaard says, "Very few pupils who have finished their grade school work in arithmetic can be depended upon to add correctly a column of numbers having two or more digits each, especially if the column is quite long."[2]

Causes of Difficulty in Arithmetic

This phase of the subject will be treated very briefly here, since it has been treated rather fully in other similar studies.[3]

Kelley believes that weaknesses causing failure can be traced to some omission in early elementary schooling.[4] Randall says, "The over-loaded arithmetic of tradition has fostered mediocrity."[5]

Brownell believes that the fact that remedial instruction is needed at all in any school is an admission that initial

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1 Garry Cleveland Myers, "Corrective Work in Arithmetic," The Grade Teacher, LI (February, 1934), p. 36.

2 P. H. Nygaard, "Accuracy in Addition," Mathematics Teacher, XXVII (March, 1934), p. 152.

3 Gertrude L. Hanley, "Corrective Load in the Fundamentals of Arithmetic in Grades IV, V, and VI." Unpublished Master's thesis of Boston University, 1938.

Dorothy Yarbrough, "A Diagnosis of Pupils' Errors in Arithmetic with a View to Corrective Work Carried on Through the Cooperation of the Teachers." Unpublished Master's thesis of Boston University, 1938.

4 Anna A. Kelley, "Teaching Remedial Arithmetic," American School Board Journal, XCI (August, 1935), p. 44.

5 Joseph H. Randall, "Corrective Arithmetic in Junior High School." Unpublished Master's thesis of Boston University, 1936.

instruction has been inadequate.[1] Brown and Coffman also are inclined to blame poor teaching.[2] Sweeney feels that teachers are too slow to accept the 100% ideal, and are too prone to be content with passing grades of 75 or 80.[3] Smith says, "A large number of errors is due to the incomplete automatization of the simple facts."[4] Wilson, after listing a number of possible causes, says, "I am of the opinion that unwillingness to abandon the traditional load of useless material in arithmetic is the greatest single cause of failure."[5]

Ridlon in her study has given a comprehensive summary of reasons for failure culled from several sources. Her summary follows here:

1. Initial teaching is begun too soon.
2. Arithmetic is not organized on a discriminating basis. Drill is not appropriate for every topic.
3. Too much drill causes haste and inefficiency.
4. Teachers often have no systematic plan for teaching the fundamental processes.
5. The drill load is too heavy.
6. Low standards of achievement.
7. Lack of diagnosis of pupils' work.
8. The fundamental facts and processes are not sufficiently well learned.

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1 William A. Brownell, "Remedial Cases in Arithmetic," Peabody Journal of Education, VII (September, 1929), p. 100.

2 Joseph C. Brown, and L. D. Coffman, op. cit., p.vi.

3 Margaret E. Sweeney, "One Hundred Per Cent in the Fundamentals," Educational Method, XVI (January, 1937), p. 170.

4 James H. Smith, "Individual Variations in Arithmetic," The Elementary School Journal, XVII (November, 1916), p. 197.

5 Guy M. Wilson, "Corrective Load in the Fundamentals of Arithmetic in Grades VI, VII, and VIII," Official Report of the American Educational Research Association, 1937, p. 240.

9. Lack of knowledge on the teacher's part of how the child works.[1]
10. Poor teaching on the part of some teachers.

Previous Studies in the Field of Corrective Arithmetic

There have been several studies made in this field by graduate students at Boston University, and by a few other individuals in various parts of the country.

In 1934 Bowdren studied, and worked individually with, five normal fifth and sixth grade pupils. She was able to bring each up to satisfactory work in arithmetic for their grade, and succeeded in getting each to obtain 100% accuracy in the fundamentals.[2]

Pucko, in 1935, worked individually with five children with low I. Q.'s who were definite "problems" in arithmetic. According to him significant gain in time and score was made in all but one of the final tests.[3]

Soles, also in 1935, worked with twenty-three children who were failing in arithmetic. They were a random selection of fourth, fifth, and sixth grade children whose I. Q.'s ranged from 84 to 132. However, he did not record the specific results of his attempts to improve their standing. His study includes

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1 Florence Ridlon, "What Need is there for Corrective Arithmetic, and What Progress is it Possible to Achieve in a Limited Time?" Unpublished Master's thesis of Boston University, 1939.

2 Marion Bowdren, "Five Case Studies of Arithmetic Failures." Unpublished Master's thesis of Boston University, 1934.

3 Roman F. Pucko, "Five Case Studies of Arithmetic Failures." Unpublished Master's thesis of Boston University, 1935.

a somewhat complete scheme of diagnostic and corrective measures for addition.[1]

In 1936 Caton diagnosed the errors made in multiplication by fourth, fifth, and sixth grade pupils, and worked remedially with a group of the fifth and sixth graders. She concluded that her study justified the statement that every normal pupil in grades five and six can secure perfect mastery in multiplication if the teaching is satisfactory.[2]

Also in 1936 Randall carried on a similar study at the Junior High School level. After testing a large group in addition and subtraction, he selected a group of eight eighth grade pupils with high I. Q.'s and low scores in the fundamentals with which to work. He showed that it is possible with pupils of higher than average intelligence to correct faults in factual knowledge and process skills with a reasonable expenditure of time and properly motivated remedial work.[3]

These earlier studies, it will be seen, were carried on, either with individuals or with small groups of children. Beginning in 1937 the scope of such studies was enlarged to include entire classes, and in 1938 and 1939, entire buildings and selected grades throughout entire school systems.

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1 Edward Soles, "Diagnostic and Corrective Measures in Addition." Unpublished Master's thesis of Boston University, 1935.

2 Anne J. Caton, "How Much Time is Needed to Take an Average Fifth or Sixth Grade Pupil from Inaccuracy to 100% Accuracy in a Fundamental Process of Arithmetic,- Multiplication for Example?" Unpublished Master's thesis of Boston University, 1936.

3 Joseph H. Randall, op. cit.

Obviously, the cooperation of the various class room teachers had to be secured, and upon them resolved the bulk of the work of applying corrective procedures to needy cases.

A forerunner to these studies made by individual graduate students was the W. P. A. project of 1936, sponsored by Wilson and carried on in fifteen school systems in greater Boston. A very small percentage of perfect scores was found. The conclusion, therefore, was that there was need for a higher order of teaching than appeared to be common. In one city, City O, the results were different, showing a mean of 99.34 and 89% of perfect in addition, for example.[1]

Table I and Table II show the results of the initial testing of the more recent studies. They are restricted, however, to the grades and the processes with which the present study is concerned; namely, grades IV, VI, and VIII, and addition, subtraction, and multiplication. That is, although Hanley's study, for instance, included grade V, because the present study does not concern grade V, the results of Hanley's findings for grade V are not included in these Tables.

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1 Guy M. Wilson, op. cit.

TABLE I. THE MEDIAN SCORES AND TIMES OF THE INITIAL TESTING FOR THE EARLIER STUDIES

Grade	Test	W.P.A.[1] 1936		Hanley[2] 1938		Yarbrough[3] 1938		Nelson[4] 1938		Houghton[5] 1939		Ridlon[6] 1939		Ringer[7] 1940	
		Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.
IV	A.P.			68	23										
	S.P.			48	22										
VI	A.P.			88	11	84	11			80	11	84	10		
	S.P.			88	10	88	9			92	9	88	7		
	M.P.			84	33	76	14			64	20	60	13		
VIII	A.P.							92	8	96	7			88	9
	S.P.							92	7	96	7			92	6
	M.P.							84	10	84	12			72	10

1 Guy M. Wilson, "Corrective Load in the Fundamentals of Arithmetic in Grades VI, VII, and VIII," Official Report of the American Educational Research Association, 1937.

2 Gertrude L. Hanley, "Corrective Load in the Fundamentals of Arithmetic in Grades IV, V, and VI."

3 Dorothy Yarbrough, "A Diagnosis of Pupils' Errors in Arithmetic with a View to Corrective Work Carried on Through the Cooperation of the Teachers."

4 Helen G. Nelson, "The Corrective Load in Arithmetic in a Junior High School."

5 Leroy K. Houghton, "To Study the Thesis that there is a use for a Corrective Program in the Fundamentals of Arithmetic in the Grammar School Curriculum."

6 Florence Ridlon, "What Need is there for Corrective Arithmetic and What Progress is it Possible to Achieve in a Limited Time?"

7 Alberta Ringer, "A Two Year Diagnostic and Corrective Study in the Four Fundamentals of Arithmetic with a Group of Children Through Grades Seven and Eight."

TABLE II. THE MEAN SCORES AND TIMES OF THE INITIAL TESTING FOR THE EARLIER STUDIES *

Grade	Test	W.P.A. 1936		Hanley 1938		Yar-brough 1938		Nelson 1938		Hough-ton 1939		Ridlon 1939		Ringer 1940	
		Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.
IV	A.P.			65	23										
	S.P.			46	22										
VI	A.P.	89	9	88	13	86	12			79	13	83	10		
	S.P.	88	7	84	11	85	9			87	10	84	8		
	M.P.	77	11	82	33	75	16			56	21	58	14		
VIII	A.P.	89						88	8	94	8			83	9
	S.P.	88						86	7	95	6			80	6
	M.P.	79						80	10	81	12			73	10

* The means have been taken to the nearest whole number.

Table I is read as follows: In Hanley's study on the initial testing in grade IV in addition the median score was 68 and the median time was 23 minutes; in subtraction, the median score was 48 and the median time, 22 minutes. In grade VI in addition the median score was 88 and the median time was 11 minutes; in subtraction, the median score was 88 and the median time 10 minutes; in multiplication, the median score was 84, the median time being 33 minutes. The remainder of the Table is read in a similar manner.

Table II shows the mean scores and times for the initial testing in the same grades and processes, and is read similarly.

Table III shows the number of children included in each of these studies.

TABLE III. THE NUMBER OF CHILDREN IN THE 1936 - 1939 STUDIES

Study	W.P.A. 1936	Hanley 1938	Yar-brough 1938	Nelson 1938	Hough-ton 1939	Ridlon 1939	Ringer 1940
No. of children	17,700	1124	127	1215	80	194	27

TABLE IV. PERCENTAGE OF CHILDREN IN NEED OF CORRECTIVE WORK AT INITIAL TESTING IN THE 1936 - 39 STUDIES*

Grade	Test	W.P.A. 1936	Hanley 1938	Yar-brough 1938	Nelson 1938	Hough-ton 1939	Ridlon 1939	Ringer 1940
IV	A.P. S.P.		100% 100%					
VI	A.P. S.P. M.P.	78% 83% 93%	99%	95% 91% 98%		97% 94% 100%	94% 91% 100%	
VIII	A.P. S.P. M.P.	68% 65% 93%			88% 83% 95%	75% 83% 95%		96% 93% 100%

* The score standard for the W.P.A. study was 96; for Yarbrough's study, 90; for all other studies it was 100. The time standards varied somewhat from study to study.

Table IV shows the percentage of children who were in need of corrective work at the time of the initial testing in the various studies. Thus it will be seen that even when the mean or average runs as high as 95, as is the case in Houghton's study in grade VIII on the S. P. Test, the percentage of pupils needing corrective work, when viewed in terms of mastery, can run as high as 83; or, as is the case in Ridlon's study in grade VI on

the A. P. Test, the mean is as high as 83, while 94% of the pupils were in need of corrective work. In this connection Wilson says, "We have apparently failed to grasp the idea that drill in simple tool material should be aimed at perfect scores, not a 75% average, which means less than 20% of the children with perfect scores."[1]

TABLE V. THE MEDIAN SCORES AND TIMES OF THE FINAL TESTING FOR THE EARLIER STUDIES

Grade	Test	W.P.A. 1936	Hanley 1938		Yar-brough 1938		Nelson 1938	Hough-ton 1939		Ridlon 1939		Ringer 1940	
		Sc.	Sc.	T.	Sc.	T.	Sc. T.	Sc.	T.	Sc.	T.	Sc.	T.
IV	A.P.	No	80	16			No						
	S.P.		84	15									
VI	A.P.	re-	92	12	96	8	re-	96	7	92	9		
	S.P.		96	9	96	7		100	7	96	6		
	M.P.	test-	84	15	92	11	test-	100	12	84	10		
VIII	A.P.	ing					ing	100	6			100	9
	S.P.							100	5			100	7
	M.P.							100	8			100	10

In Tables V and VI are found the median scores and times and the mean scores and times for the final testing for these same studies. Table V is read as follows: In Hanley's study in the final testing in grade IV on the A. P. Test the median score was 80; the median time, 16 minutes; on the S. P. Test the median score was 84; the median time, 15 minutes. The remainder of the

1 Guy M. Wilson, "Corrective Load in the Fundamentals of Arithmetic in Grades VI, VII, and VIII," Official Report of the American Educational Research Association, 1937.

Table is read in the same way. Table VI is read similarly, the scores and times given being the means.

TABLE VI. THE MEAN SCORES AND TIMES OF THE FINAL TESTING FOR THE EARLIER STUDIES

Grade	Test	W.P.A. 1936		Hanley 1938		Yar-brough 1938		Nelson 1938	Hough-ton 1939		Ridlon 1939		Ringer 1940	
		Sc.	T.	Sc.	T.	Sc.	T.	Sc. T.	Sc.	T.	Sc.	T.	Sc.	T.
IV	A.P.			80	18									
	S.P.	No		74	20			No						
VI	A.P.	re-		90	13	96	9	re-	95	7	91	10		
	S.P.			91	10	96	7		99	7	93	7		
	M.P.	test-		80	17	92	12	test-	96	12	83	11		
VIII	A.P.								99	6			99	9
	S.P.	ing						ing	99	4			99	7
	M.P.								99	9			96	10

* The means have been taken to the nearest whole number.

From a comparison of Tables I and II with Tables V and VI it will be seen that considerable gains both in score and time were secured in every instance. In most cases, the gains are significant, statistically speaking. They are significant in multiplication, and approach statistical significance in addition and subtraction.

In 1939 Gillmore made a similar study at the Senior High School level, testing widely and showing that the need for corrective arithmetic persists even to this level. He worked individually with four failing pupils and proved that success under the 100% Plan is possible even with pupils of low I. Q.[1]

1 Ralph H. Gillmore, "Corrective Arithmetic in Senior High School." Unpublished Master's thesis of Boston University, 1939.

In addition to these studies undertaken by Boston University students there have been others at scattered points throughout the United States. A few of them will be briefly mentioned here. Such a study was carried on by the University of Kansas in three small school systems in 1925-26. A total of 357 children in grades VII - X was tested in the fundamentals. The scores made fell far below the standard scores. Fifty per cent of the high school freshmen did not equal the standard scores for fourth grade pupils.[1]

A similar but smaller study was conducted in 1927 in the fourth grade at Buffalo Lake, Minnesota.[2]

In 1929 Rubie Mann tested 240 Junior High School pupils for automatic response to the more difficult combinations in the four processes. Her conclusion was, "This 7A group has not attained anything like mastery of the 132 combinations used in this survey." Only 2% indicated complete mastery of all four processes.[3]

Also in 1929 Ora Hanna made such a study in her own seventh grade in Cedarville, Ohio. She found that all but one needed remedial work in all four processes, and that one, in all but subtraction, even though the group as a whole rated above the

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1 F. P. O'Brien, Improvement of Instruction in Arithmetic, pp.1-42.

2 Henry J. Otto, "Remedial Instruction in Arithmetic," The Elementary School Journal, XXVIII (October, 1927), pp. 124-133.

3 Rubie Mann, "The Need of Junior High School Pupils for Stronger Elementary Bonds in Arithmetic," Master's thesis of the University of Southern California, 1929.

standard set for the grade.[1]

Williams and Whitaker report a study made in eleven Chicago schools in 1936 which studied arithmetic deficiencies and undertook remedial measures.[2]

Ballenger writes of how he attacked the addition problem in his own school in Iowa City, Iowa. His goal was 100% accuracy. He found short attention span one of the greatest weaknesses with which he had to contend.[3]

Foote, a graduate student at the University of New Hampshire, studied the arithmetic situation in two New Hampshire high schools. He discovered that the arithmetic age median of the group was one year, nine months less than the mental age median. He found the poorest results among those who had not had any formal arithmetic for at least a year. His data shows that his remedial group made a greater advance in both computation and reasoning than did any of the other groups who had had merely some form of regular high school mathematics.[4]

Stull, a graduate student at New York State College for Teachers, surveyed the arithmetic achievement in a Junior High

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1 Walter S. Guiler, "Improving Computational Ability," The Elementary School Journal, XXX (October, 1929), pp.111-116.

2 Claude L. Williams, and Ruth L. Whitaker, "Diagnosis of Arithmetic Difficulties," The Elementary School Journal, XXXVII (April, 1937), pp.592-600.

3 H. L. Ballenger, "Overcoming Some Addition Difficulties," Journal of Educational Research, XIII (February, 1926), pp.111-17.

4 Lewis F. Foote, "The Need and Value of Remedial Arithmetic." Unpublished Master's thesis of University of New Hampshire, 1933.

School. Although in his study he gives more attention to class means and comparisons of class means with standard means than to individual scores; nevertheless, he found the pupils tested deficient in addition and multiplication, and concluded that they needed more drill in accuracy in the fundamentals.[1]

Arthur Smith, a graduate student at the University of Chicago, has dealt with a control as well as an experimental group in his study on remedial arithmetic. He equated his groups with some care, taking into consideration teachers' efficiency, pupil general attainment and arithmetic achievement, as well as age and size of groups. The experimental group received regular remedial help on the fundamentals, while the control group had merely regular class work. The gains made by both the experimental and control groups, when the groups were matched as wholes, are shown in Table VII. The tests used were a general arithmetic attainment test containing arithmetic facts and very simple examples which was constructed by the investigator, and the computation part of the Stanford Achievement Test.

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1 J. Milton Stull, "A Survey of the Arithmetic Achievement of the Seventh and Eighth Grades of the Hornell Junior High School." Unpublished Master's thesis of New York State College for Teachers, 1936.

TABLE VII. COMPARISON OF GAINS IN MEAN SCORES OBTAINED IN SECOND TESTS OF THE SMITH STUDY

Group	Attainment Test			* Difference	Stanford Achievement Test in Computation			* Difference
	Test 1	Test 2	Gain in score		Test 1 Form V	Test 2 Form W	Gain in score	
			Third Grade					
Experimental	224.9	262.16	37.26	21.06	34.63	46.69	12.06	5.31
Control	227.2	243.4	16.2	-----	35.21	41.96	6.75	---
			Fourth Grade					
Experimental	87.88	110.93	23.05	11.45	54.26	58.57	4.31	.74
Control	88.4	100.0	11.6	-----	54.18	57.75	3.57	---

* Difference favorable to experimental group.

In addition to considering the groups as wholes Smith compared 26 pairs of third grade and 34 pairs of fourth grade pupils. In Grade III in the attainment test in 20 of the 26 pairs, and in the computation test in 18 of the 26 pairs the gains made by the pupil from the experimental group exceeded the gains made by the pupil from the control group. In the computation test 3 pairs were tied. In Grade IV in the attainment test in 26 of the 34 pairs, and in the computation test, in 20 of the 34 pairs, gains by the pupil from the experimental group exceeded the gains made by the pupil from the control group. In both tests 2 pairs were tied.[1]

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1 Arthur J. Smith, "The Value of a Diagnostic and Remedial Program in Arithmetic." Unpublished Master's thesis of the Univeristy of Chicago, 1936.

Place of this Study

In spite of the fact that the field of corrective arithmetic is not a new one, in the opinion of the writer, there is still room for further studies in it. There are two principal reasons for this. First, data does not become convincing, nor can it carry weight, until study after study, proving essentially the identical thing, be made. An isolated study, even two or three studies, mean at best only a partial answer to a problem. Repeated studies along similar lines supporting similar conclusions carry the weight of proof. "Not only is reliability vastly increased by massing experiments, but so also is validity."[1] In the field of corrective arithmetic each study so far has reached a similar conclusion. Will this study add a further burden of proof to the conclusions already reached; or will a different set of conditions be discovered that will produce a different conclusion?

Second, such a study should bring inspiration and stimulation to the teachers in the school system where it is carried on. Too often teachers are content with fairly good class averages, and with a goodly number of their pupils reaching the passing grade of 75, forgetting that "averages are often used to cover up the tragedy of errors."[2] Often unless it is particularly

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1 Charles C. Peters, "An Example of Replication of an Experiment for Increased Reliabilty," Journal of Educational Research, XXXII (September, 1938), p.4.

2 Guy M. Wilson, and Gertrude L. Hanley, "For Basic Drill in Arithmetic, What Norm or Average is Satisfactory?" Mathematics Teacher, XXXII (April, 1939), p.175.

brought to their attention, teachers do not realize how very few of their pupils are reaching the 100% mark in the fundamentals of arithmetic. Neither do they realize the improvement that may be brought about by a few minutes of systematic remedial work regularly given on the fundamentals. To bring such things to the minds of the teachers, to help them to realize some of the possibilities is the second reason for another study in the field.

Furthermore, this study has an aspect which is new to Boston Univeristy studies. There is to be a control group in addition to the experimental group. One fourth grade and one sixth grade and one building containing five eighth grades are to be given the initial tests exactly as the other rooms; however, the test results will not be made known to either teachers or pupils in these rooms. They are to receive no directions, or suggestions for remedial work. It is hoped that the class work in these rooms will proceed as usual, in order that any difference in the results of the retests between this group and the experimental group may be noted.

Also, the writer is to work remedially with two different classes, a fourth grade and an eighth grade, in order to note differences in the time and procedures necessary to bring the groups up to 100% accuracy.

Plan of Procedure for this Study

The plan of procedure for this study is as follows:

1. The study is to include pupils in the fourth, sixth, and eighth grades only.

2. The testing is to be done in addition and subtraction in grade IV and in addition, subtraction, and multiplication in grades VI and VIII. The Wilson Tests, Addition Process (A.P.), Subtraction Process (S.P.), and Multiplication Process (M.P.) will be used.* Initial tests will be given in October, and retests in March.

3. One building containing one fourth grade and one sixth grade and one building containing five eighth grades are to receive no stress on, and no particular instructions for, remedial work based on the results of the diagnostic tests. In these two buildings regular class work will proceed as usual.

4. The writer is to work remedially with one fourth grade and one eighth grade.

5. In the other fourth, sixth, and eighth grades, with the exceptions of the buildings mentioned in 3 above, remedial work is to be carried on by the regular class room or arithmetic teachers. For this, the writer is to make some suggestions.

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* Copies of these tests will be found in the Appendix.

CHAPTER II

THE INITIAL TESTING

Composition of the Group Tested

Testing Procedure

Scoring of the Tests

Test Results

CHAPTER II

THE INITIAL TESTING

Composition of the Group Tested

For the present study a total of 1026 children were given the initial tests in October. These included 337 fourth grade pupils, 348 sixth grade pupils, and 341 eighth grade pupils. Thirty-five rooms with thirty-five different teachers in nine buildings were involved.

Since the school system does not have a program of intelligence testing for each pupil, and since I.Q.'s were not available in most instances, the intelligence rating of the pupils has had to be disregarded in this study. It is assumed that since every fourth, sixth, and eighth grade in the school system was tested that those tested represent a random scattering such as would be found in any unselected group anywhere. Some authors appear to think that intelligence is not the strong factor in computation that it is in the reasoning phases of arithmetic.[1] There is some evidence from such studies as the one by Soles that any pupil with an I.Q. of 80 can be brought to mastery in

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1 Homer B. Reed, Psychology of Elementary School Subjects, p. 368.

O. C. France, and P. R. Stevenson, "Remedial Instruction in Arithmetic," Educational Research Bulletin, Ohio State University, Vol.VII (1923), p.293.

Rubie Mann, "The Need of Junior High School Pupils for Stronger Elementary Bonds in Arithmetic." Unpublished Master's thesis of University of Southern California, 1929.

the fundamentals.[1]

In the spring of 1939, in connection with a general survey of the school system conducted by The New England School Survey Associates, the Metropolitan Achievement Test was administered in grades III, VI, and VIII. The medians in arithmetic for Grade III were, on the fundamentals, 4-1, showing a difference of +2 from the test norm, and on the problems, 3-4, showing a difference of -5 from the test norm. A word of explanation will help at this point. The 4-1 on the fundamentals for Grade III means that the third grade pupils reached the first month of the fourth year, which of course would be two months above the expectation for the third grade in May. The third grade median on problems of 3-4 means that instead of making 3-9, the expectation, they made five months less, namely 3-4; therefore a difference of -5 from the norm. A score of 4-1 on the fundamentals means that 56 of the 85 examples were solved correctly. In other words, there was considerable opportunity for making mistakes even though the expected norm was exceeded.

The grade norm reached by the sixth grade was 6-7 on the fundamentals, a difference of -2 from the norm, and 6-6 on problems, a difference of 3 from the norm; by the eighth grade, 8-9, a difference of 0 from the norm. Grade XII was given the Progressive Achievement Test. The median score in arithmetic

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1 Edward Soles, "Diagnostic and Corrective Measures in Addition." Unpublished Master's thesis of Boston University, 1935.

was 11-9, a difference of -10 from the test norm.[1]

Testing Procedure

The tests for the present study were administered by the classroom teachers in Grades IV and VI and by the arithmetic teachers in Grade VIII. To acquaint the teachers with the study, and to insure that all tests would be administered similarly, a letter of instruction was sent to each teacher. A copy of this letter appears in Exhibit A on page 26.

Scoring of the Tests

To reduce to a minimum the variability in the scoring of the tests, all of the tests were scored by the writer. The scores were then recorded on the same sheets on which the teachers had already recorded the names of the pupils and the time taken for each test. Exhibits B, C, and D are sample sheets, one for each grade. On these sample sheets the last names of the children have been omitted.

Test Results

The score standard for all tests for all grades was set at 100. The time standard varies with the test and the grade. It was set in each case after a careful survey of other similar studies and after careful comparison of scores and times in the

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1 George H. Baldwin et al, "A Study of the Schools of Newport, Rhode Island," pp.27,28.

EXHIBIT A. COPY OF FIRST LETTER SENT TO TEACHERS CONTAINING DIRECTIONS FOR GIVING THE TESTS.

The accompanying tests are part of a project sponsored by Boston University and agreed to by the Newport School Committee. Your co-operation will be appreciated.

The addition test is to be given Monday, Oct. 2nd; the subtraction test on Tuesday, Oct. 3rd; and the multiplication test on Wednesday, Oct. 4th. Before giving any of the tests please have the enclosed paper prepared with the names of the children written in, alphabetically, last name first.

The procedure each day is essentially the same. Always stress the particular process to be used.

Distribute the tests, and have the pupils fill in their names, ages, grade, etc. Say to the pupils: "This is a test in addition.* You are to add in each one of the examples. There is no time limit. You may take as long as is necessary to finish the page. When you have finished every example, turn your paper over and continue with your assigned work." (Note: the only point here from the standpoint of the testing program is to keep the children busy so that they will not interfere with those who have not yet finished.) "Pencils up! Ready, begin!"

Note the exact time when the test is begun. As each pupil finishes and turns his paper over, please record in the space provided for it, beside each child's name, the number of minutes that child has taken. The child does not need to record his own time. In fact, if the teacher can record the time without the children being aware of it, so much the better.

When each set of papers is collected, please arrange the papers in alphabetical order and send them to your principal's office. You do not need to correct them. On Wednesday please include the sheet containing the list of names and record of time taken for each test. Thank you!

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* On Tuesday say, "This is a test in subtraction. You are to subtract -" etc.
On Wednesday say, "This is a test in multiplication. You are to multiply -" etc.

EXHIBIT B. A SAMPLE SHEET SHOWING NAMES, AGES, SCORES, AND TIME FOR ONE FOURTH GRADE.

School _____ Grade IV Teacher _____

Name	Age	A. P. Test Score	A. P. Test Time	S. P. Test Score	S. P. Test Time
Albert	9 - 1	60	25	92	19
Muriel	9 - 1	88	46	88	36
Emmett	9 - 1	72	48	92	14
Edward	9 - 8	absent		absent	
Robert	9 - 8	84	35	24	32
Kristin	9 - 1	88	23	72	23
David	11 - 4	52	59	0	32
Esther	12 - 2	96	20	60	14
Robert	13 - 7	80	37	36	38
Arline	9 - 4	88	23	44	19
Alton	9 - 3	60	35	64	24
Edward	8 - 8	88	30	68	19
Miriam	9 - 9	84	21	72	19
Earle	10 - 3	92	14	8	39
Leroy	12 - 4	88	28	68	15
Joseph	12 - 7	28	28	0	13
Carter	9 - 8	68	16	88	10
John	9 - 4	76	21	48	12
Rose	9 - 10	96	14	64	10
Susan	9 - 3	96	21	84	15
Robert	8 - 9	92	20	84	16
Anne	9 - 4	76	20	92	15
Melvin	9 - 2	64	18	56	15
William	9 - 7	68	44	60	19
Gloria	9 - 7	88	44	56	19

EXHIBIT C. A SAMPLE SHEET SHOWING NAMES, AGES, SCORES, AND TIME FOR ONE SIXTH GRADE.

School _____ Grade VI Teacher _____

Name	Age	A. P.Test Score	A. P.Test Time	S. P.Test Score	S. P.Test Time	M. P.Test Score	M. P.Test Time
Robert	11 - 7	92	22	44	14	76	13
Artemesia	11 - 1	72	29	84	10	72	22
John	12 -10	92	17	92	10	68	11
Dorothy	11 -10	92	15	72	10	68	19
Betty	11 - 1	92	10	92	4	80	6
Jessie	11 -11	92	14	92	7	80	12
Margaret	10 - 8	96	23	60	11	40	11
Kathleen	11 - 3	96	10	100	9	80	17
Roger	11 - 2	84	14	84	12	52	15
Charles	10 -11	84	7	84	3	76	7
Arlene	11 - 4	100	20	92	9	88	10
Dorothy	13 - 4	96	10	52	11	64	13
Barbara	11 - 4	88	6	100	5	76	7
Henry	15 - 4	88	9	64	8	48	13
William	13 - 1	76	27	100	14	92	23
Joseph	13 - 2	96	7	84	6	64	11
Thomas	13 - 0	72	15	80	8	44	18
Winifred	10 -11	80	19	72	9	80	16
Fred	11 - 1	92	13	68	8	84	8
Edith	13 - 3	92	15	72	9	76	19
Marston	11 - 5	84	15	88	8	72	17
Alfred	14 - 2	88	18	92	8	76	14
Alice	11 - 1	96	25	100	5	72	12
Catherine	11 - 5	96	20	80	6	76	16
Edmund	11 - 0	92	11	60	6	56	12
Doris	11 - 1	100	13	100	20	56	20
Jocelyn	11 - 6	88	15	80	11	72	18
Dorothy	12 - 9	100	14	88	11	72	19
Thomas	10 - 5	76	17	84	15	76	20
Raymond	11 - 3	100	21	64	12	76	21
Marion	11 - 1	84	14	92	7	92	12

EXHIBIT D. A SAMPLE SHEET SHOWING NAMES, AGES, SCORES, AND TIME FOR ONE EIGHTH GRADE

School _____ Grade VIII Teacher _____

Name	Age	A.P.Test Score	A.P.Test Time	S.P.Test Score	S.P.Test Time	M.P.Test Score	M.P.Test Time
Margaret	12 - 7	56	13	84	7	88	11
John	12 - 9	84	9	96	7	92	11
Ruth	12 - 9	100	9	100	8	68	10
Alice	13 - 5	96	8	100	5	76	9
Thomas	13 - 2	60	12	96	8	88	14
Geraldine	16 - 0	80	11	88	8	64	13
Olivia	15 - 0	absent		96	6	92	11
Faith	13 - 3	76	10	80	5	72	8
Charles	12 - 8	92	9	88	7	68	9
Theresa	13 - 1	68	6	92	4	84	6
Doris	14 - 3	80	8	92	5	92	9
George	14 -11	84	6	100	4	68	9
Elaine	12 - 9	80	10	92	5	76	9
John	15 - 1	84	10	100	6	absent	
John	13 - 0	84	9	88	6	92	9
Helen	15 - 9	68	7	100	5	88	9
Mary	14 - 7	80	7	88	5	64	9
Robert	13 - 8	96	6	88	5	88	9
Edna	12 -11	92	7	100	6	84	9
William	13 - 3	92	9	88	9	absent	
Gertrude	16 - 3	68	6	80	7	56	8
Dorothy	13 - 5	84	8	100	8	92	11
Fred	13 - 2	100	9	100	7	84	14
Dalton	13 - 8	88	10	80	8	84	13
Marian	16 - 4	88	12	100	7	76	12
Doris	13 - 8	96	11	92	5	72	10
Arthur	16 - 4	96	7	96	8	80	7
Marion	14 - 0	84	9	88	5	84	15
Robert	13 -10	96	6	92	9	80	9
Marian	16 -10	88	13	92	8	76	14

present study. While "speed without accuracy is of little value"[1]; nevertheless, "it is desirable to develop as high a rate of speed in calculation as is thoroughly consistent with absolute accuracy."[2]

Table VIII shows the distribution according to time and score of all fourth grades on the A. P. Test. From this it will be seen that of the 323 children taking the test, only 8 or 2.47% achieved perfect scores. Of these only 2 were able to achieve a perfect score within the time standard of 13 minutes. The corrective load, therefore, was 99.40% of the group. Within the time standard were 59 or 17.70%, although their scores went as low as 40. The range of scores was from 24 to 100, the median being 80 and the mean 77.52. The time ranged from 8 to 70 minutes, the median being 21 and the mean 21.7 minutes. Such excessive slowness would indicate poor work habits and a lack of mastery of the facts.[3]

Tables IX and X are sample Tables of individual fourth grades on the A. P. Test. Table IX shows comparable tabled results for the fourth grade making the best showing on the test, while Table X shows tabled results for the fourth grade making the poorest showing on the same test. The former shows that out of a total of 30 pupils 4 or 13.32% made perfect scores, with one of

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1 Lois C. Mossman, Principles of Teaching and Learning in the Elementary School, p. 243.

2 Paul Klapper, The Teaching of Arithmetic, p. 91.

3 Guy M. Wilson, "The Challenge of 100% Accuracy in the Fundamentals of Arithmetic," Educational Method, XV (November, 1935), p. 92.

TABLE VIII. DISTRIBUTION ACCORDING TO TIME AND SCORE OF ALL FOURTH GRADES ON THE INITIAL A. P. TEST.

Score	Time in minutes 8	9	10	11	12	13	14	15	16	17	18	19	20	21 to 25	26 to 35	36 to 70	f	Percentages
100			1	1					2				2	2			8	2.47
96				2		3	1			2	2	2	1	8	1		22	6.79
92	1		1			3	4		4	3	2		4	3	7	2	33	10.21
88	1		1	1	2	3	1	3	4	4	2	1		7	9	4	44	13.64
84	1	1	2	2	3	2	2		2	4	4		2	7	4	2	37	11.45
80	1	1	2	2					2		2	1	3	4	7	2	27	8.35
76		1			1	3	1	1	3	2	3		1	7	9	3	36	11.14
72		2	1			3		1	2	1	2	2	2	4	6	3	29	8.97
68		1			2	1		1	3	2		1	2	1	5	5	24	7.42
64			1						2		2			5	4	2	16	4.95
60									1			2		4	5	3	15	4.64
56							1	2	2		2		2	1	3		12	3.71
52								2		1					1	1	5	1.54
48						2								2		1	5	1.54
44															1	2	3	.92
40		1				1								2		1	5	1.54
36																		
32												1					1	.30
28															1		1	.30
24															1		1	.30
f	4	7	9	8	8	21	10	10	27	19	21	10	19	57	64	29	323	100.18

57
17.10%

266
82.90%

Score		Time
24 - 100	Range	8 - 70
80	Median	20
77.52	Mean	21.7

Number up to accuracy and time standards - 2 or 0.60%
Number not up to above standards - 321 or 99.40%

Score standard - 100
Time standard - 13 minutes

TABLE IX. DISTRIBUTION ACCORDING TO TIME AND SCORE OF GRADE IV, BUILDING F, ROOM 1, ON THE INITIAL A. P. TEST

Score	Time in minutes																				
	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26 to 35	36 to 42	f	Percentages
100		1						2			1									4	13.32
96												1	1							2	6.66
92					1						1									2	6.66
88								3										1		4	13.32
84			1						2				1	1				1	1	7	23.31
80								1												1	3.33
76	1		1				1								1					4	13.32
72	1			1				1										1		4	13.32
68																			1	1	3.33
64																					
60																					
56																					
52																					
48																					
44																					
40	1																			1	3.33
f	3	1	2	1	1		1	7	2		2	1	2	1	1			3	2	30	99.90

8 (9–13 minutes): 26.64%

22 (15–42 minutes): 73.36%

Score		Time
40 - 100	Range	10 - 42
84	Median	16
83.2	Mean	15.3

Number up to accuracy and time standards - 1 or 3.33%

Number not up to above standards - 29 or 96.67%

Score standard - 100

Time standard - 13 minutes

TABLE X. DISTRIBUTION ACCORDING TO TIME AND SCORE OF GRADE IV, BUILDING C, ROOM 2, ON THE INITIAL A. P. TEST.

Time in minutes

Score	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	25 to 30	31 to 40	41 to 52	f	Percentages
100																					
96																					
92																					
88															1	1				2	6.90
84						1				1			1			1				4	13.80
80	1		1	1										1						4	13.80
76							1				1									2	6.90
72								1											1	2	6.90
68		1															1			2	6.90
64															1			1		2	6.90
60												1			1		1			3	10.34
56									1		1						1			3	10.34
52								1		1										2	6.90
48						1														1	3.44
44																		1		1	3.44
40						1														1	3.44
f	1	1	1	1		3	1	2	1	2	2	1	1	1	3	2	3	2	1	29	99.00

7 (times 8–13)
24.08%

22 (times 14–52)
75.92%

Score		Time
40 - 88	Range	8 - 52
68	Median	18
67.17	Mean	20.5

Number up to accuracy and time standards - 0
Number not up to above standards - 29 or 100%

Score standard - 100
Time standard - 13 minutes

of them within the accepted time standard; whereas the latter shows no scores above 88. In the former the scores range from 44 to 100, the median being 84 and the mean 83.25, while the time ranges from 10 to 42 minutes with the median at 16 and the mean at 15.3 minutes. In Table X the range of scores is from 40 to 88 with the median at 68 and the mean at 67.17. The time ranges from 8 to 52 minutes, the median being 18 minutes and the mean 20.5 minutes.

Table XI shows the distribution according to time and score for all fourth grades on the S. P. Test. Of the 326 children taking the test, again there were 8 or 2.44%, who were able to achieve a score of 100. Five accomplished this within the time standard of 12 minutes. There were 110 or 33.66% who completed the test within 12 minutes, although their scores extended as low as 0. The scores thus ranged from 0 to 100, the median being 60 and the mean 56.01. The time ranged from 5 to 55 minutes, the median being 15 and the mean 16.5 minutes. The corrective load was found to be 98.47% of the group.

Tables XII and XIII are sample Tables of individual fourth grades on the S. P. Test. Table XII shows results for the fourth grade making the best showing on the test, and Table XIII for the fourth grade making the poorest showing. In neither case are they the same grades shown in Tables IX and X. Table XIII shows a corrective load of 100%; whereas Table XII has 4 or 18.16% with perfect scores, and a corrective load of only 71.84%. In Table XII the range of scores is from 32 to 100, the median being 92 and the mean 92.09. In Table XIII the scores range

TABLE XI. DISTRIBUTION ACCORDING TO TIME AND SCORE OF <u>ALL</u> FOURTH GRADES ON THE INITIAL S. P. TEST

Time in minutes

Score	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21 to 30	31 to 40	55	f	Percentages
100	1		1			1		2		1				1	1					8	2.44
96		1	1	1	1	6	1	1		1	1	1				1	4	2		22	6.73
92			1	1	2	2	2		1	2	2		2	2	5		2			24	7.34
88					2	3	1	3	2	2		1	1			1	2	1		19	5.81
84		1	1		2	1	1		2	2	1	2	1				1	1		16	4.89
80			2		2	1	1	1		2	1	1		1	2		1			15	4.59
76			1			1		3	1	1	1			1	1		3			13	3.97
72						1	1				1				3		4			10	3.06
68						1	1	1	1	3	1				1	1				10	3.06
64			1	1		2	1		2			2			1	3	2			15	4.59
60			1		2			1	2	1		1	1		3	1	1			14	4.28
56		1				2		1			2	1		2	1	1	1			12	3.67
52					1	1			1	1	1	2		1		1	2	1		12	3.67
48				1		3	2	1		1	1			1	1		1			12	3.67
44						1	1		1			1			2	1	2			9	2.75
40						2	1	1	1	2				2	2	1	4	1		17	5.20
36						1		1	1					2	1		2	2		10	3.06
32						1	1										1			3	.91
28					1						3			1	2	2	2	1		12	3.67
24					1				1			1		1	1	1	6	2		14	4.28
20					1	1				1	1	3			1		1			9	2.75
16					2		1		3		1	1				3	1			12	3.67
12		1		1	1	1		3			1	1	1	1	1	1	3			16	4.89
8					1	1		1		1	1			1	1			1	1	9	2.75
4			1			1				1	1			2						6	1.83
0						1	1				1				1			1		5	1.53
f	1	4	10	5	19	35	16	20	19	22	21	18	6	19	30	19	46	13	1	326	99.06

110 (5–12 minutes) — 33.66%

216 (13–55 minutes) — 66.34%

Score		Time
0 - 100	Range	5 - 55
60	Median	15
56.01	Mean	16.5

Number up to accuracy and time standards - 5 or 1.53%

<u>Number not up to above standards - 321 or 98.47%</u>

TABLE XII. DISTRIBUTION ACCORDING TO TIME AND SCORE OF GRADE IV, BUILDING G, ROOM 2, ON THE INITIAL S. P. TEST

Score	Time in minutes															f	Percentages
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		
100	1		1			1		1								4	18.16
96		1		1		3										5	22.72
92			1			1	1					1		1		5	22.72
88					1											1	4.54
84			1		1							1				3	13.63
80							1	1								2	9.09
76																	
72																	
68																	
64												1				1	4.54
60																	
56																	
52																	
48																	
44																	
40																	
36																	
32							1									1	4.54
f	1	1	3	1	2	5	3	2				1	2		1	22	99.94

18
81.84%

4
18.16%

Score		Time
32 - 100	Range	5 - 19
92	Median	10
92.09	Mean	10.6

Number up to accuracy and time standards - 4 or 18.16%
Number not up to above standards - 18 or 71.84%

Score standard - 100
Time standard - 12 minutes

TABLE XIII. DISTRIBUTION ACCORDING TO TIME AND SCORE OF GRADE IV, BUILDING A, ROOM 2, ON THE INITIAL S. P. TEST

Score	Time in minutes																		
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21 to 25	26 to 30	31 to 40	f	Percentages
100									1										1	2.77
96																				
92																				
88									1										1	2.77
84																		1	1	2.77
80																				
76		1						1											2	5.55
72																				
68																				
64															1				1	2.77
60				1			1												2	5.55
56																				
52																1			1	2.77
48					1														1	2.77
44																				
40													1	1					2	5.55
36													1						1	2.77
32																				
28				1						1									2	5.55
24													1				1		2	5.55
20				1															1	2.77
16						1		1											2	5.55
12	1					1				1	1				1		1		6	16.66
8				1	1								1						3	8.33
4		1			1					1			1						4	11.10
0					1	1											1		3	8.33
f	1	2		4	4	3	1	2	2	3	1		5	1	2	1	3	1	36	99.90

15 (41.55%) — 21 (58.45%)

Score		Time
0 - 100	Range	6 - 40
18	Median	14
30.33	Mean	15.3

Number up to accuracy and time standards - 0
Number not up to above standards - 36 or 100%

from 0 to 100, the median being 18, and the mean 30.33. In Table XII the time ranges from 5 to 19 minutes, the median being 10 and the mean 10.6 minutes. In Table XIII the time ranges from 6 to 40 minutes, the median time being 14 minutes and the mean time 15.3 minutes.

Table XIV shows the distribution of time and score for all sixth gradds on the A. P. Test. Of the 341 children taking the test 47 or 13.77% achieved perfect scores. Of these 25 accomplished it within the time standard of 10 minutes. The scores ranged from 40 to 100. The median score was 88, the mean 89.83. The time ranged from 3 to 35 minutes, the median being 11 and the mean 12.02 minutes. The corrective load was found to be 92.68%.

Tables XV and XVI are sample Tables of individual sixth grades on the A. P. Test. Table XV shows the results for the sixth grade making the best showing on the test, and Table XVI for the sixth grade making the poorest showing on the same test. In Table XV 6 achieved perfect scores within the 10 minute time standard, making the corrective load 81.25% of the class. In Table XVI only 2 achieved perfect scores and only 1 within the time standard, making the corrective load 96.67% of the class. In Table XV the scores range from 80 to 100, with the median at 94 and the mean at 92.50. In Table XVI the scores range from 64 to 100 with the median at 88 and the mean at 86.80. The time, in Table XV, ranges from 7 to 35 minutes, the median being 16 and the mean 17.4 minutes.

Table XVII shows the time and score distribution for all sixth grade pupils on the S. P. Test. Of the 340 pupils taking

TABLE XIV. DISTRIBUTION ACCORDING TO TIME AND SCORE OF ALL SIXTH GRADES ON THE INITIAL A. P. TEST.

Score	Time in minutes																									
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21 to 25	26 to 35	f	Percentages
100	1	1	2	3	4	4	4	6	5		5	4	2			2	1	2	1		47	13.77
96		1	3		12	10	6	11	5	7		5		1	3	5	2	2	6	1	80	23.44
92		1	2	3	9	4	5	6	6	3	7	4	5	1	1	2	1		1	1	68	19.82
88			1	2	4	3	8	5	6	3	4	6	2	3		3	1	2			53	15.52
84		1		1	3	4	4	6	4	2	1	3	2	1		1		1	1		35	10.25
80			2		1	2		7	3	3	2					1	1	2	3	2	29	8.49
76					2		1	2	1		1	2								1	10	2.93
72						1		1				1			1				1	2	7	2.05
68										2		1								1	4	1.17
64											1					1					2	.58
60					1																1	.29
56							1									1					2	.58
52										1											1	.29
48																						
44										1											1	.29
40							1														1	.29
f	1	4	10	9	36	28	30	44	30	25	17	29	10	5	15	7	10		13	8	341	99.76

162 (46.98%) | 179 (53.02%)

Score		Time
40 - 100	Range	3 - 35
92	Median	11
89.83	Mean	12.02

Number up to accuracy and time standards - 25 or 7.32%
Number not up to above standards - 316 or 92.68%

Score standard - 100
Time standard - 10 minutes

TABLE XV. DISTRIBUTION ACCORDING TO TIME AND SCORE OF GRADE VI, BUILDING C, ROOM 4, ON THE INITIAL A. P. TEST

Score	Time in minutes																			f	Percentages
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20				
100	1	2			1		2													6	18.75
96	1	1				1	3	2	2											10	31.25
92			1	2				1	2											6	18.75
88	1									1	2			1						5	15.62
84						1	1													2	6.23
80				1	1											1				3	9.38
f	1	3	3	3	3	4	6	4		1	2			1		1				32	100.00

23
71.16%

9
18.84%

Score		Time
80 - 100	Range	4 - 20
94	Median	9
92.50	Mean	9.4

Number up to accuracy and time standards - 6 or 18.75%
Number not up to above standards - 26 or 81.25%

Score standard - 100
Time standard - 10 minutes

TABLE XVI. DISTRIBUTION ACCORDING TO TIME AND SCORE OF GRADE VI, BUILDING A, ROOM 4, ON THE INITIAL A. P. TEST.

Score	Time in minutes																	
	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21 to 27	35	f	Percentages
100	1				1												2	6.66
96				1				1				1			3		6	19.98
92				1			2			2					1		6	19.98
88			1						1	1				1			4	13.32
84				1				1				1			1		4	13.32
80					1		1								1		3	9.99
76																		
72								1							2		3	9.99
68																1	1	3.33
64												1					1	3.33
f	1		1	3	2		3	3	1	3		3		1	8	1	30	99.90

(7–10 minutes): 5, 16.65% (11–35 minutes): 25, 83.35%

Score		Time
64 - 100	Range	7 - 35
88	Median	16
86.80	Mean	17.4

Number up to accuracy and timr standards - 1 or 3.33%
Number not up to above standards - 29 or 96.67%

Score standard - 100
Time standard - 10 minutes

TABLE XVII. DISTRIBUTION ACCORDING TO TIME AND SCORE OF ALL SIXTH GRADES ON THE INITIAL S. P. TEST.

Score	Time in minutes																						
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	f	Percentages
100	2	1	4	13	8	12	13	6	7	3	1	1	6	1	2		1	1	1		1	84	24.70
96		1	6	9	6	13	12	3	7	3	7	2	1	2	2	1	1					76	22.34
92	1	1	5	5	9	10	8	6	8	4	1	3	1			1	1					64	18.82
88			2	5	4	3	7	1	2	3	1	1					1					30	8.82
84		1	2	1	4	2	2		2		1			1							1	17	4.99
80		1			2	4	2	2	2	3	1	1										18	5.29
76			1		3		1		1	1	3	2										12	3.53
72			1			2	2	3	3		1	1	2	2								17	4.99
68						1	2		2				1									6	1.76
64					1		2				1	1										5	1.47
60					1			1		1			1									4	1.18
56									1					1								2	.59
52										1												1	.29
48																							
44													2									2	.59
40																							
36																							
32																							
28																							
24																							
20																							
16						1																1	.29
12																							
8																							
4																							
0									1													1	.29
f	3	5	21	33	38	48	51	22	36	18	17	12	14	7	4	2	4	1	1		2	340	99.94

Times 2–8: 199 (61.11%); times 9–22: 141 (38.89%)

Score		Time
0 - 100	Range	2 - 22
92	Median	8
89.31	Mean	8.6

Number up to accuracy and time standards - 53 or 15.58%
Number not up to above standards - 287 or 84.42%

test 84 or 24.70% achieved perfect scores. Of these 53 were able to accomplish it within the time standard of 8 minutes. The corrective load for the group, therefore, was 84.42%. The scores ranged from 0 to 100, the median being 92, the mean, 89.31. The time ranged from 2 to 22 minutes, with the median at 8, and the mean at 8.6 minutes.

Tables XVIII and XIX are sample Tables of individual sixth grades on the S. P. Test. Table XVIII shows the tabled results for the sixth grade making the best showing on the test. Of the 33 pupils, 19 or 57.57% achieved perfect scores, although only 4 of them were within the time standard of 8 minutes. The corrective load was 87.88%. The scores ranged from 72 to 100 with the mean at 96.12. The time ranged from 7 to 18 minutes, the median being 13 and the mean, 12.3 minutes. Table XIX shows the tabled results for the sixth grade making the poorest showing on the S. P. Test. There were 5 perfect scores, 2 of them being within the time standard. The corrective load was 93.54%. Scores ranged from 44 to 100, with the median at 84 and the mean at 81.68. The time ranged from 3 to 20 minutes, with the median at 9 and the mean at 9.2 minutes.

Table XX shows the time and score distribution for all sixth grades on the M. P. Test. There were but 2 perfect scores out of the total of 343 children taking the test. Both these were up to the time standard of 12 minutes. The corrective load was, therefore, 99.42%. Scores ranged from 4 to 100, with the median at 76 and the mean at 75.15. Time ranged from 6 to 39 minutes, with the median at 14 and the mean at 14.7 minutes.

TABLE XVIII. DISTRIBUTION ACCORDING TO TIME AND SCORE OF GRADE VI, BUILDING F, ROOM 2, ON THE INITIAL S. P. TEST

Score	Time in minutes													f	Percentages
	7	8	9	10	11	12	13	14	15	16	17	18			
100	2	2	1	3	2		1	4	1	2		1		19	57.57
96		1		1	1	1	2	1	1	2	1			11	33.33
92				1										1	3.03
88															
84															
80															
76															
72							2							2	6.06
f	2	3	1	5	3	1		3	7	2	4	1	1	33	99.99

5 — 15.15%

28 — 84.85%

Score	Time
72 - 100	7 - 18
100	13
96.12	12.3

Number up to accuracy and time standards - 4 or 12.12%
Number not up to above standards - 29 or 87.88%

Score standard - 100
Time standard - 8 minutes

TABLE XIX. DISTRIBUTION ACCORDING TO TIME AND SCORE OF GRADE VI, BUILDING A, ROOM 3, ON THE INITIAL S. P. TEST

Score	Time in minutes																			f	Percentages
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			
100		2					1					1						1		5	16.15
96																					
92	1			2	1	1	1				1									7	22.71
88					1			1												2	6.46
84	1		1				1		1											4	12.92
80			1		1			1												3	9.68
76																					
72							2	1												3	9.68
68						1														1	3.23
64						1				1										2	6.46
60			1					1												2	6.46
56																					
52								1												1	3.23
48																					
44												1								1	3.23
f	1	1	2	3	2	5	4	3	4	2	1	2						1		31	100.22

14 — 45.22%

17 — 54.78%

Score		Time
44 - 100	Range	3 - 20
84	Median	9
81.68	Mean	9.2

Number up to accuracy and time standards - 2 or 6.46%
Number not up to above standards - 29 or 93.54%

Score standard - 100
Time standard - 8 minutes

TABLE XX. DISTRIBUTION ACCORDING TO TIME AND SCORE OF <u>ALL</u> SIXTH GRADES ON THE INITIAL M. P. TEST

Score	Time in minutes 6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23 to 30	31 to 39	f	Percentages
100					1	1														2	.58
96		1		2	1		1	3			1		2							11	3.21
92				1	2		2		1	1		2		1			1	2		13	3.79
88				4	2	4	1	3	2	1	2	2	6	4	1			1		33	9.61
84	2		2	1	5	2	5	2	3	5	1	2	4	2	3	7	1	1		48	13.98
80	1	6	2		7	4	5	1	7	2	4	2	1	4	2	1		1	1	51	14.86
76		3	1	2	3		6	5	4	4	4	2	4	1	3	2	1	1		46	13.98
72	1	1	2	3	2	4	7	7	4	1	1	2	1	1	1	1	2	3		44	12.82
68		1	1	2		1	3	3			1	3		2	1			1		19	5.54
64		1	2			5	5	1	3	2	2				1	2	1	1	1	27	7.87
60			1	3		2		1	2	4		1								14	4.08
56			1	1	1		1	1	1	1				1	2	1		2		13	3.79
52						2	1		1	1	1							1		7	2.04
48					1			1	1	1	1		1		1		1		1	9	2.62
44													1							1	.29
40						1				1										2	.58
36																					
32																					
28																					
24							1													1	.29
20																			1	1	.29
16																					
12																					
8																					
4																		1		1	.29
f	4	13	12	19	24	26	38	28	29	24	18	16	20	16	15	14	7	15	4	343	99.94

Times 6–12: 136 — 39.58%

Times 13–39: 207 — 60.42%

Score		Time
4 - 100	Range	6 - 39
76	Median	14
75.15	Mean	14.7

Number up to accuracy and time standards - 2 or .58%

Number not up to above standards - 341 or 99.42%

Tables XXI and XXII are sample Tables of individual sixth grades on the M. P. Test. Table XXI shows the tabled results for the sixth grade making the best showing on the test. There was, however, but 1 perfect score and the corrective load was 96.38%. Scores ranged from 52 to 100, with the median at 80 and the mean at 77.38. The time ranged from 6 to 21 minutes, the median being 12 and the mean 12.7 minutes. Table XXII shows the results for the sixth grade making the poorest showing on the same test. The highest score was 88, the corrective load being 100%. Scores ranged from 40 to 88, the median being 68 and the mean 69.86. Time ranged from 11 to 34 minutes, the median being 18 1/2 and the mean 18.9 minutes.

Table XXIII shows the distribution according to time and score of all eighth grades on the A. P. Test. Of the 323 pupils taking the test 46 or 14.21% achieved perfect scores. Of these 26 were up to the time standard of 8 minutes. The corrective load was 91.94%. Scores ranged from 44 to 100 with the median at 92 and the mean at 88.42. The time ranged from 3 to 20 minutes, the median being 8 and the mean 8.27 minutes.

Tables XXIV and XXV are sample Tables of individual eighth grades on the A. P. Test. Table XXIV shows the tabled results for the eighth grade making the best showing on the test. Of the 30 pupils 11 or 31.63% achieved perfect scores, 4 of them within the time standard. The corrective load was 86.68%. Scores ranged from 68 to 100, the median being 96 and the mean 92.97. Time ranged from 4 to 20 minutes with the median at 9 and the mean at 9.7 minutes. Table XXV shows the results for

TABLE XXI. DISTRIBUTION ACCORDING TO TIME AND SCORE OF GRADE VI, BUILDING C, ROOM 4, ON THE INITIAL M. P. TEST

Score	Time in minutes																f	Percentages
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21		
100					1												1	3.12
96						1											1	3.12
92									2								2	6.25
88							1		2								3	9.38
84 1					1											2	4	12.50
80				1	2	1		2	1								7	21.85
76		1						1									2	6.25
72				1	1	2											4	12.50
68			2				1										3	9.38
64		1															1	3.12
60			1						1								2	6.25
56		1															1	3.12
52					1												1	3.12
f	1	3	3	2	6	4	2	3	2	2	2					2	32	99.96

19 — 59.40%

13 — 40.60%

Score		Time
52 - 100	Range	6 - 21
80	Median	12
77.38	Mean	12.7

Number up to accuracy and time standards - 1 or 3.12%
Number not up to above standards - 31 or 96.88%

Score standard - 100
Time standard - 12 minutes

TABLE XXII. DISTRIBUTION ACCORDING TO TIME AND SCORE OF GRADE VI, BUILDING E, ROOM 3, ON THE INITIAL M. P. TEST

Score	Time in minutes																			
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27 to 30	31 to 34	f	Percentages
100																				
96																				
92																				
88	1								1										2	7.14
84											1								1	3.58
80				1					2									1	4	14.28
76		1				1		1		1		1							5	17.85
72				1										1					2	7.14
68		1					2		1	1							1		6	21.42
64				2						1							1		4	14.28
60																				
56																				
52				1															1	3.58
48						1												1	2	7.14
44																				
40					1														1	3.58
f	1	2		5	1	2	2	1	4	3	1	1		1			2	2	28	99.99

(11–12 minutes: 3, 10.72%; 14 minutes to 31–34: 25, 89.28%)

Score		Time
40 - 88	Range	11 - 34
68	Median	18 1/2
69.86	Mean	18.9

Number up to accuracy and time standards - 0
Number not up to above standards - 28 or 100%

Score standard - 100
Time standard - 12 minutes

TABLE XXIII. DISTRIBUTION ACCORDING TO TIME AND SCORE OF ALL EIGHTH GRADES ON THE INITIAL A. P. TEST.

Score	Time in minutes																			f	Percentages
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			
100	1	3	4	8	6	4	8	5	1	3	2	1								46	14.21
96		4	11	7	13	7	5	3	3		3									56	17.30
92	1	2	8	8	11	8	9	6	4	1	3			1						62	19.15
88		3	5	6	12	5	6	8	2	6	1									54	16.68
84		2	5	5	5	5	7	4			1									34	10.41
80					6	11	4	8	2		2								1	34	10.41
76				1	2	4		2		1		1								11	3.39
72		1				2	2	1		1		1								8	2.47
68			1	2	2	1		1	2			1								10	3.09
64								1	1	2										4	1.23
60										1										1	.31
56							1				1									2	.62
52																					
48																					
44									1											1	.31
f	2		34		57		42		16		13										
		15		37		47		39		15		4		1					1	323	99.97
		175						148													
		54.25%						45.75%													

Score		Time
44 - 100	Range	3 - 20
92	Median	8
88.42	Mean	8.27

Number up to accuracy and time standards - 26 or 8.06%
Number not up to above standards - 297 or 91.94%

Score standard - 100
Time standard - 8 minutes

TABLE XXIV. DISTRIBUTION ACCORDING TO TIME AND SCORE OF GRADE VIII, BUILDING I, ROOM 1, ON THE INITIAL A. P. TEST

Score	Time in minutes																			f	Percentages
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20				
100	1	1	1	1		3	1		2	1										11	36.63
96		1			3	1		1												7	23.33
92				1			2	1												4	13.32
88						1														1	3.33
84				1		1														2	6.66
80																	1			1	3.33
76				1						1										2	6.66
72						1														1	3.33
68										1										1	3.33
f	1	2	1	6	2	5	5	2	2	1	2						1			30	99.92

12
39.96%

18
60.04%

Score		Time
68 - 100	Range	4 - 20
96	Median	9
92.07	Mean	9.7

Number up to accuracy and time standards - 4 or 13.32%
Number not up to above standards - 26 or 86.68%

Score standard - 100
Time standard - 8 minutes

TABLE XXV. DISTRIBUTION ACCORDING TO TIME AND SCORE OF GRADE VIII, BUILDING H, ROOM 3, ON THE INITIAL A. P. TEST

Score	Time in minutes													f	Percentages
	4	5	6	7	8	9	10	11	12	13					
100						2								2	6.90
96			1	1	1		1							4	13.80
92				1		2								3	10.34
88	1						1		1					4	13.80
84				1	1	3	1							6	20.70
80				1	1		1	1						4	13.80
76							1							1	3.44
72															
68			2	1										3	10.34
64															
60									1					1	3.44
56										1				1	3.44
f	1	3	5	3	7	5	1	2	2					29	100.00

12 — 41.40%

17 — 58.60%

Score		Time
56 - 100	Range	5 - 13
84	Median	9
83.2	Mean	9.06

Number up to accuracy and time standards - 0
Number not up to above standards - 29 or 100%

Score standard - 100
Time standard - 8 minutes

the eighth grade making the poorest showing on the same test. There were 2 perfect scores, but neither was achieved within the time standard of 8 minutes; therefore the corrective load was 100%. Scores ranged from 56 to 100, the median being 84 and the mean 83.2. The time ranged from 5 to 13 minutes with the median at 9 and the mean at 9.06 minutes.

Table XXVI shows the time and score distribution for all eighth grades on the S. P. Test. Of the 335 pupils taking the test 87 or 25.93% achieved perfect scores, 61 of them accomplishing it within the time standard of 5 minutes. The corrective load was 81.77%. Scores ranged from 52 to 100 with the median at 92 and the mean at 91.87. The time ranged from 2 to 12 minutes, the median being 5 and the mean 5.4 minutes.

Tables XXVII and XXVIII are sample Tables of individual eighth grades on the S. P. Test. Table XXVII shows results for the eighth grade making the best showing on the test. There were 12 or 34.28% perfect scores. Of these 10 were achieved within the time standard. The corrective load was 71.50%. Scores ranged from 72 to 100, the median being at 96 and the mean at 93.37. The time ranged from 3 to 8 minutes with the median at 4 and the mean at 4.5 minutes. Table XXVIII shows results for the eighth grade making the poorest showing on the same test. There were 5 or 15.62% perfect scores, 3 being achieved within the time standard. The corrective load was found to be 90.64%. Scores ranged from 72 to 100, with the median at 92 and the mean at 91.25. The time ranged from 3 to 10 minutes with the median at 5 and the mean at 5.6 minutes.

TABLE XXVI. DISTRIBUTION ACCORDING TO TIME AND SCORE OF ALL EIGHTH GRADES ON THE INITIAL S. P. TEST

Score	Time in minutes											f	Percentages
	2	3	4	5	6	7	8	9	10	11	12		
100	3	16	18	24	7	10	4	13	1			87	25.93
96		5	17	20	18	5	3	12		1		72	21.45
92		2	17	24	10	9	4	21				69	20.56
88	2	7	8	8	10	7	4	2				48	14.40
84		1	2	4	1	4	1	1				14	4.17
80			5	5	7	4	4					25	7.45
76			2	2	2	1	1	1				9	2.68
72		1	2		1		2					6	1.79
68			1		1			1				3	.89
64													
60													
56					1							1	.30
52								1				1	.30
f	5		72		58		23		7		1		
		32		87		40		9		1		335	99.92
			196				139						
			58.80%				41.20%						

Score		Time
52 - 100	Range	2 - 12
92	Median	5
91.87	Mean	5.4

Number up to accuracy and time standards - 61 or 18.23%
Number not up to above standards - 274 or 81.77%

Score standard - 100
Time standard - 5 minutes

TABLE XXVII. DISTRIBUTION ACCORDING TO TIME AND SCORE OF GRADE VIII, BUILDING I, ROOM 4, ON THE INITIAL S. P. TEST

Score	Time in minutes						f	Percentages
	3	4	5	6	7	8		
100	3	6	1	1	1		12	34.28
96		4	3				7	19.99
92		2	3	1	2	1	9	25.71
88		1				1	2	5.71
84			2				2	5.71
80								
76		2					2	5.71
72				1			1	2.85
f	3	15	9	3	3	2	35	99.96

27 8

76.95% 23.05%

Score		Time
72 - 100	Range	3 - 8
96	Median	4
93.37	Mean	4.5

Number up to accuracy and time standards - 10 or 28.50%
Number not up to above standards - 25 or 71.50%

Score standard - 100
Time standard - 5 minutes

TABLE XXVIII. DISTRIBUTION ACCORDING TO TIME AND SCORE OF GRADE VIII, BUILDING I, ROOM 2, ON THE INITIAL S. P. TEST

Score	Time in minutes									f	Percentages
	3	4	5	6	7	8	9	10			
100	1	1	1	1	1					5	15.62
96		2	2		1	1		1		7	21.87
92	1	3	2		2					8	25.00
88	2	1	1	2						6	18.75
84											
80		1	1			2				4	12.50
76			1							1	3.12
72		1								1	3.12
f	4	9	8	3	4	3		1		32	99.98

21 11
65.68% 34.32%

Score		Time
72 - 100	Range	3 - 100
92	Median	5
91.25	Mean	5.6

Number up to accuracy and time standards - 3 or 9.36%
Number not up to above standards - 29 or 90.64%

Score standard - 100
Time standard - 5 minutes

Table XXIX shows the distribution according to time and score for all eighth grades on the M. P. Test. Only 7 of the 330 pupils taking the test achieved perfect scores and only 5 were able to accomplish it within the time standard of 9 minutes. The corrective load, therefore, was 98.48%. Scores ranged from 40 to 100. The median score was 84 and the mean score, 81.05. The time ranged from 3 to 20 minutes with the median at 9 and the mean at 9.3 minutes.

Tables XXX and XXXI are sample Tables of individual eighth grades on the M. P. Test. Table XXX shows results for the eighth grade making the best showing on the test. There were 2 perfect scores, both being achieved within the time standard. The corrective load was found to be 93.56% of the class. Scores ranged from 56 to 100 with the median at 88 and the mean at 85.55. The time ranged from 5 to 18 minutes, with the median at 9 and the mean at 8.5 minutes. Table XXXI shows the results for the eighth grade making the poorest showing on the same test. The corrective load was 100%. Scores ranged from 44 to 96 with the median at 80 and the mean at 77.70. The time ranged from 5 to 14 minutes, the median being 8 and the mean 8.8 minutes.

Table XXXII is a summary Table showing the distribution of scores on a percentage basis for all grades and all processes. It is read as follows: A score of 100 was achieved by 2.47% of Grade IV on the A. P. Test, and by 2.44% on the S. P. Test; by 13.77% of Grade VI on the A. P. Test, 24.70% on the S. P. Test, and 0.58% on the M. P. Test; by 14.21% of Grade VIII on the A. P. Test, 25.93% on the S. P. Test, and 2.12% on the M. P. Test.

TABLE XXIX. DISTRIBUTION ACCORDING TO TIME AND SCORE OF ALL EIGHTH GRADES ON THE INITIAL M. P. TEST

Score	Time in minutes																	f	Percentages
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
100						2	3		1		1								7	2.12
96			2	4	3	4	3	1		2					1			1	21	6.36
92		1	5	9	10	6	5	7	4	2	1								50	15.15
88			3	9	6	6	5	2	3	1	1				1				37	11.21
84		1	5	8	10	7	11	6	3	3	6	2			1				63	19.08
80	1	1	2	6	7	6	5	4	2	1	1							1	37	11.21
76			4	5	4	8	2		6	1	3						1		34	10.30
72		1	5	3	7	4	5	1	3	1	2								32	9.70
68				3	3	3	4	2	3	1									19	5.75
64			1	3	2	2	1		1										10	3.03
60		1	1	1	2		1		2				1	1					10	3.03
56		1		2	2														5	1.52
52										1									1	.30
48								1											1	.30
44									1										1	.30
40									1		1								2	.60
f	1	6	52	49	25	14	2	2	1											
			28	58	42	29	15	1	2	2									330	99.97
			194					136												
			58.52%					41.48%												

Score		Time
40 - 100	Range	3 - 20
84	Median	9
81.05	Mean	9.3

Number up to accuracy and time standards - 5 or 1.52%
Number not up to above standards - 325 or 98.48%

Score standard - 100
Time standard - 9 minutes

TABLE XXX. DISTRIBUTION ACCORDING TO TIME AND SCORE OF GRADE VIII, BUILDING I, ROOM 1, ON THE INITIAL M. P. TEST

Score	Time in minutes															f	Percentages
	5	6	7	8	9	10	11	12	13	14	15	16	17	18			
100				2												2	6.44
96			2	2	1											5	16.11
92	1	1	1	2		1	1									7	22.56
88				1				1	1							3	9.67
84	1		1			1	1									4	12.89
80			2	2		1										5	16.11
76																	
72		2														2	6.44
68			1													1	3.23
64																	
60														1		1	3.23
56			1													1	3.23
f	2	3	8	7	3	3	2	1	1					1		31	99.91

23 — 74.22%

8 — 15.78%

Score		Time
56 - 100	Range	5 - 18
88	Median	9
85.55	Mean	8.5

Number up to accuracy and time standards - 2 or 6.44%
Number not up to above standards - 29 or 93.56%

Score standard - 100
Time standard - 9 minutes

TABLE XXXI. DISTRIBUTION ACCORDING TO TIME AND SCORE OF GRADE VIII, BUILDING I, ROOM 2, ON THE INITIAL M. P. TEST

Score	Time in minutes														f	Percentages
	5	6	7	8	9	10	11	12	13	14						
100																
96		1													1	3.03
92		1	1	2						1					5	15.15
88			1												1	3.03
84			3			1				2					6	18.18
80	1		1	1	1	1	1								6	18.18
76		1		2											3	9.09
72	1				1			1							3	9.09
68					1	1			1						3	9.09
64			1												1	3.03
60		1		1			1								3	9.09
56																
52																
48																
44									1						1	3.03
f	2	4	7	6	3	3	1	3	2	2					33	99.99

22 — 66.67% 11 — 33.33%

Score		Time
44 - 96	Range	5 - 14
80	Median	8
77.70	Mean	8.8

Number up to accuracy and time standards - 0
Number not up to above standards - 33 or 100%

Score standard - 100
Time standard - 9 minutes

TABLE XXXII. DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL GRADES AND PROCESSES ON THE INITIAL TESTING

Score	Grade IV A.P.	Grade IV S.P.	Grade VI A.P.	Grade VI S.P.	Grade VI M.P.	Grade VIII A.P.	Grade VIII S.P.	Grade VIII M.P.
100	2.47	2.44	13.77	24.70	.58	14.21	25.93	2.12
96	6.79	6.73	23.44	22.34	3.21	17.30	21.45	6.36
92	10.21	7.34	19.82	18.82	3.79	19.15	20.56	15.15
88	13.64	5.81	15.52	8.82	9.61	16.68	14.40	11.21
84	11.45	4.89	10.25	4.99	13.98	10.41	4.17	19.08
80	8.35	4.59	8.49	5.29	14.86	10.41	7.45	11.21
76	11.14	3.97	2.93	3.53	13.39	3.39	2.68	10.30
72	8.97	3.06	2.05	4.99	12.82	2.47	1.79	9.70
68	7.42	3.06	1.17	1.79	5.54	3.09	.89	5.75
64	4.95	4.59	.58	1.47	7.87	1.23		3.03
60	4.64	4.28	.29	1.18	4.08	.31		3.03
56	3.71	3.67	.58	.59	3.79	.62	.30	1.52
52	1.54	3.67	.29	.29	2.04		.30	.30
48	1.54	3.67			2.62			.30
44	.92	2.75	.29	.59	.29	.31		.30
40	1.54	5.20	.29		.58			.60
36		3.06						
32	.30	.91						
28	.30	3.67						
24	.30	4.28			.29			
20		2.75			.29			
16		3.67		.29				
12		4.89						
8		2.75						
4		1.83			.29			
0		1.53		.29				
Range	24-100	0-100	40-100	0-100	4-100	44-100	52-100	40-100
Median	80	60	92	92	76	92	92	84
Mean	77.52	56.01	89.83	89.31	75.15	88.42	91.87	81.05

Percentages for the other scores are read in a similar manner.

Tables XXXIII - XL show the distribution of scores on a percentage basis for all grades by buildings and rooms and for all processes. Table XXXIII is read as follows: On the A. P. Test in Grade IV, in Building A, Room 1 there were no perfect scores; 5.55% of the class achieved a score of 96; 19.43%, a score of 92; 13.88%, a score of 88; and so on. The remainder of the Table is read in a similar manner, as are the following Tables.

Table XLI shows the median and mean scores for all grades and processes for the October testing. It is read as follows: In Grade IV on the A. P. Test the median score was 80, the mean score 77.52; on the S. P. Test the median score was 60 and the mean score 56.01. The median and mean scores for Grades VI and VIII are read similarly.

Table XLII shows the number and percentage of perfect scores for all grades and all processes. It is read as follows: In Grade IV on the A. P. Test 8 pupils or 2.47% of all those taking the test achieved perfect scores; on the S. P. Test, 8 or 2.44% achieved perfect scores. The perfect scores in Grade VI on the A. P. Test were 47 or 13.77% of the group; on the S. P. Test, 84 or 24.70%; and on the M. P. Test, only 2 or 0.58%. The numbers and percentages for Grade VIII are read similarly. In this Table the time factor is not considered.

Table XLIII shows the corrective load for all grades and processes at the time of the October testing. It is read as follows: The corrective load in Grade IV in addition was 321 or

TABLE XXXIII. DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL FOURTH GRADES ON THE INITIAL A. P. TEST

Score	Building A Room 1	Building A Room 2	Bldg.B Room 1	Building C Room 1	Building C Room 2	Building D Room 1	Building D Room 2
100				3.33		8.69	
96	5.55	8.57				4.34	12.51
92	19.43	8.57	11.11	19.98		4.34	8.33
88	13.88	11.42	16.67	19.98	6.90	4.34	24.99
84	11.10	17.14		13.32	13.80	4.34	8.33
80	13.88	8.57		6.66	13.80	4.34	4.17
76	13.88	8.57	11.11	6.66	6.90	21.73	8.33
72	2.77		16.67	6.66	6.90	13.04	4.17
68	8.33	8.57	11.11	16.67	6.90	8.69	8.33
64	5.55	7.42	16.67	3.33	6.90	4.34	4.17
60		2.85	11.11	3.33	10.34	4.34	8.33
56	2.77	5.71			10.34	4.34	
52			5.55		6.90	4.34	4.17
48		5.71			3.44	4.34	
44	2.77				3.44		
40		2.85			3.44	4.34	
36							
32							
28							4.17
24							

Score	Bldg.D Room 3	Bldg.E Room 1	Bldg.F Room 1	Building G Room 1	Building G Room 2	
100			13.32	5.00		
96	13.63	11.76	6.66	10.00	4.54	
92	4.54	17.64	6.66	5.00	9.09	
88	9.09	14.70	13.32	15.00	13.63	
84	4.54	5.88	23.31	15.00	13.63	
80	22.72	8.82	3.33	5.00	4.54	
76	13.63	2.94	13.32	15.00	18.16	Range 24 - 100
72	13.63	14.70	13.32	5.00	18.16	Median 80
68	4.54	2.94	3.33	5.00	4.54	Mean 77.52
64		5.88				
60	4.54	8.82			4.54	
56		2.94		20.00	4.54	
52						
48					4.54	
44	4.54					
40			3.33			
36						
32	4.54					
28						
24		2.94				

TABLE XXXIV. DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL FOURTH GRADES ON THE INITIAL S. P. TEST.

Score	Building A Room 1	Building A Room 2	Bldg.B Room 1	Building C Room 1	Building C Room 2	Building D Room 1	Building D Room 2
100		2.77		3.33	6.66		
96	8.10		11.11	6.66	9.99	13.04	
92	2.70		11.11	16.67	3.33	8.69	12.51
88	5.40	2.77		3.33	3.33	13.04	8.33
84	5.40	2.77	11.11	3.33	3.33		8.33
80				9.99	3.33	4.34	
76	5.40	5.55		9.99	9.99		
72			5.55	9.99		4.34	8.33
68				9.99			8.33
64	5.40	2.77	5.55	3.33		4.34	8.33
60	8.10	5.55					8.33
56	2.70			3.33	13.32	8.69	8.33
52	5.40	2.77	5.55	3.33	3.33	4.34	
48		2.77		6.66	3.33	4.34	4.17
44	5.40		11.11		6.66	8.69	4.17
40	13.51	5.55	16.67	6.66		4.34	
36	5.40	2.77	5.55		3.33	4.34	4.17
32	2.70				3.33		
28		5.55	5.55		9.99		
24	5.40	5.55			3.33	8.69	4.17
20	10.80	2.77			3.33	4.34	
16		5.55		3.33			
12	5.40	16.66	5.55		3.33	4.34	
8		8.33	5.55		3.33		4.17
4	2.70	11.10			3.33		
0		8.33					8.35

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TABLE XXXIV (Continued) DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL FOURTH GRADES ON THE INITIAL S. P. TEST.

Score	Bldg. D Room 3	Bldg.E Room 1	Bldg.F Room 1	Building G Room 1	Building G Room 2
100					18.16
96	8.33			10.00	22.72
92	4.17	3.12	6.66	5.00	22.72
88		6.25	16.66	5.00	4.54
84	8.33	3.12	3.33		13.63
80		6.25	9.99	15.00	9.09
76		6.25	3.33		
72	4.17	3.12	3.33		
68	8.33	6.25	3.33	5.00	
64	12.51	3.12	3.33		4.54
60		6.25	3.33	20.00	
56	4.17			5.00	
52		9.38	3.33	5.00	
48		3.12	13.32	5.00	
44					
40	4.17	3.12		10.00	
36		9.38			
32					4.54
28	16.67	3.12	3.33		
24			16.66	5.00	
20	4.17		3.33		
16	8.33	18.75		5.00	
12	8.33	3.12	3.33	5.00	
8	8.33	3.12	3.33		
4					
0		3.12			

Range 0 - 100
Median 60
Mean 56.01

TABLE XXXV. DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL SIXTH GRADES ON THE INITIAL A. P. TEST.

Score	Building A Room 3	Building A Room 4	Building C Room 3	Building C Room 4	Building D Room 4	Building D Room 5
100	12.89	6.66	8.34	18.75	16.67	14.28
96	22.56	19.98	38.89	31.25	24.99	33.32
92	29.00	19.98	13.90	18.75	8.33	14.28
88	16.11	13.32	5.55	15.62	16.67	4.76
84	9.67	13.32	13.90	6.25	20.83	14.28
80	3.23	9.99	5.55	9.38	8.33	14.28
76	3.23		2.78		4.17	4.76
72	3.23	9.99	5.55			
68		3.33				
64		3.33				
60			2.78			
56			2.78			
52						
48						
44						
40						

Score	Building D Room 6	Building D Room 7	Building E Room 2	Building E Room 3	Bldg.F Room 2	Bldg.G Room 3
100	16.00	20.00	11.11	10.34	26.47	3.70
96	20.00	36.00	22.22	13.80	11.76	7.40
92	24.00	20.00	25.93	20.70	20.58	22.21
88	16.00	12.00	18.51	24.13	11.76	33.32
84	12.00	4.00	7.37	10.34	5.88	7.40
80	8.00	4.00	3.70	20.70	8.82	7.40
76			7.37		2.94	7.40
72					2.94	
68						7.40
64						3.70
60						
56			3.70			
52					2.94	
48						
44		4.00				
40	4.00				2.94	

Range 40 - 100
Median 88
Mean 89.83

TABLE XXXVI. DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL SIXTH GRADES ON THE INITIAL S. P. TEST.

Score	Building A		Building C		Building D	
	Room 3	Room 4	Room 3	Room 4	Room 4	Room 5
100	16.15	16.66	11.10	41.92	12.51	17.38
96		19.98	24.99	35.47	20.85	13.04
92	22.71	23.31	27.77	9.68	12.51	39.12
88	6.46	9.99	16.66	6.45	16.68	13.04
84	12.92	3.33	5.55	3.22	12.51	8.69
80	9.68	9.99	5.55		8.33	
76		6.66	2.77		8.33	
72	9.68		2.77	3.22		8.69
68	3.23	3.33			4.17	
64	6.46				4.17	
60	6.46		2.77			
56						
52	3.23					
48						
44	3.23					
40						
36						
32						
28						
24						
20						
16		3.33				
12						
8						
4						
0		3.33				

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TABLE XXXVI (Continued) DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL SIXTH GRADES ON THE INITIAL S. P. TEST

Score	Building D Room 6	Building D Room 7	Building E Room 2	Building E Room 3	Bldg.F Room 2	Bldg.G Room 3
100	4.00	24.99	28.56	14.28	57.57	44.43
96	28.00	20.85	17.85	24.99	33.33	25.92
92	28.00	24.99	10.71	14.28	3.03	14.81
88	8.00	8.33	7.14	7.14		7.37
84			7.14	3.58		3.70
80	12.00	4.17	7.14	7.14		
76	4.00	8.33		14.28		
72	4.00	4.17	10.71	7.14	6.06	3.70
68	8.00		3.58			
64		4.17	3.58			
60				3.58		
56			3.58	3.58		
52						
48						
44	4.00					
40						
36						
32						
28						
24						
20						
16						
12						
8						
4						
0						

Range 0 - 100
Median 92
Mean 89.31

TABLE XXXVII. DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL SIXTH GRADES ON THE INITIAL M. P. TEST

Score	Building A		Building C		Building D	
	Room 3	Room 4	Room 3	Room 4	Room 4	Room 5
100		3.45		3.12		
96		3.45	5.55	3.12	4.17	4.00
92	6.44		2.78	6.25		4.00
88	3.23	10.34	5.55	9.38		20.00
84	3.23	13.79	16.68	12.50	25.02	12.00
80	12.89	6.89	16.68	21.85	12.51	12.00
76	22.56	13.79	8.34	6.25	8.83	20.00
72	19.33	6.89	13.90	12.50	16.68	12.00
68	6.44	3.45	2.78	9.38	4.17	12.00
64	6.44	13.76	8.34	3.12	4.17	
60			13.90	6.25	12.51	
56	6.44	6.89		3.12	12.51	
52	3.23	3.45	2.78	3.12		4.00
48	3.23	6.89	2.78			
44	3.23					
40	3.23					
36						
32						
28						
24		3.45				
20		3.45				
16						
12						
8						
4						

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TABLE XXXVII (Continued) DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL SIXTH GRADES ON THE INITIAL M.P. TEST

Score	Building D Room 6	Building D Room 7	Building E Room 2	Building E Room 3	Bldg.F Room 2	Bldg.G Room 3
100						
96					11.76	3.70
92	8.00	8.00	11.10	7.14	8.82	
88	4.00	12.00	22.21	3.58	20.58	11.10
84	20.00	12.00	11.10	14.28	20.58	7.40
80	16.00	28.00	14.80	17.85	8.82	18.50
76	16.00	16.00	22.21	7.14	5.88	14.80
72	8.00	4.00		21.42	11.76	18.50
68	4.00	4.00	3.70	14.28	5.88	3.70
64	12.00	4.00	3.70			14.80
60	4.00	4.00	7.40			3.70
56		8.00		3.58		3.70
52	4.00		3.70	7.14	5.88	
48						
44				3.58		
40						
36						
32						
28						
24						
20						
16						
12						
8						
4	4.00					

Range 4 - 100
Median 76
Mean 75.15

TABLE XXXVIII. DISTRIBUTION OD SCORES ON A PERCENTAGE BASIS FOR ALL EIGHTH GRADES ON THE INITIAL A. P. TEST

	Building H					
Score	Room 1	Room 2	Room 3	Room 4	Room 5	Room 6
100	10.71	6.66	6.90	4.17	19.98	14.81
96	14.28	6.66	13.80	16.67	23.31	11.11
92	24.99	26.64	10.34	24.99	23.31	33.30
88	21.42	33.30	13.80	16.67	13.32	11.11
84	14.28	9.99	20.70	8.33	9.99	
80	10.71	13.32	13.80	20.83	6.66	18.51
76	3.58		3.44	4.17		
72		3.33		4.17	3.33	
68			10.34			3.70
64						3.70
60			3.44			
56			3.44			
52						
48						
44						3.70

	Building I				
Score	Room 1	Room 2	Room 3	Room 4	Room 5
100	36.63	13.80	19.98	8.82	12.50
96	23.33	10.34	9.99	38.22	18.75
92	13.32	17.20	23.31	8.82	9.38
88	3.33	20.70	13.32	20.58	15.62
84	6.66	6.88	9.99	8.82	18.75
80	3.33	10.34	6.66	5.88	9.38
76	6.66	3.44	9.99		6.25
72	3.33	3.44		5.88	3.12
68	3.33	10.34	3.33		3.12
64		3.44	3.33	2.94	
60					
56					3.12
52					
48					
44					

Range 44 - 100
Median 92
Mean 88.42

TABLE XXXIX. DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL EIGHTH GRADES ON THE INITIAL S. P. TEST

	Building H					
Score	Room 1	Room 2	Room 3	Room 4	Room 5	Room 6
100	28.64	22.71	29.99	7.69	27.58	29.62
96	14.28	16.15	13.32	34.61	31.03	22.21
92	21.42	22.71	23.31	26.92	20.68	14.81
88	21.42	12.92	19.98	19.23	6.90	7.40
84	10.71	3.23	3.33	3.84	3.44	3.70
80	3.58	3.23	9.99	7.69	10.34	14.81
76		6.46				3.70
72		9.68				
68		3.23				
64						
60						
56						
52						3.70

	Building I				
Score	Room 1	Room 2	Room 3	Room 4	Room 5
100	37.50	15.62	29.06	34.28	20.60
96	34.37	21.87	16.14	19.99	14.70
92	9.37	25.00	19.37	25.71	20.60
88	12.50	18.75	16.14	5.71	14.70
84			3.22	5.71	8.82
80	6.25	12.50	6.44		8.82
76		3.12	6.44	5.71	2.94
72		3.12		2.85	2.94
68			3.22		2.94
64					
60					
56					2.94
52					

Range 52 - 100
Median 92
Mean 91.87

TABLE XL. DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL EIGHTH GRADES ON THE INITIAL M. P. TEST

	Building H					
Score	Room 1	Room 2	Room 3	Room 4	Room 5	Room 6
100	7.14			4.00	3.45	
96	10.71	6.90		12.00	6.89	10.71
92	7.14	10.34	17.85	12.00	3.45	10.71
88	10.71	10.34	10.71	20.00	17.24	7.14
84	17.85	24.10	21.42	20.00	17.24	21.42
80	3.58	13.78	7.14	8.00	10.34	3.58
76	21.48	13.78	14.28	8.00	10.34	21.42
72	10.71	6.90	7.14	12.00	17.24	3.58
68		3.44	10.71		3.45	10.71
64		3.44	7.14	4.00	3.45	3.58
60	10.71	3.44			3.45	
56			3.58		3.45	
52		3.44				3.58
48						3.58
44						
40						

	Building I				
Score	Room 1	Room 2	Room 3	Room 4	Room 5
100	6.44		3.23		
96	16.11	3.03	3.23		2.94
92	22.56	15.15	9.67	26.46	26.46
88	9.67	3.03	3.23	20.58	11.76
84	12.89	18.18	22.56	26.46	8.82
80	16.11	18.18	16.11	11.76	11.76
76		9.09	6.44	2.94	8.82
72	6.44	9.09	12.89	8.82	11.76
68	3.23	9.09	12.89		8.82
64		3.03	6.44		2.94
60	3.23	9.09		2.94	
56	3.23				2.94
52					
48					
44		3.03			
40			3.23		2.94

Range 40 - 100
Median 84
Mean 81.05

TABLE XLI. SCORE MEDIANS AND MEANS FOR ALL GRADES AND ALL PROCESSES

Grade	A. P. Test Median	A. P. Test Mean	S. P. Test Median	S. P. Test Mean	M. P. Test Median	M. P. Test Mean
IV	80	77.52	60	56.01		
VI	92	89.83	92	89.31	76	75.15
VIII	92	88.42	92	91.87	84	81.05

TABLE XLII. NUMBER AND PERCENTAGE OF PERFECT SCORES FOR ALL GRADES AND ALL PROCESSES

Grade	A. P. Test No.	A. P. Test Percentage	S. P. Test No.	S. P. Test Percentage	M. P. Test No.	M. P. Test Percentage
IV	8	2.47	8	2.44		
VI	47	13.77	84	24.70	2	0.58
VIII	46	14.21	87	25.93	7	2.12

TABLE XLIII. CORRECTIVE LOAD FOR ALL GRADES AND ALL PROCESSES*

Grade	A. P. Test No.	A. P. Test Percentage	S. P. Test No.	S. P. Test Percentage	M. P. Test No.	M. P. Test Percentage
IV	321	99.40	321	98.47		
VI	316	92.68	287	84.42	341	99.42
VIII	297	91.94	174	81.77	325	98.48

* Corrective load based on score standard of 100 for all grades and all processes and on time standards as follows:

	A. P. Test	S. P. Test	M. P. Test
Gr. IV	13 minutes	12 minutes	
Gr. VI	10 "	8 "	12 minutes
Gr. VIII	8 "	5 "	9 "

99.49%; in subtraction, 321 or 98.47%. In Grade VI the corrective load in addition was 316 or 92.68%; in subtraction, 287 or 84.42%; and in multiplication, 341 or 99.42%. The corrective load for the eighth grade is read similarly. Thus it will be seen that with the exception of sixth and eighth grade subtraction, the corrective load for all grades and processes ran very close to 100%. There were just three pupils, eighth grade pupils, who achieved perfect scores in all three tests.

In addition to reproducing Table I which showed the median scores and times of the initial testing for the earlier studies, Table XLIV shows the median scores and times of the initial testing for the present study. Table XLV shows the mean scores and times for the same studies, including the present one.

From this comparison it will be seen that in general all the classes tested ranked lower in multiplication than in either addition or subtraction. With the exception of Grade IV there was only slight difference between the addition and subtraction means, but a perceptible drop in multiplication means from the addition and subtraction levels. It will be seen also that in the majority of instances the mean scores for the present study were higher than the mean scores for the previous studies.

Table XLVI shows a comparison between the corrective load of the present study and the corrective load of four of the earlier studies, when determined by the score and time standards of the present study. Lack of the necessary data made it impossible to thus determine the corrective load for the other earlier studies.

TABLE XLIV. THE MEDIAN SCORES AND TIMES OF THE INITIAL TESTING FOR THE EARLIER STUDIES AND FOR THE PRESENT STUDY

Grade	Test	W.P.A. 1936		Hanley 1938		Yar-brough 1938		Nelson 1938		Hough-ton 1939		Ridlon 1939		Ringer 1940		Present Study	
		Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.
IV	A.P.			68	23											80	20
	S.P.			48	22											60	15
VI	A.P.			88	11	84	11			80	11	84	10			92	11
	S.P.			88	10	88	9			92	9	88	7			92	8
	M.P.			84	33	76	14			64	20	60	13			76	14
VIII	A.P.							92	8	96	7			88	9	92	8
	S.P.							92	7	96	7			92	6	92	5
	M.P.							84	10	84	12			72	10	84	9

TABLE XLV. THE MEAN SCORES AND TIMES OF THE INITIAL TESTING FOR THE EARLIER STUDIES AND FOR THE PRESENT STUDY

Grade	Test	W.P.A. 1936		Hanley 1938		Yar-brough 1938		Nelson 1938		Hough-ton 1939		Ridlon 1939		Ringer 1940		Present Study	
		Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.
IV	A.P.			65	23											78	22
	S.P.			46	22											56	17
VI	A.P.	89	9	88	13	86	12			79	13	83	10			90	12
	S.P.	83	7	84	11	85	9			87	10	84	8			89	9
	M.P.	77	11	82	33	75	16			56	21	58	14			75	15
VIII	A.P.	89						88	8	94	8			83	9	88	8
	S.P.							86	7	95	6			80	6	92	5
	M.P.							80	10	81	12			73	10	81	9

TABLE XLVI. A COMPARISON OF THE CORRECTIVE LOAD OF SOME OF THE EARLIER STUDIES WITH THAT OF THE PRESENT STUDY WHEN DETERMINED BY IDENTICAL STANDARDS*

Grade	Test	Hanley 1938	Yarbrough 1938	Houghton 1939	Ridlon 1939	Present Study
IV	A.P. S.P.	99.65%				99.40%
VI	A.P. S.P. M.P.	93.28%	96.80% 93.60% 97.60%	96.70% 93.84% 96.77%	90.82% 91.20% 100.00%	92.68% 84.42% 99.42%
VIII	A.P. S.P. M.P.			80.00% 86.95% 95.45%		91.94% 81.77% 98.48%

* The standards of the present study.

A careful study of this Table with Table XLV reveals some interesting facts. It shows once more how little about the corrective load can be learned from a study of mean scores alone, and reveals again the truth of the statement that "averages tend to cover up the tragedy of errors."[1] A few specific examples will make this point clear. The mean scores for Grade VIII on the M. P. Test in Houghton's study and in the present study for that grade were identical; namely, 81. However, the corrective load in the present study is 98.48% and only 95.45% in Houghton's study. In Grade VIII on the S. P. Test in Houghton's study the mean score was 95 and in the present study, 92. However, instead of finding the corrective load

1 Guy M. Wilson, and Gertrude L. Hanley, "For Basic Drill in Arithmetic, What Norm or Average is Satisfactory?" The Mathematics Teacher, XXXII (April, 1939), p.175.

higher in the present study as one might suppose, it is found to be much lower; namely, 81.77%, in contrast to Houghton's 86.95%. Again, in Grade VI on the M. P. Test in Ridlon's study the mean score was 58, while in the present study it was 75. But instead of finding as great a discrepancy in the corrective load, the difference is less than 1%; the corrective load in Ridlon's study being 100%, and in the present study, 99.42%.

CHAPTER III

ERRORS ON THE INITIAL TESTS

Errors in Addition

Errors in Subtraction

Errors in Multiplication

CHAPTER III

ERRORS ON THE INITIAL TESTS

Each pupil's errors were analyzed for each test. A record was kept of just which examples each child missed, with the reason for the failure analyzed as closely as possible. A sample sheet is shown in Exhibit E. A similar sheet was made for each child.

Errors in Addition

Anyone who has attempted to analyze addition errors knows that it is very nearly impossible, through inspection alone, to truly diagnose the causes for such errors. However, when similar errors persist and when crutch marks are used, it is often possible to conclude with reasonable accuracy what the pupil has done.

Table XLVII shows the distribution by grades of the more common types of error found on the A. P. Test. It is read as follows: 119 errors on the primary facts were made by fourth grade pupils; while only 37 such errors were made in the sixth grades and 31 in the eighth grades. The decade facts took a big toll, probably indicating that decade facts are not as well taught in the beginning as are the primary facts. 1238 errors on decade facts were made in Grade IV, 676 in Grade VI, and 503 in Grade VIII. Zeros or gaps caused errors in 32 cases in Grade IV, 9 cases in Grade VI, and 5 cases in Grade VIII. The

EXHIBIT E. DIAGNOSIS OF ERRORS : A SAMPLE SHEET

Child's name - Eugene School_____ Gr.VI Teacher_____

Type of error	Examples missed
A. P. Test	
Primary facts	
Decade facts	o v w x
Zeros or gaps	
Carried when no need	
Carried too few	
Carried too many	m r
Failed to carry	
Decimal point	
Omitted whole example	
Omitted part example	y
Jumped a decade	
Skipped a decade	
S. P. Test	
Subtraction facts	
Minuend from subtrahend	
Zeros or gaps	a q
Forgot had borrowed	w
Borrowed when no need	f
Used wrong process	
Omitted decimal point	
Omitted whole example	b
Omitted part example	
Borrowed too many	
M. P. Test	
Multiplication facts	
Addition facts	i
Carrying difficulties	n
Zeros or gaps	e
Faulty arrangement partial product	
Misread own figures	
Failed to use a part of multiplier	
Decimal point	t
Omitted whole example	
Wrong process	

TABLE XLVII. DISTRIBUTION OF CHIEF ERRORS MADE BY ALL GRADES ACCORDING TO THE TYPE OF ERROR ON THE INITIAL A. P. TEST

Type of error	Grade IV	Grade VI	Grade VIII
Primary facts	119	37	31
Decade facts	1238	676	503
Zeros or gaps	32	9	5
Carried when no need	10	28	7
Carried too few	75	67	132
Carried too many	39	59	131
Failed to carry	13	58	63
Omitted decimal point	222	10	14
Omitted whole example	20	5	25
Omitted part example	22	11	7
Miscellaneous			
Jumped a decade	12	18	17
Skipped a decade	17	4	1
Added 1 to answer		1	
Transposed answer			3
Number of pupils taking the test	323	341	323

remainder of the Table is read similarly. It will be seen that carrying errors were more prevalent in Grade VIII than in either Grade IV or Grade VI. Decimal point errors were very common in Grade IV, but were practically negligible in the other grades.

An illustration of "jumped a decade"is as follows:

60		60
78		78
84	instead of	84
55		55
85		85
462		362

"skipped a decade"

60		60
78		78
84	instead of	84
55		55
85		85
262		362

"transposed answer"

78		78
64		64
97	instead of	97
9		9
78		78
236		326

Table XLVIII shows the distribution of errors on the A. P. Test according to the specific examples in the test.* It is read as follows: On example a 64 fourth grade pupils, 22 sixth grade pupils, and 17 eighth grade pupils failed. The remainder of the Table is read similarly. It will be seen that in all grades example x had by far the greatest number of errors, with example y ranking second. The least number of errors occurred

* Copies of the tests used appear in the Appendix.

TABLE XLVIII. THE NUMBER OF PUPILS IN ALL GRADES WHO MISSED EACH EXAMPLE OF THE A. P. TEST

Test example	Number of pupils Grade IV	Grade VI	Grade VIII
a	64	22	17
b	24	17	19
c	27	14	30
d	17	14	13
e	21	4	4
f	12	5	9
g	14	6	11
h	23	20	17
i	23	6	3
j	11	9	8
k	16	19	13
l	38	11	19
m	41	20	21
n	59	28	44
o	74	37	42
p	123	51	55
q	108	52	59
r	97	43	49
s	85	49	47
t	102	50	43
u	143	67	72
v	188	97	94
w	134	52	67
x	232	145	130
y	147	63	58
Number of pupils taking the test	323	341	323

in Grade IV on example j; in Grade VI on example e; and in Grade VIII on example i.

Errors in Subtraction

Subtraction examples lend themselves to diagnosis far more readily than do addition examples. Table XLIX shows the distribution of errors made by all grades according to the type of error on the S. P. Test. It is read as follows: A lack of knowledge of the subtraction facts caused errors in 398 cases in Grade IV, in 176 cases in Grade VI, and in 172 cases in Grade VIII. In Grade IV there were 153 attempts to take the minuend from the subtrahend. There were 50 such attempts in Grade VI and 31 in Grade VIII. The remainder of the Table is read in a similar manner. It will be seen that the majority of errors in Grade IV were caused by zeros or gaps. The second largest cause for error in Grade IV was borrowing and then proceeding as if there had been no borrowing. This was the largest cause of errors in both Grade VI and Grade VIII. In Grade IV there were 13 children who showed a complete lack of knowledge of the borrowing process, causing 264 examples to be missed for this reason.

An illustration of "took minuend from subtrahend" is as follows:

829			829
57		instead of	57
832			772

"forgot had borrowed"

9261		9261
4780		4780
5581		4481

TABLE XLIX. DISTRIBUTION OF CHIEF ERRORS MADE BY ALL GRADES ACCORDING TO THE TYPE OF ERROR ON THE INITIAL S. P. TEST.

Type of error	Grade IV	Grade VI	Grade VIII
Subtraction facts	398	176	172
Took minuend from subtrahend	153	50	31
Zeros or gaps	1492	176	48
Forgot had borrowed	791	324	139
Borrowed when no need	92	67	91
Used wrong process	135	22	23
Omitted decimal point	27	21	6
Omitted whole example	33	7	4
Omitted part example		14	7
Miscellaneous			
Borrowed too many	9	1	4
Added the borrow	1		
Complete ignorance of the borrowing process	264		
Number of pupils taking the test	326	340	335

"borrowed too many"

$$\begin{array}{r} {\scriptstyle 7} \\ 14\not{9}1 \\ 843 \\ \hline 638 \end{array} \qquad \text{instead of} \qquad \begin{array}{r} 1491 \\ 843 \\ \hline 648 \end{array}$$

Table L shows the distribution of errors made by all grades according to the specific examples on the S. P. Test. It is read thus: On example a 83 fourth grade children, 37 sixth grade children, and 14 eighth graders made errors. On example b errors were made by 62 fourth grade children, 28 sixth grade children, and 24 eighth grade children. The remainder of the Table is read in a similar manner. It will be seen that a great many more errors were made on each example by Grade IV than by Grade VI or Grade VIII. In Grade IV the most errors were on example s, while both Grade VI and Grade VIII made the most errors on example y. The fewest errors made by Grade IV on any example were made on example c, while the fewest errors made by Grade VI and Grade VIII were made on examples h and e respectively.

Grades VI and VIII had fewer errors in subtraction than in either of the other two processes.

Errors in Multiplication

Table LI shows the distribution of errors according to the type of error on the M. P. Test. It is read as follows: In Grade VI 522 errors were caused by a lack of knowledge of multiplication facts. In Grade VIII 525 errors had the same cause. A lack of knowledge of addition facts caused 221 errors in Grade VI and 124 errors in Grade VIII. The remainder of the

TABLE L. THE NUMBER OF PUPILS IN ALL GRADES WHO MISSED EACH EXAMPLE OF THE S. P. TEST

Test example	Number of pupils Grade IV	Grade VI	Grade VIII
a	83	37	14
b	62	28	24
c	61	26	29
d	173	45	45
e	98	20	6
f	158	50	40
g	114	31	7
h	117	19	25
i	203	34	30
j	152	40	29
k	135	22	15
l	136	35	27
m	106	26	32
n	166	25	24
o	174	51	41
p	100	30	20
q	141	29	13
r	148	39	38
s	232	67	38
t	144	28	21
u	172	28	13
v	141	20	12
w	160	43	20
x	179	34	33
y	205	72	72
Number of pupils taking the test	326	340	335

TABLE LI. DISTRIBUTION OF CHIEF ERRORS MADE BY ALL GRADES ACCORDING TO THE TYPE OF ERROR ON THE INITIAL M. P. TEST.

Type of error	Grade VI	Grade VIII
Multiplication facts	522	525
Addition facts	221	124
Carrying difficulties	198	181
Zeros or gaps	222	232
Faulty arrangement of the partial product	161	118
Misread own figures	16	24
Failed to use a part of multiplier	145	57
Decimal point	531	203
Miscellaneous		
Omitted whole example	13	5
Used wrong process		7
Multiplier not always multiplier	4	5
Number of pupils taking the test	343	330

Table is read similarly. It will be seen that in both grades addition fact ignorance and carrying difficulties caused a large percentage of the multiplication errors. Wrong placement of the partial product due to ignorance of correct placement, and mistakes due to untidy placement also caused many errors. The decimal point proved to be a source of much trouble. In Grade VI 531 errors, and in Grade VIII, 293 errors were caused by this alone.

Table LII shows the distribution of errors on the M. P. Test according to the specific examples in the test. It is read as follows: On example a 20 errors were made by sixth grade pupils and 30 by eighth grade pupils. On example b 20 errors were made by sixth grade pupils and 16 by eighth grade pupils. The remainder of the Table is read similarly. It will be seen that in Grade VI example t caused the greatest number of errors. This was due largely to the decimal point appearing in an unusual place, as $680. when there were no cents indicated. The second greatest number of errors made by sixth grade pupils was made on example g. Grade VIII made its largest number of errors on example e, with examples x and t ranking next in order of difficulty.

TABLE LII. THE NUMBER OF PUPILS IN ALL GRADES WHO MISSED EACH EXAMPLE OF THE M. P. TEST

Test example	Number of pupils Grade VI	Grade VIII
a	20	30
b	20	16
c	16	12
d	24	21
e	175	204
f	35	25
g	205	56
h	65	34
i	51	30
j	42	32
k	51	52
l	42	33
m	44	43
n	115	97
o	84	75
p	36	40
q	91	84
r	106	60
s	89	60
t	290	140
u	74	43
v	70	50
w	119	78
x	188	150
y	70	52
Number of pupils taking the test	343	330

CHAPTER IV

CORRECTIVE PROCEDURES

Purposes of Corrective Work

Corrective Work by the Classroom Teachers

Corrective Work by the Writer

In the Eighth Grade

In the Fourth Grade

CHAPTER IV

CORRECTIVE PROCEDURES

Purposes of Corrective Work

"The use of standard tests of measurement is an advantage, but it is not enough to measure the ability of the class or the individual without going further and definitely locating the deficiencies."[1] Osburn says, "The fundamental thesis of corrective arithmetic is the idea that the function of the teacher is to help the child to learn things of value in arithmetic which he is capable of learning but has not learned."[2]

The tests used in this study are of the inventory diagnostic type; they are "teaching" tests. Inorder to help the teachers to discover in what particulars the children were weak, and to enable them to plan for corrective procedures, the tests were redistributed to the teachers for use with the pupils. Each set of corrected tests was left for a minimum of one week with the teachers of the experimental group. The letters appearing in Exhibits F and G are copies of the letters sent to the teachers with the corrected tests.

Newcomb points out the importance of teachers knowing just which combinations or processes are difficult for each pupil. He says, "Without knowledge of this kind much time is wasted,

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1 Arthur S. Gist, "Errors in the Fundamentals of Arithmetic," School and Society, VI (August 11, 1917), p. 175.

2 Worth J. Osburn, Corrective Arithmetic, Vol.I, p. 100.

EXHIBIT F. A COPY OF THE SECOND LETTER SENT TO THE TEACHERS OF THE EXPERIMENTAL GROUP

Dear Miss _____,

I am herewith returning the addition tests, corrected, that the children may see where they made their mistakes. I suggest for the beginning of the remedial work that a list of the typical errors be placed on the board, using the suggestions of the pupils supplemented by those of the teacher. For instance, such a list would include such errors as ignorance of combination, counting, confusion due to zeros or gaps, carrying errors, such as forgetting to carry, forgetting what the "carry" was, adding it twice, etc. etc.

I suggest that each child make and keep a list of his own particular errors. Later he may keep a record of his improvement.

Please have the tests again collected, arranged in alphabetical order, and again sent to your principal's office.

100% accuracy in the fundamentals is now considered an attainable goal. I submit the following suggestions for regular, daily, remedial work as aids in reaching that goal:

1. Plan to spend at least 10 minutes a day on remedial work.
2. Try to point out the specific difficulty to each pupil and to show him a definite method of overcoming it.
3. Group the pupils according to similarity of errors and work in small groups as much as possible.
4. Use the 100% pupils as pupil leaders.
5. Have each pupil make flash cards of his unknown facts and encourage him to use them at odd moments throughout the day until they become automatic.
6. Organize the material to be learned. Don't try to do everything every day.
7. Teach the pupils to always go back and check their work.
8. Give five written examples three times a week. Have them include zeros, gaps, carrying, decimal point and dollar sign, and one with no carrying.
   Give a variety of combinations. These should be carefully prepared to fit the needs of the pupils at the particular time.
   Individual graphs kept by the children of the results of these tests are often a real incentive to better work.

These are suggestions only and are by no means inclusive. Each teacher will want to add others as fits her particular class.

There will be retests given the first of March. You will want to do some remedial work in each of the three processes before that time.

EXHIBIT G. A COPY OF THE THIRD LETTER SENT TO THE TEACHERS OF THE EXPERIMENTAL GROUP

Dear Miss _____,

I am herewith returning the corrected subtraction and multiplication tests. I expect that you are still working on the correction of the addition errors and that you are not yet ready to begin on subtraction or multiplication. However, since it will be impossible for me to know just when you are ready for them, and since I must return every teacher's at the same time, I am returning them now.

I suggest that you both let the pupils see them, and that you examine them yourself, and then file away the individual lists of errors for use when you are ready for them. Subtraction and multiplication examples lend themselves to diagnosis far better than do addition examples.

Follow the same procedures as you did with the addition tests. Make a list of typical errors on the board, such as borrowed when no need, forgot to borrow, took minuend from subtrahend, zero difficulties, etc. Help each pupil to list his own particular errors.

The following are listed by Lazar in her book, Diagnostic and Remedial Work in Arithmetic Fundamentals as suggested remedial methods in subtraction:

1. Emphasize the importance of "paying back" or "carrying" when "borrowing" is necessary. Give special attention to pupils who "carry" when it is unnecessary.
2. Give more examples with zero combinations. Stress the meaning of zero as "not any."
3. Advise the pupils to use the method which they know best. There is no best method. Avoid changing methods. Avoid oral class recitations of subtraction examples in a group where several methods are used.
4. Teach checking.

Keep to the original plan of spending ten minutes a day on remedial work in the fundamentals as nearly as possible. It will also be well to continue giving five examples three times a week, with the pupils keeping individual graphs of the results. These examples should include zeros in the minuend and subtrahend, double and triple borrowing, examples with no borrowing, and occasional examples in money.

For the multiplication work list such errors on the board as lack of knowledge of multiplication facts, zero difficulties, faulty placement of partial product, wrong carrying in the addition, incorrect placement of decimal point, etc.

continued on next page

EXHIBIT G. (Continued) A COPY OF THE THIRD LETTER SENT TO THE TEACHERS OF THE EXPERIMENTAL GROUP

Remedial methods suggested by Lazar include:

1. Stress the importance of accuracy in multiplying, carrying, and adding partial products. Show how one little mistake will make the whole example wrong.
2. Emphasize careful placement of the partial product as an aid to accuracy.
3. Give sufficient drill in examples involving zero difficulties.
4. Discover which are generally weak combinations. Post them. Give special attention to the zero combinations.

Give plenty of practice in examples with single zero and double zero in the multiplier and multiplicand, and with one, two, and three place multipliers, with and without carrying, also examples in money.

Both sets of tests will be collected by me on Friday, Nov. 3rd. Please have them rearranged in alphabetical order and sent to your principal's office by Friday morning. Thank you!

The retests are to be given the first week of March.

many combinations receive no drill whatever, and others are drilled upon excessively."[1]

Corrective Work by the Classroom Teachers

From informal reports received from time to time, as well as from results of a questionnaire*[2] sent out to each teacher in the experimental group, the writer was able to make some inferences as to the amount and type of the corrective work being done. The majority of the teachers worked conscientiously at the task. At least two, after half-hearted attempts, gave up altogether on the plea that they could not afford the time from the regular arithmetic work of the grade. In contrast to these there were at least four who did exceptionally fine work and who expressed themselves as being surprised at what they were able to accomplish thereby.

The questionnaire was checked by seventeen teachers as follows, the number below the words indicating the number of teachers who checked that particular word.

1. Self-diagnosis of their own faulty habits by pupils working aloud at the blackboard. Remedial questioning by the teacher to correct faults indicated in such self-analysis.

Very much	Considerable	Some	Very little	None
6	6	3	0	1

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1 Ralph S. Newcomb, Modern Methods of Teaching Arithmetic, p.76.

* A copy of the questionnaire appears in the Appendix. It was adapted from one used by Smith in his study.

2 Arthur J. Smith, "The Value of a Diagnostic and Remedial Program in Arithmetic." Unpublished Master's thesis of the University of Chicago, 1936.

2. Discussion with each pupil of the most common errors that he made in each process.

Very much	Considerable	Some	Very little	None
9	5	1	2	0

3. Cooperative class work at the blackboard. One child works while others observe and check, or all pupils work and exchange observations and checking. The teacher present as guide.

Very much	Considerable	Some	Very little	None
8	7	2	0	0

4. Teaching of, and insistence upon, checking, as an aid to accuracy.

Very much	Considerable	Some	Very little	None
13	3	1	0	0

5. Special daily drill exercises to eliminate errors and establish correct facts or processes.

Very much	Considerable	Some	Very little	None
14	1	2	0	0

6. Careful and detailed explanation of difficult processes in an effort to have children rationalize the techniques as far as possible.

Very much	Considerable	Some	Very little	None
14	3	0	0	0

7. The use of individual graphs that the pupil may see his progress and strive to beat his own record.

Very much	Considerable	Some	Very little	None
0	1	1	2	13

8. Correction of common difficulties through general class instruction followed by exercises to establish correct fact or concept.

Very much	Considerable	Some	Very little	None
9	7	1	0	0

9. Games or devices to stimulate interest.

Very much	Considerable	Some	Very little	None
3	4	8	0	2

10. Incentive provided for correction of difficulties through a progress chart.

Very much	Considerable	Some	Very little	None
1	1	1	0	14

11. Pupil's name and difficulties catalogued in a teacher's class record of individual difficulties for the teacher's reference and study.

Very much	Considerable	Some	Very little	None
6	1	6	0	4

12. A record of errors made kept by each child for individual study.

Very much	Considerable	Some	Very little	None
0	5	4	2	6

13. Pupils having difficulty come early in the morning or devote some other "private" time to the correction of difficulties.

Very much	Considerable	Some	Very little	None
9	4	2	0	1

14. Note pupils' answers in regular work or in tests and make inferences as to why such results were secured.

Very much	Considerable	Some	Very little	None
9	4	3	1	0

15. Have the pupils work orally and "think aloud" thus giving significant facts about the pupils' methods of work.

Very much	Considerable	Some	Very little	None
8	5	2	1	1

16. Have the pupil tell how he thought out a certain process, after the answer has been obtained.

Very much	Considerable	Some	Very little	None
5	3	7	2	0

It will be seen that the items that were checked "very much" the greatest number of times were numbers 5 and 6, indicating that nearly every teacher was working daily at the task. The item which was checked "none" the greatest number of times was number 10, indicating that very few teachers were using progress

charts.

The lack of validity of such a five-point questionnaire is recognized by the writer. What to one teacher might seem "very much" to another might seem "considerable". However, it is at least indicative of the work that was done.

Corrective Work by the Writer

The writer worked remedially with one eighth grade and one fourth grade group. Each was met three times a week for fifteen minutes. In each case an attempt was made to diagnose each child's errors on each test, lists of such errors being kept by both the child concerned and by the writer. Where the initial test was insufficient to reveal the exact cause of the error, as was often the case in addition, the pupil was heard in working orally until the error was located. Pupils who seemed accurate but slow were also heard orally; since "it is as important for the teacher to discover how the pupil performs as to discover what his results are."[1]

Educators agree that it is motivated drill that brings the best results. Newcomb says, "One of the fundamental things is to secure the cooperation of the pupil in overcoming the difficulty. That wins half the battle."[2] Reed writes,"Motivated practice produces larger gains in arithmetic than unmotivated practice."[3]

1 Harry Grove Wheat, The Psychology and Teaching of Arithmetic, p. 522.

2 Ralph S. Newcomb, op. cit., p. 128.

3 Homer B. Reed, Psychology of Elementary School Subjects,p.352.

Myers, in writing along this same line to teachers, says, "Your success with backward pupils will depend upon the extent to which you can inspire them to want to discover their own troubles and overcome them."[1]

In Grade VIII the writer found that the desire to gain 100% accuracy was sufficient incentive for the group to work. Individual graphs were kept of the results of the daily work, and great interest was manifested in them, bearing out the thought that "awareness of success and progress in arithmetic drill is an extremely effective device in itself."[2] Few, if any, of the pupils had previously learned the decade facts in addition. Individual flash cards were made and used by the pupils in pairs. Charts of the facts, as found in My Addition Drill Book[3] were also made and used. After a pupil gained five perfect scores in succession he was excused from further drill in that process. All partook of the occasional check-up tests, however. At the close of seventeen fifteen-minute drill periods on addition, twenty-five of the thirty pupils seemed to require no further drill. Five, however, still needed more time. These were "counters". All were striving to overcome the habit and were making definite progress, but had not yet reached the goal.

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1 Garry Cleveland Myers, "Corrective Work in Arithmetic," Grade Teacher, LI (February, 1934), p. 36.

2 Harry A. Greene, "A Critique of Remedial and Drill Material in Arithmetic," Journal of Educational Research, XXI (April, 1930), p. 270.

3 Guy M. Wilson, My Addition Drill Book.

In view of the fact that it was necessary to spend some time on subtraction and multiplication before the retests, it was necessary to leave the specific work in addition at this point.

Evidently the work in addition had some carry-over into subtraction, for in subtraction every one of the thirty pupils succeeded in achieving 100 in the daily drill work every day, so that only a two weeks period was needed in that process.

Several found causes for stumbling in multiplication. Zeros and faulty placement of the partial product caused a great deal of difficulty. The pupils worked enthusiastically at their particular errors. At the close of twelve fifteen-minute drill periods twenty-seven of the thirty pupils seemed to have brought themselves up to the standard. The arithmetic teacher of this group said that the improvement in the ordinary arithmetic work of the group due to this drill on the fundamentals was very noticeable.

In Grade IV it was necessary to provide some outside source of motivation. The desire to reach the 100% goal meant almost nothing to the children in the beginning. Practically all of the children were "counters"; none had learned the decade facts; only a few had felt any need for accuracy, and none, for speed. Practically every error on the initial test was caused either by inaccuracy due to counting or by guessing at a decade combination.

In addition to much flash card drill in pairs and in teams the following devices were among those which were found to be very effective:

Box Race[1]

16				13			
12				27			
10				14			
9				31			
33				26			

Pass out such a form to each child. Tell what process is to be used. Say, "Ready - 7 go!" The 7 is placed above the first vertical column of squares and added (or subtracted) to each of the numbers in the column in turn, placing the answer only in the square. As each child finishes he stands. A record is kept of the order in which the rows complete the column. Papers are exchanged and corrected. The first row up with no errors receives a point. A new number is given and the game proceeds as before.

Number Contest

Three children go to the board, the rest work at their seats. An example is dictated. The first to have the correct answer receives a point for his row.

Ninepins[2]

A child is chosen to be "It". Nine children are selected from the class to face him. The teacher gives combinations

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1 Elda L. Merton, et al, The Problem of the Elementary School Principal in the Light of the Testing Movement, pp. 395-429.

2 Guy M. Wilson, The Motivation of Arithmetic, p. 44.

rapidly, as 17+9; 26+5. If the child who is "It" answers before the first child in line, he has knocked down a ninepin, and this child takes his seat. If any child in the line answers first he remains in line until all have had their turn. Each ninepin knocked down counts 2. The score is kept by a pupil at the board.

Rows as Teams

The first child in each row goes to the board for the same example. The one finding the correct answer first scores 3 points, others who get it right 2 points, and those who make a mistake but whose work is corrected by a member of his team before time is called score 1 point. The second child in each row goes to the board and the game proceeds as before.

The fourth grade pupils were much slower to understand the idea of 100% accuracy. Klapper's statement that both speed and accuracy are qualities which respond readily to systematic and regular drill and show steady increase when appropriate exercises are devised[1] proved itself true in this particular fourth grade. A great change was manifested in the children's attitudes, and improvement began slowly to result in their work. The statements that "time is needed to replace faulty habits"[2] and that "errors are remarkably persistent and can be eliminated only by great effort on everyone's part"[3] are particularly true of the

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1 Paul Klapper, The Teaching of Arithmetic, p. 92.

2 Anna A. Kelley, "Teaching Remedial Arithmetic", American School Board Journal, XCI (August, 1935), p. 47.

3 Luella Cole, Psychology of the Elementary School Subjects, p. 211.

the fourth grade.

An effort was made to teach the decade facts, since the children obviously did not know them, and since "learning the primary facts does not guarantee a knowledge of the decade facts."[1] The grouping scheme used by Wilson in My Addition Drill Book[2] was used. Each child made a notebook of the facts.

Believing that "unless a pupil has acquired the habit of checking his results, he is not master of the situation"[3], an effort was made to teach checking.

Later on individual graphs were made and kept to show progress, and the children became keen to beat their own records.

Four months were spent on addition with these fourth grade children - a total of thirty-nine fifteen-minute periods. Even then the group as a whole was by no means brought up to the standard. However, some individuals were, and the group as a whole showed definite progress. All were conscious of the goal; all knew how to work in order to achieve it. "Counting" was in obvious disfavor with the entire group - they realized how it slowed them up in contests.

One month, only thirteen fifteen-minute periods, was left for subtraction. As in the case of the eighth grade there seemed to be a carry-over from the addition to the subtraction drill. The

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1 Lois C. Mossman, Principles of Teaching and Learning in the Elementary School, p. 245.

2 Guy M. Wilson, op. cit.

3 Joseph C. Brown, and L. D. Coffman, How to Teach Arithmetic, p. 57.

original test scores for subtraction in this fourth grade were very much lower than the original addition scores in the grade. Many children were hazy as to method. Once that was understood there seemed to be little difficulty. In nearly every case there was a constant improvement in scores. The percentage of perfect scores in the daily drill examples ranged from 70 to 90% of the class. Subtraction graphs were made by each child. Each strove to reach and maintain the 100% level on his graph. Maintaining this level was a point of great pride with each one.

There seemed to be three factors that contributed to improved scores in each instance;- first, a knowledge of the facts; second, a clear understanding of method; and third, pupil interest.

CHAPTER V

THE FINAL TESTING

Testing Procedure

Test Results

CHAPTER V

THE FINAL TESTING

Testing Procedure

The final tests were given during the first week of March. These were the same Wilson Tests that were given in October. They were administered by the classroom or arithmetic teachers, in exactly the same manner as were the initial tests in October. A copy of the letter appearing in Exhibit H was sent to each teacher with the tests.

As was the case in October, all of the tests were scored by the writer.

Test Results

Table LIII shows the distribution according to time and score for all fourth grades on the final A. P. Test. From this it will be seen that of the 319 children taking the test, 60 or 18.78% achieved perfect scores. Of these only 23 were able to achieve a perfect score within the time standard of 13 minutes. The corrective load was, therefore, 92.80% of the group. Within the time standard were 124 or 38.81%, although their scores went as low as 56. The range of scores was from 44 to 100, the median being 92 and the mean 88.61. The time ranged from 6 to 42 minutes, the median being 15 and the mean 15.9 minutes.

Tables LIV and LV show similar tabled results for the

EXHIBIT H. COPY OF LETTER SENT TO TEACHERS WITH THE FINAL TESTS

It is now time for the arithmetic retests. They are to be given as follows:

Addition	-	Monday, March 4th
Subtraction	-	Tuesday, March 5th
Multiplication	-	Wednesday, March 6th

The procedure is the same as for the original tests in October. Always stress the particular prpcess to be used. There is no time limit; but please record on the accompanying paper the exact time taken by each pupil for each test exactly as you did before.

We hope there will be a great many perfect scores this time, and an improvement in every instance.

After the tests are collected please arrange the papers in alphabetical order and send them to your principal's office. You do not need to correct them.

The addition tests will be called for on Monday afternoon and the subtraction and multiplication tests on Thursday morning. Be sure to include the paper on which you have recorded the times with the last tests.

Thank you very much for your cooperation. It has been greatly appreciated.

TABLE LIII. DISTRIBUTION ACCORDING TO TIME AND SCORE OF ALL FOURTH GRADES ON THE FINAL A. P. TEST

Score	Time in minutes																								
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21 to 25	26 to 30	31 to 42	f	Percentages
100		3	1	1	3	5	37	2	4	4	3	6	2	5		6	1	4	60	18.78
96		3		2	7	3	35	1	6	1	2	4	3	5		4	1	2	52	16.28
92		2		2	8	4	47	6	3	4	3	4	1	3		9	3	1	64	20.03
88	1	1	2		2	1	45	3	2	1	6	1	1	4		2	2	3	41	12.83
84		1	2	1	2	1	43	2	1	1	1	3	5	1		2	3	2	35	10.96
80		1					24	2	1	3	1			1		1		1	17	5.32
76				2	1		22	1	2	1		3				3	2	1	20	6.26
72						2				1	1	2				3	2		11	3.44
68				1			1	2								1	1		6	1.88
64				1	1			1									1		4	1.25
60											1					1	1	1	4	1.25
56							1	1				1							3	.94
52										1									1	.31
48																				
44																1			1	.31
f	1	5	24	22	21	17	24	19		17									319	99.84
	11	10	16	35	19	18	12		33		15									
	124							195												
	38.81%							61.19%												

Score		Time
44 - 100	Range	6 - 42
92	Median	15
88.61	Mean	15.9

Number up to accuracy and time standards - 23 or 7.20%
Number not up to above standards - 296 or 92.80%

Score standard - 100
Time standard - 13 minutes

TABLE LIV. DISTRIBUTION ACCORDING TO TIME AND SCORE OF THE FOURTH GRADE EXPERIMENTAL GROUP ON THE FINAL A. P. TEST

Score	Time in minutes																						
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21 to 25	26 to 30	31 to 42	f	Percentages
100		2	1	1	3	5	2	7	2	3	3	3	5	25		6	1	4	55	19.03
96		3		2	7	3	3	4	1	6	1	2	4	35		4	1	2	51	17.65
92		2		1	8	2	4	6	5	3	3	3	3	13		7	2	1	54	18.68
88	1	1	2		2	1	3	5	3	2	1	6	1	13		2	2	3	39	13.49
84		1	2		1	1	4	3	2	1	1	1	2	41		1	2	2	29	10.03
80		1					2	4	1	1	2	1		1		1		1	15	5.19
76				2	1		2	1	1	2	1		2			3	1	1	17	5.88
72						2					1	1	2			3	2		11	3.81
68								1	2							1	1		5	1.73
64				1	1				1								1		4	1.38
60												1				1	1	1	4	1.38
56								1	1				1						3	1.04
52											1								1	.35
48																				
44																1			1	.35
f	1		5		23		20	19		14		20		18			14						
		10		7		14			32		18		18		11	30		15	289	99.99
					112									177						
					38.75%									61.25%						

Score		Time
44 - 100	Range	6 - 42
92	Median	15
88.64	Mean	15.9

Number up to accuracy and time standards - 21 or 7.27%
Number not up to above standards - 268 or 92.73%

Score standard - 100
Time standard - 13 minutes

TABLE LV. DISTRIBUTION ACCORDING TO TIME AND SCORE OF THE FOURTH GRADE CONTROL GROUP ON THE FINAL A. P. TEST

Score	Time in minutes																	
	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21 to 25	26 to 28	f	Percentages
100	1					1			1	1		1					5	16.65
96							1										1	3.33
92			1		2		1	1		1		1			2	1	10	33.30
88						1								1			2	6.66
84			1	1								1	1		1	1	6	19.98
80								1		1							2	6.66
76							1					1				1	3	9.99
72																		
68			1														1	3.33
f	1		3	1	2	2	3	2	1	3		4	1	1	3	3	30	99.90

12 (39.76%) — 18 (60.24%)

Score		Time
68 - 100	Range	7 - 28
92	Median	15
88.13	Mean	15.9

Number up to accuracy and time standards - 2 or 6.66%
Number not up to above standards - 28 or 93.34%

Score standard - 100
Time standard - 13 minutes

experimental and control fourth grade groups on the final A. P. Test.[1] The results for the experimental group are shown in Table LIV. There were 19.03% who achieved perfect scores, 7.27% accomplishing it within the time standard. Scores ranged from 44 to 100 with the median at 92 and the mean at 88.64. The time ranged from 6 to 42 minutes, the median being 15 and the mean 15.9 minutes. The results for the control group are shown in Table LV. There were 16.65% who achieved perfect scores, 6.66% accomplishing it within the time standard. The corrective load was 92.73%. Scores ranged from 68 to 100, with the median at 92 and the mean at 88.13. The time ranged from 7 to 28 minutes, with the median at 15 and the mean at 15.9 minutes.

Table LVI shows the distribution according to time and score for all fourth grades on the S. P. Test. Of the 319 children taking the test, there were 107 or 33.53% who achieved perfect scores. Of these 75 or 23.51% were able to accomplish it within the time standard of 12 minutes. There were 175 or 54.87% who completed the test within the 12 minutes, although their scores extended as low as 8. The scores thus ranged from 8 to 100, the median being 96 and the mean 86.18. The time ranged from 4 to 42 minutes, the median being 12 and the mean 12.9 minutes. The corrective load was found to be 76.49% of the group.

Tables LVII and LVIII show similar results for the experimental and control fourth grade groups on the final S. P. Test. The results for the experimental group are shown in Table LVII.

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1 Specific comparisons between the experimental and control groups will be made in a later chapter.

TABLE LVI. DISTRIBUTION ACCORDING TO TIME AND SCORE OF ALL FOURTH GRADES ON THE FINAL S. P. TEST

Score	Time in minutes																								
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21 to 25	26 to 34	42	f	Percentages
100	15	4	10	15	8	9	18	56	1	103	2	3	1	4				2			107	33.53
96	1	3	3	4	2	8	7	42	2	3	3	5	4					4			55	17.24
92	1	1	2	4	1	3	1	33	6	2	3	1	2		3			4		1	41	12.85
88			1		4	5	2	1	3	2	1	1	2		3			1			26	8.15
84					3	2	1	1	1	1			1					1			11	3.45
80					1	1	1		1	1			1	1							7	2.19
76				1	2		1	1	1	3	3										12	3.76
72					1	2	1	3	2	1		1			1				1		13	4.07
68		1				2		2		1									2		8	2.51
64					1	1			1										1		4	1.25
60				2		1		1				1	1		1						7	2.19
56											1	1									2	.63
52							1														1	.31
48																		1			1	.31
44												1						1	1		3	.94
40					1		1						1								3	.94
36							1		1	1		1	1					1	1		7	2.19
32							1														1	.31
28																						
24									1	1				1							3	.94
20														1							1	.31
16									1												1	.31
12					1																1	.31
8							2											1	1		4	1.25
	7			16	24			36	19		25		13		3			16		1		
f	1	9		27		36	19		17		17		15		11				7		319	99.94

175
54.87%

144
45.13%

Score		Time
8 - 100	Range	4 - 42
96	Median	12
86.18	Mean	12.9

Number up to accuracy and time standards - 75 or 23.51%
Number not up to above standards - 244 or 76.49%
Score standard - 100
Time standard - 12 minutes

TABLE LVII. DISTRIBUTION ACCORDING TO TIME AND SCORE OF THE FOURTH GRADE EXPERIMENTAL GROUP ON THE FINAL S. P. TEST

Score	Time in minutes																								
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21 to 25	26 to 34	42	f	Percentages
100	15		4	1	0	15	8	9	18	5	6	1	9	3	2	3	1	4	1			106	36.68
96	1		3	3	4	2	7	7	3	2	2	2	3	5	4			4			52	17.99
92			1	1	4		3	3	1	2	5	2	3	1	2		2	4		1	35	12.11
88				1		4	4	1	1		2	2	1	1	2		2				21	7.27
84						3	2	1	1			1			1			1			10	3.46
80						1	1	1			1	1			1	1					7	2.42
76						2		1		1	1	2	2								9	3.11
72						1	2	1		3	1	1		1							10	3.46
68			1				2		2			1							2		8	2.77
64						1				1									1		3	1.04
60					2		1		1							1					5	1.73
56												1									1	.35
52								1													1	.35
48																		1			1	.35
44													1					1	1		3	1.04
40						1		1						1							3	1.04
36										1	1	1	1						1		5	1.73
32								1													1	.35
28																						
24									1					1							2	.70
20														1							1	.35
16																						
12					1																1	.35
8							2											1	1		4	1.38
	6		15		23		36			16		22		12		3		14		1		
f	1		9		26		33		15		14		14	15		8			6		289	100.03

164
56.75%

125
43.25%

Score		Time
8 - 100	Range	4 - 42
96	Median	11
87.31	Mean	12.8

Number up to accuracy and time standards - 75 or 25.95%
Number not up to above standards - 214 or 74.05%
Score standard - 100
Time standard - 12 minutes

TABLE LVIII. DISTRIBUTION ACCORDING TO TIME AND SCORE OF THE FOURTH GRADE CONTROL GROUP ON THE FINAL S. P. TEST

Score	Time in minutes																							f	Percentages
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	27	34						
100									1															1	3.33
96					1		1		1															3	10.00
92	1		1						1	1						1								6	20.00
88					1	1			1						1		1							5	16.67
84									1															1	3.33
80																									
76			1							1	1													3	10.00
72									1						1				1					3	10.00
68																									
64					1																			1	3.33
60											1	1												2	6.66
56											1													1	3.33
52																									
48																									
44																									
40																									
36						1												1						2	6.66
32																									
28																									
24									1															1	3.33
20																									
16								1																1	3.33
f	1		1	1	1	3	2	2	3	5	1	3	1		2	1	1	1	1					30	99.99

11
46.63%

19
63.37%

Score		Time
16 - 100	Range	5 - 34
88	Median	14
75.33	Mean	14.5

Number up to accuracy and time standards - 0
Number not up to above standards - 30 or 100%

Score standard - 100
Time standard - 12 minutes

There were 36.68% who achieved perfect scores, 25.95% accomplishing it within the time standard. The corrective load was 74.05%. Scores ranged from 8 to 100, with the median at 96 and the mean at 87.31. The time ranged from 4 to 42 minutes, with the median at 11 and the mean at 12.8 minutes. The results for the control group are shown in Table LVIII. There were 3.33% who achieved perfect scores; however there was no one to achieve a perfect score within the time standard. The corrective load was 100%. Scores ranged from 16 to 100, with the median at 88 and the mean at 75.33. The time ranged from 5 to 34 minutes, with the median at 14 and the mean at 14.5 minutes.

Table LIX shows the distribution of time and score for all sixth grades on the A. P. Test. Of the 326 children taking the test 70 or 21.42% achieved perfect scores. Of these 46 accomplished it within the time standard of 10 minutes. The scores ranged from 60 to 100. The median score was 92, the mean 90.83. The time ranged from 4 to 39 minutes, the median being 9 and the mean 10.04 minutes. The corrective load was found to be 85.92%.

Tables LX and LXI show similar results for the experimental and control sixth grade groups on the final A. P. Test. The results for the experimental group are shown in Table LX. There were 17.63% who achieved perfect scores, 11.25% accomplishing it within the time standard. The corrective load was 88.75% of the group. Scores ranged from 64 to 100 with the median falling at 92 and the mean at 90.30. Time ranged from 4 to 39 minutes, the median being 9 and the mean 10.04 minutes. The results for the control group are shown in Table LXI. There were 39.96%

TABLE LIX. DISTRIBUTION ACCORDING TO TIME AND SCORE OF ALL SIXTH GRADES ON THE FINAL A. P. TEST

Score	Time in minutes																				
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21 to 30	39	f	Percentages
100	2	3	9	11	6	4	11	6	1	6	2	1		4	1		1	2		70	21.42
96	2	4	4	5	6	7	12	4	7	1	2	3	1			1	2		1	62	18.97
92		6	4	5	8	6	7	3	3	1	1	2	1	1				3		51	15.61
88	3	5	4	5	8	8	7	8	2	4	1	2	1				1	2		61	18.67
84	1	3	5	5	3	4	6	2	1	3			1	2				1		37	11.32
80	1		1	1	2	3	1	1		2	1	1		1				1		16	4.90
76		1	1		2	2	4	1				1		2				1		15	4.59
72						1	4	2	1				1							9	2.75
68				1	1															2	.61
64							1							1						2	.61
60		1																		1	.31
f	9	23	28	33	36	35	53	27	15	17	7	10	5	11	1	1	4	10	1	326	99.76

(Times 4–10): 217, 66.40%

(Times 11–39): 109, 33.60%

Score		Time
60 - 100	Range	4 - 39
92	Median	9
90.83	Mean	10.04

Number up to accuracy and time standards - 46 or 14.08%
Number not up to above standards - 280 or 85.92%

Score standard - 100
Time standard - 10 minutes

TABLE LX. DISTRIBUTION ACCORDING TO TIME AND SCORE OF THE SIXTH GRADE EXPERIMENTAL GROUP ON THE FINAL A. P. TEST

Score	Time in minutes																					f	Percentages
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21 to 30		39			
100	2	3	6	9	6	4	7	5	6	2	1		4	1		1		1				58	17.63
96	2	3	3	5	5	7	10	4	7	1	2	3	1			1	2			1		57	17.33
92		5	3	4	8	6	6	3	3	1		2	1	1				3				46	13.98
88	3	5	3	5	8	8	6	6	2	4	1	2	1				1	2				57	17.33
84	1	3	5	5	3	4	6	2	1	3			1	1				1				36	10.94
80	1		1	1	2	3	1	1		2	1	1		1				1				16	4.86
76		1	1		2	2	3	1				1		2				1				14	4.26
72						1	3	2	1				1									8	2.43
68				1	1																	2	.61
64							1							1								2	.61
f	9		22		35		43		14		6		5		1		4			1			
			20		30		35		24		17		10		10		1		9			296	99.98

194
58.98%

102
41.02%

Score		Time
64 - 100	Range	4 - 39
92	Median	9
90.30	Mean	10.04

Number up to accuracy and time standards - 37 or 11.25%
Number not up to above standards - 259 or 88.75%

Score standard - 100
Time standard - 10 minutes

TABLE LXI. DISTRIBUTION ACCORDING TO TIME AND SCORE OF THE SIXTH GRADE CONTROL GROUP ON THE FINAL A. P. TEST

Score	Time in minutes																		f	Percentages
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21			
100	3	2				4	1	1									1		12	39.96
96	1	1			1	2													5	16.65
92	1	1		1		1				1									5	16.65
88		1				1	2												4	13.32
84													1						1	3.33
80																				
76						1													1	3.33
72						1													1	3.33
68																				
64																				
60	1																		1	3.33
f	3	6	3	1		10	3	1	1			1					1		30	99.90

23 — 76.69%

7 — 23.31%

Score		Time
60 - 100	Range	5 - 21
96	Median	10
92.53	Mean	9.2

Number up to accuracy and time standards - 9 or 29.97%
Number not up to above standards - 21 or 70.03%

Score standard - 100
Time standard - 10 minutes

who achieved perfect scores, 29.97% accomplishing it within the time standard. The corrective load was 70.03%. Scores ranged from 60 to 100 with the median at 96 and the mean at 92.53. The time ranged from 5 to 21 minutes, with the median at 10 and the mean at 9.2 minutes.

Table LXII shows the time and score distribution for all sixth grades on the S. P. Test. Of the 330 pupils taking the test 154 or 46.66% achieved perfect scores. Of these 116 or 35.15% accomplished it within the time standard of 8 minutes. The corrective load for the group, therefore, was 64.85%. The scores ranged from 60 to 100, the median being 96 and the mean 92.04. The time ranged from 2 to 21 minutes, with the median at 7 and the mean at 7.5 minutes.

Tables LXIII and LXIV show similar results for the experimental and control sixth grade groups on the final S. P. Test. The results for the experimental group are shown in Table LXIII. There were 45.15% who achieved perfect scores, 36.19 accomplishing it within the time standard. The corrective load was 63.81% of the group. Scores ranged from 60 to 100, the median being 96 and the mean 95.12. The time ranged from 2 to 20 minutes, the median being 6 and the mean 6.3 minutes. The results for the control group are shown in Table LXIV. There were 62.06% who achieved perfect scores, 24.14% accomplishing it within the time standard. The corrective load was 75.86%. Scores ranged from 72 to 100, the median falling at 100 and the mean at 96.97. The time ranged from 2 to 21 minutes, the median being 10 and the mean 10.4 minutes.

TABLE LXII. DISTRIBUTION ACCORDING TO TIME AND SCORE OF ALL SIXTH GRADES ON THE FINAL S. P. TEST

Score	Time in minutes																					f	Percentages
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21			
100	9	20	26	21	26	14	7	11	9	1	4		4	1	1					1		154	46.66
96	1	21	41	31	9	7	6	5	5	3	2		1		1		1	1	1			82	24.85
92	2	3	3	8	5	9	5	2	5	1			2	1					1	1		48	14.54
88		1	1	5	2	4	4		3													20	6.06
84				1			1		21			1										6	1.82
80						2	1		11					1								6	1.82
76			1		4					1			1									7	2.12
72			1			1								1								3	.91
68							1		1		1											3.	.91
64																							
60									1													1	.30
f	3	40		51		33	26		3		4		2		1		2						
		15		53		49	18	15		5		7		1		1		2				330	100.01
				244								86											
				73.94%								26.06%											

Score		Time
60 - 100	Range	2 - 21
96	Median	7
92.04	Mean	7.5

Number up to accuracy and time standards - 116 or 35.15%
Number not up to above standards - 214 or 64.85%

Score standard - 100
Time standard - 8 minutes

TABLE LXIII. DISTRIBUTION ACCORDING TO TIME AND SCORE OF THE SIXTH GRADE EXPERIMENTAL GROUP ON THE FINAL S. P. TEST

Score	Time in minutes																				f	Percentages
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			
100	8	18	24	21	24	14	7	10	7		2		1		1						136	45.15
96	2	12	13	19	6	6	5	4	3	2		1		1		1	1				76	25.23
92	23	3	8	5		9	5	2	4	1			2	1							45	14.94
88	1	1	5	2	4	4		2													19	6.31
84			1			1	2	1			1										6	2.00
80					2	1	1	1					1								6	2.00
76		1		4					1			1									7	2.32
72		1											1								2	.66
68						1	1		1												3	1.00
64																						
60						1															1	.33
f	2		36		51		33		22		2		4		1		1		1			
		14		51		45		18		13		3		4		1					301	99.94
						232								69								
						77.09%								22.91%								

Score		Time
60 - 100	Range	2 - 20
96	Median	6
95.12	Mean	6.3

Number up to accuracy and time standards - 109 or 36.19%
Number not up to above standards - 192 or 63.81%

Score standard - 100
Time standard - 8 minutes

TABLE LXIV. DISTRIBUTION ACCORDING TO TIME AND SCORE OF THE SIXTH GRADE CONTROL GROUP ON THE FINAL S. P. TEST

Score	Time in minutes																					f	Percentages
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21			
100			1	2		2			1	2	1	2		3	1					1		18	62.06
96	1		2			1			1									1				6	20.69
92									1										1	1		3	10.34
88									1													1	3.45
84																							
80																							
76																							
72						1																1	3.45
f	1		1	4.2		4			4	2	1	2		3	1			1	1	2		29	99.99

12
41.38%

17
58.62%

Score		Time
72 - 100	Range	2 - 21
100	Median	10
96.97	Mean	10.4

Number up to accuracy and time standards - 7 or 24.14%
Number not up to above standards - 22 or 75.86%

Score standard - 100
Time standard - 8 minutes

Table LXV shows the time and score distribution for all sixth grades on the M. P. Test. Of the 329 children taking the test 41 or 12.46% achieved perfect scores. Of these 23 or 6.99% were able to accomplish it within the time standard of 12 minutes. There were 187 who completed the test within 12 minutes, but their scores extended as low as 20. There was a range of scores, then, extending from 20 to 100, with the median falling at 92 and the mean at 88.24. The time ranged from 4 to 35 minutes, with the median at 12 and the mean at 13.1 minutes.

Tables LXVI and LXVII show similar results for the experimental and control sixth grades on the final M. P. Test. The results for the experimental group are shown in Table LXVI. Perfect scores were achieved by 11.71% of the group, 7.67% accomplishing it within the time standard. The corrective load was 92.33%. Scores ranged from 60 to 100, the median being 88 and the mean 87.67. The time ranged from 4 to 35 minutes, the median being 11 and the mean 12.04 minutes. The results for the control group are shown in Table LXVII. Perfect scores were obtained by 20% of the group. However, taking time into consideration, the corrective load was 100%. Scores ranged from 20 to 100, the median being 92 and the mean 88.27. The time ranged from 12 to 35 minutes, the median being 24 and the mean 23.6 minutes.

Table LXVIII shows the distribution according to time and score of all eighth grades on the A. P. Test. Of the 323 pupils taking the test 94 or 29.05% achieved perfect scores. Of these 74 or 22.94% were able to accomplish it within the time standard

TABLE LXV. DISTRIBUTION ACCORDING TO TIME AND SCORE OF ALL SIXTH GRADES ON THE FINAL M. P. TEST

Score	Time in minutes																				f	Percent-ages
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21 to 25	26 to 30	31 to 35		
100				4	3	5	2	7	2	1	1	4		1	1		2	5	1	2	41	12.46
96			1	3	5	5	8	10	6	5	3	2	2	4	3		1	4	2	1	65	19.75
92				4	7	6	9	7	5	4	1	7		1	2	2		1			56	17.02
88	1			1	6	7	2	4	7	3	4	5	3	1		2	1	2	3		52	15.80
84				1	4		2	7		3	2	6	2				1	2	1		31	9.42
80			2	1	2		2	1	5	4	1	2	1			1		4	1		27	8.21
76			1	1	1		6	2	1	5	1			1		2		1			22	6.69
72		1	1	1	1	2	3	4	2		1				1	1					18	5.47
68						1	1	1				2		1			1				7	2.13
64				1			1		1		1			1			1			1	7	2.13
60					1																1	.30
56															1						1	.30
52																						
48																						
44																						
40																						
36																						
32																						
28																						
24																						
20																			1		1	.30
f	1	1	5	17	30	26	35	43	29	25	15	28	8	10	8	8	7	19	9	4	329	99.98

Time 4 to 12	Time 13 to 35
187	142
57.15%	42.85%

Score		Time
20 - 100	Range	4 - 35
92	Median	12
88.24	Mean	13.1

Number up to accuracy and time standards - 23 or 6.99%
Number not up to above standards - 305 or 93.01%

Score standard - 100
Time standard - 12 minutes

TABLE LXVI. DISTRIBUTION ACCORDING TO TIME AND SCORE OF THE SIXTH GRADE EXPERIMENTAL GROUP ON THE FINAL M. P. TEST

Time in minutes

Score	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21 to 25	26 to 30	31 to 35	f	Percentages
100				4	3	5	2	7	2	1	1	4		1	1		2	2			35	11.71
96			1	3	5	5	8	10	6	5	3	2	2	4	3			1			58	19.39
92				4	7	6	9	7	4	4	1	7			1	1					51	17.05
88	1			1	6	7	2	4	6	3	4	5	2	1		2	1	1	1		47	15.72
84				1	4		2	7		3	2	6	2				1	2			30	10.03
80			2	1	2		2	1	5	4	1	2	1			1		2			24	8.03
76			1	1	1		6	2	1	5	1			1		1		1			21	7.02
72		1	1	1	1	2	3	4	2		1				1	1					18	6.02
68						1	1	1				2		1			1				7	2.34
64				1			1		1		1			1			1			1	7	2.34
60					1																1	.33
f	1	1	5	17	30	26	36	43	27	25	15	28	7	9	6	6	6	9	1	1	299	99.98

4 to 12 minutes: 185, 61.88%

13 to 35 minutes: 114, 38.12%

Score		Time
60 - 100	Range	4 - 35
88	Median	11
87.67	Mean	12.04

Number up to accuracy and time standards - 23 or 7.67%
Number not up to above standards - 276 or 92.33%

Score standard - 100
Time standard - 12 minutes

TABLE LXVII. DISTRIBUTION ACCORDING TO TIME AND SCORE OF THE SIXTH GRADE CONTROL GROUP ON THE FINAL M. P. TEST

Score	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	33	35	f	Percentages
100										1		1		1	1					2		6	20.00
96									1			1	2		1		1				1	7	23.33
92	1					1	1	1					1									5	16.67
88	1				1						1						1		1			5	16.67
84																	1					1	3.33
80											1			1				1				3	10.00
76								1														1	3.33
72																							
68																							
64																							
60																							
56							1															1	3.33
52																							
48																							
44																							
40																							
36																							
32																							
28																							
24																							
20																1						1	3.33
f	2				1	1	2	2	1	1	2	2	3	2	2	1	3	1	1	2	1	30	99.99

2 (12 minutes): 6.67%
28 (13–35 minutes): 93.33%

Score		Time
20 - 100	Range	12 - 35
92	Median	24
88.27	Mean	23.6

Number up to accuracy and time standards - 0
Number not up to above standards - 30 or 100%

Score standard - 100
Time standard - 12 minutes

TABLE LXVIII. DISTRIBUTION ACCORDING TO TIME AND SCORE OF ALL EIGHTH GRADES ON THE FINAL A. P. TEST

Score	Time in minutes															f	Percentages
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
100	13	12	27	13	12	6	4	8	1	4		1	2			94	29.05
96	1	4	5	12	15	13	4	6	2		2		1			65	20.09
92		1	9	12	16	8	4	4		3	3	1	1	1		65	20.09
88	1	2	1	5	13	5	4	6	4							41	12.67
84	1		1	3	7	6	4	2	1		1					26	8.03
80		1	1	3	5	1	1	1		1						14	4.33
76				2		1										3	.93
72			1	1	1						1					4	1.24
68				1		1										2	.62
64				1	1	1	1									4	1.24
60						1										1	.31
56				1										1		2	.62
52			1					1								2	.62
f	1		22		54	43		28		8	2		2				
	6		46		70	22		8		7	4					323	99.84
	242					81											
	74.97%					25.03%											

Score		Time
52 - 100	Range	2 - 16
92	Median	7
92.00	Mean	7.3

Number up to accuracy and time standards - 74 or 22.94%
Number not up to above standards - 249 or 77.06%

Score standard - 100
Time standard - 8 minutes

of 8 minutes. The corrective load was 77.96%. There were 242 who completed the test within 8 minutes, but their scores extended as low as 52. Scores ranged, then, from 52 to 100, with both the median and mean falling at 92. The time ranged from 2 to 16 minutes, the median being 7 and the mean 7.3 minutes.

Tables LXIX and LXX show similar results for the experimental and control eighth grade groups on the final A. P. Test. The results for the experimental group are shown in Table LXXIX. Of the 167 pupils, 71 or 42.45% achieved perfect scores. There were 53 or 31.27% who were able to accomplish it within the time standard. The corrective load was 68.73%. Scores ranged from 80 to 100, the median falling at 96 and the mean at 95.21. The time ranged from 2 to 16 minutes, the median being 7 and the mean 7.6 minutes. The results for the control group are shown in Table LXX. Of the 156 pupils in the group 23 or 14.81% achieved perfect scores. There were 21 or 13.44% able to accomplish it within the time standard. The corrective load was 86.56%. Scores ranged from 52 to 100, the median being 92 and the mean 88.51. The time ranged from 3 to 16 minutes, the median being 7 and the mean 7.05 minutes.

Table LXXI shows the time and score distribution for all eighth grades on the S. P. Test. Of the 323 pupils taking the test 170 or 52.53% achieved perfect scores, 123 of them accomplishing it within the time standard of 5 minutes. The corrective load was 61.80%. Scores ranged from 40 to 100 with the median at 100 and the mean at 92.98. The time ranged from 2 to

TABLE LXIX. DISTRIBUTION ACCORDING TO TIME AND SCORE OF THE EIGHTH GRADE EXPERIMENTAL GROUP ON THE FINAL A. P. TEST

Score	Time in minutes															f	Percentages
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
100	1		1	0	1	9	10	11	2	3	7	1	4		1	2	71	42.45
96			1	3	4	9	8	1	4	2		1		1			34	20.33
92				5	9	4	3	4	2		3	2		1	1		24	20.33
88					1	4	3	3	2								16	9.56
84				1	1	4	1	1			1						10	5.98
80						2											2	1.18
f	1		11		25		17		17	7			1		1			
				28		34		12		5		4		4			167	99.83
					116					51								
					69.37%					30.63%								

Score		Time
80 - 100	Range	2 - 16
96	Median	7
95.21	Mean	7.6

Number up to accuracy and time standards - 53 or 31.27%
Number not up to above standards - 114 or 68.73%

Score standard - 100
Time standard - 8 minutes

TABLE LXX. DISTRIBUTION ACCORDING TO TIME AND SCORE OF THE EIGHTH GRADE CONTROL GROUP ON THE FINAL A. P. TEST

Score	Time in minutes															f	Percentages
	3	4	5	6	7	8	9	10	11	12	13	14	15	16			
100	32	8	3	1	4	1	1									23	14.81
96	13	2	8	6	5	3	2			1						31	19.96
92	3	4	3	12	5		2			1	1					31	19.96
88	12	1	4	9	2	1	3	2								25	16.10
84	1		2	3	5	3	1	1								16	10.30
80	1	1	3	3	1	1	1		1							12	7.72
76			2		1											3	1.93
72		1	1	1						1						4	2.57
68			1		1											2	1.28
64			1	1	1	1										4	2.57
60					1											1	.64
56			1										1			2	1.28
52		1					1									2	1.28
f	6	18	36	10		3	3										
	11	29	26	11		1	1	1								156	99.76
	126			30													
	81.14%			18.86													

Score		Time
52 - 100	Range	3 - 16
92	Median	7
88.51	Mean	7.05

Number up to accuracy and time standards - 21 or 13.44%
Number not up to above standards - 135 or 86.56%

Score standard - 100
Time standard - 8 minutes

TABLE LXXI. DISTRIBUTION ACCORDING TO TIME AND SCORE OF ALL EIGHTH GRADES ON THE FINAL S. P. TEST

Score	Time in minutes											f	Percentages
	2	3	4	5	6	7	8	9	10	11	12		
100	8	36	45	34	16	12	8	2	6	2	1	170	52.53
96	1	1	11	16	17	11	10	12				69	21.32
92	2	3	10	13	4	3	1					37	11.43
88	1	3	7	6	4	4		1				24	7.42
84	2	3		2	1			2				10	3.09
80	1	1	2		1							5	1.55
76			1	1	1							3	.93
72			2	1								3	.93
68								1				1	.31
64													
60													
56													
52													
48													
44													
40			1									1	.31
f	15	83	37	10	6	1							
	57	75	29	8	2							323	99.82
	230			93									
	71.26%			28.74%									

Score		Time
40 - 100	Range	2 - 12
100	Median	5
92.98	Mean	4.9

Number up to accuracy and time standards - 123 or 38.20%
Number not up to above standards - 200 or 61.80%

Score standard - 100
Time standard - 5 minutes

12 minutes, the median being 5 and the mean 4.9 minutes.

Tables LXXII and LXXIII show similar results for the experimental and control eighth grade groups on the final S. P. Test. The results for the experimental group are shown in Table LXXII. Of the 167 pupils, 130 or 77.74% achieved perfect scores, 52 accomplishing it within the time standard. The corrective load was 47.97%. Scores ranged from 88 to 100, the median being 100 and the mean 98.80. The time ranged from 2 to 12 minutes, the median being 5 and the mean 5.2 minutes. The results for the control group are shown in Tables LXXIII. Of the 156 pupils 40 or 25.64% achieved perfect scores, 36 accomplishing it within the time standard. The corrective load was 76.92%. Scores ranged from 40 to 100 with the median at 96 and the mean at 92.51. The time ranged from 2 to 9 minutes, the median being 4 and the mean 4.5 minutes.

Table LXXIV shows the distribution according to time and score for all eighth grades on the M. P. Test. Of the 320 pupils taking the test 53 or 16.57% achieved perfect scores, 36 accomplishing it within the time standard of 9 minutes. The corrective load was 88.75%. Scores ranged from 52 to 100, the median falling at 92 and the mean at 88.83. The time ranged from 3 to 18 minutes, the median being 8 and the mean 8.7 minutes.

Tables LXXV and LXXVI show similar results for the experimental and control eighth grade groups on the final M. P. Test. The results for the experimental group are shown in Table LXXV. Of the 164 pupils 47 or 28.66% achieved perfect scores, 30 of them accomplishing it within the time standard. The corrective load

TABLE LXXII. DISTRIBUTION ACCORDING TO TIME AND SCORE OF THE EIGHTH GRADE EXPERIMENTAL GROUP ON THE FINAL S. P. TEST

Score	Time in minutes											f	Percentages
	2	3	4	5	6	7	8	9	10	11	12		
100	5	24	32	26	14	11	7	2	6	2	1	130	77.74
96		4	4	7	3	6	1	2				27	16.15
92	1		1	1	2	1	1					7	4.19
88			1	1		1						3	1.79
f	6	38	19	9	6	1							
		28	35	19	4	2						167	99.88
		107		60									
		64.12%		35.88%									

Score		Time
88 - 100	Range	2 - 12
100	Median	5
98.80	Mean	5.2

Number up to accuracy and time standards - 87 or 52.03%
Number not up to above standards - 80 or 47.97%

Score standard - 100
Time standard - 5 minutes

TABLE LXXIII. DISTRIBUTION ACCORDING TO TIME AND SCORE OF THE EIGHTH GRADE CONTROL GROUP ON THE FINAL S. P. TEST

Score	Time in minutes									f	Percentages
	2	3	4	5	6	7	8	9			
100	3	12	13	8	2	1	1			40	25.64
96	1	7	12	10	8	4				42	26.92
92	1	3	9	12	3	2				30	19.23
88	1	3	6	5	2	3		1		21	13.46
84	2	3		2	1			2		10	6.41
80	1	1	2		1					5	3.21
76			1	1	1					3	1.92
72			2	1						3	1.92
68								1		1	.64
64											
60											
56											
52											
48											
44											
40			1							1	.64
f	9		45		18		1				
		29		40		10		4		156	99.99
		123				33					
		78.85%				21.15%					

Score		Time
40 - 100	Range	2 - 9
96	Median	4
92.51	Mean	4.5

Number up to accuracy and time standards - 36 or 23.08%
Number not up to above standards - 120 or 76.92%

Score standard - 100
Time standard - 5 minutes

TABLE LXXIV. DISTRIBUTION ACCORDING TO TIME AND SCORE OF ALL EIGHTH GRADES ON THE FINAL M. P. TEST

Score	Time in minutes																	f	Percentages
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18			
100	1		5	4	5	9	12		44	4	3	1			1			53	16.57
96			4	7	6	13	10	9	4	2	3	3	1			1		63	19.69
92			3	5	6	8	6	4	5	3	5	2	2					49	15.31
88		1	2	5	12	5	5	4	2	3	3		1	1				44	13.75
84			6	5	15	4	7	4	3		1		1					46	14.38
80			3	2	6	3	2	3	4			1			1			25	7.81
76			2	2	5	3	1	2	2	1								18	5.63
72			1	3	2	1	2		1	2								12	3.75
68										1								1	.31
64					1					1		1						3	.94
60			1			1												2	.63
56						2			1									3	.94
52							1											1	.31
f	1		27		58		46		26		15		5		2				
		1		33		49		30		17		8		1		1		320	100.02
				215						105									
				67.19%						32.81%									

Score		Time
52 - 100	Range	3 - 18
92	Median	8
88.83	Mean	8.7

Number up to accuracy and time standards - 36 or 11.25%
Number not up to above standards - 284 or 88.75%

Score standard - 100
Time standard - 9 minutes

TABLE LXXV. DISTRIBUTION ACCORDING TO TIME AND SCORE OF THE EIGHTH GRADE EXPERIMENTAL GROUP ON THE FINAL M. P. TEST

Score	Time in minutes																	f	Percentages
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18			
100	1		2	4	4	8	11	4	4	4	3	1			1			47	28.66
96			2	5	4	9	8		8	3	2	2	3	1			1	48	29.27
92				1	3	5	5	3	5	2	5	2	2					33	20.12
88		1			3	1	1	1	1	1	2		1	1				13	7.93
84		1	2	1	1	3	3	1		1		1						14	8.54
80							1	1	1			1			1			5	3.05
76							1		1									2	1.22
72																			
68										1								1	.61
64																			
60																			
56									1									1	.61
f	1		6		15		30		17		13		5		2				
				12		24		20		10		7		1		1		164	100.01
				88							76								
				53.66%							46.34%								

Score		Time
56 - 100	Range	3 - 18
96	Median	9
93.54	Mean	9.7

Number up to accuracy and time standards - 30 or 18.29%
Number not up to above standards - 134 or 81.71%

Score standard - 100
Time standard - 9 minutes

TABLE LXXVI. DISTRIBUTION ACCORDING TO TIME AND SCORE OF THE EIGHTH GRADE CONTROL GROUP ON THE FINAL M. P. TEST

Score	Time in minutes											f	Percentages
	4	5	6	7	8	9	10	11	12	13	14		
100	3		1	1	1							6	3.85
96	2	2	2	4	2	1	1		1			15	9.62
92	3	4	3	3	1	1		1				16	10.26
88	1	1	5	9	4	4	3	1	2	1		31	19.87
84	5	3	1	4	3	4	1	2				32	20.51
80	3	2	6	3	1	2	3					20	12.82
76	2	2	5	3		2	1	1				16	10.27
72	1	3	2	1	2		1	2				12	7.69
68													
64			1				1	1				3	1.92
60	1			1								2	1.28
56				2								2	1.28
52					1							1	.64
f	1		21		25		10		7		1		
		21		43		16		9		2		156	100.01
			127				29						
			83.21%				16.79%						

Score		Time
52 - 100	Range	4 - 14
84	Median	7
83.87	Mean	7.7

Number up to accuracy and time standards - 6 or 3.85%
Number not up to above standards - 150 or 96.15%

Score standard - 100
Time standard - 9 minutes

was 81.71%. Scores ranged from 56 to 100, the median being 96 and the mean 93.54. The time ranged from 3 to 18 minutes, the median being 9 and the mean 9.7 minutes. The results for the control group are shown in Table LXXVI. Of the 156 pupils 6 or 3.85% achieved perfect scores, all 6 of them accomplishing it within the time standard. The corrective load was 96.15%. Scores ranged from 52 to 100, the median falling at 84 and the mean at 83.87. The time ranged from 4 to 14 minutes, the median being 7 and the mean 7.7 minutes.

Table LXXVII[1] is a summary Table showing the distribution of scores on a percentage basis for all grades and all processes for both the initial and final testings. It is read as follows: A score of 100 was achieved in October by 2.47%, and in March by 18.78%, of Grade IV on the A. P. Test; and on the S. P. Test by 2.44% in October and by 29.05% in March; by 13.77% of Grade VI on the A. P. Test in October, and by 46.66% in March; by 0.58% on the M. P. Test in October, and by 12.46% in March; by 14.21% of Grade VIII on the A. P. Test in October and by 29.05% in March; by 25.93% of Grade VIII on the S. P. Test in October, and by 52.53% in March; by 2.12% on the M. P. Test in October, and by 16.57% in March. Percentages for the other scores are read in a similar manner.

Tables LXXVIII - LXXXV show the distribution of scores on a percentage basis for all grades by buildings and rooms, and for

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1 In this Table and in all the following Tables of this chapter the grades are considered as wholes, no reference being intended for experimental and control groups as such.

TABLE LXXVII. DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL GRADES AND PROCESSES ON THE INITIAL AND FINAL TESTINGS

Score	Grade IV A.P. Test Oct.	Grade IV A.P. Test Mar.	Grade IV S.P. Test Oct.	Grade IV S.P. Test Mar.	Grade VI A.P. Test Oct.	Grade VI A.P. Test Mar.	Grade VI S.P. Test Oct.	Grade VI S.P. Test Mar.
100	2.47	18.78	2.44	33.53	13.77	21.42	24.70	46.66
96	6.79	16.28	6.73	17.24	23.44	18.97	22.34	24.85
92	10.21	20.03	7.34	12.85	19.82	15.61	18.82	14.54
88	13.64	12.83	5.81	8.15	15.52	18.77	8.82	6.06
84	11.45	10.96	4.89	3.45	10.25	11.32	4.99	1.82
80	8.35	5.32	4.59	2.19	8.49	4.90	5.29	1.82
76	11.14	6.26	3.97	3.76	2.93	4.59	3.53	2.12
72	8.97	3.44	3.06	4.07	2.05	2.75	4.99	.91
68	7.42	1.88	3.06	2.51	1.17	.61	1.76	.91
64	4.95	1.25	4.59	1.25	.58	.61	1.47	
60	4.64	1.25	4.28	2.19	.29	.31	1.18	.30
56	3.71	.94	3.67	.63	.58		.59	
52	1.54	.31	3.67	.31	.29		.29	
48	1.54		3.67	.31				
44	.92	.31	2.75	.94	.29		.59	
40	1.54		5.20	.94	.29			
36			3.06	2.19				
32	.30		.91	.31				
28	.30		3.67					
24	.30		4.28	.94				
20			2.75	.31				
16			3.67	.31			.29	
12			4.89	.31				
8			2.75	1.25				
4			1.83					
0			1.53				.29	
Range	24-100	44-100	0-100	8-100	40-100	60-100	0-100	60-100
Median	80	92	60	96	92	92	92	96
Mean	77.52	88.61	56.01	86.18	89.83	90.83	89.31	92.04

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TABLE LXXVII. (Continued) DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL GRADES AND PROCESSES ON THE INITIAL AND FINAL TESTINGS

Score	Grade VI M.P. Test Oct.	Grade VI M.P. Test Mar.	Grade VIII A.P. Test Oct.	Grade VIII A.P. Test Mar.	Grade VIII S.P. Test Oct.	Grade VIII S.P. Test Mar.	Grade VIII M.P. Test Oct.	Grade VIII M.P. Test Mar.
100	.58	12.46	14.21	29.05	25.93	52.53	2.12	16.67
96	3.21	19.75	17.30	20.09	21.45	21.32	6.36	19.69
92	3.79	17.02	19.15	20.09	20.56	11.43	15.15	15.31
88	9.61	15.80	16.68	12.67	14.40	7.42	11.21	13.75
84	13.98	9.42	10.41	8.03	4.17	3.09	19.08	14.38
80	14.86	8.21	10.41	4.33	7.45	1.55	11.21	7.81
76	13.39	6.69	3.39	.93	2.68	.93	10.30	5.63
72	12.82	5.47	2.47	1.24	1.79	.93	9.70	3.75
68	5.54	2.13	3.09	.62	.89	.31	5.75	.31
64	7.87	2.13	1.23	1.24			3.03	.94
60	4.08	.30	.31	.31			1.52	.63
56	3.79	.30	.62	.62	.30		.30	.94
52	2.04			.62	.30		.30	.31
48	2.62						.30	
44	.29		.31				.60	
40	.58					.31		
36								
32								
28								
24	.29							
20	.29	.30						
16								
12								
8								
4	.29							
0								
Range	4-100	20-100	44-100	52-100	52-100	40-100	40-100	52-100
Median	76	92	92	92	92	100	84	92
Mean	75.15	88.24	88.42	92.00	91.87	92.98	81.05	88.83

TABLE LXXVIII. DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL FOURTH GRADES ON THE INITIAL AND FINAL A. P. TESTS

Score	Building A Room 1 Oct.	Building A Room 1 Mar.	Building A Room 2 Oct.	Building A Room 2 Mar.	Building B Room 1 Oct.	Building B Room 1 Mar.	Building C Room 1 Oct.	Building C Room 1 Mar.
100		13.85		13.85		29.40	3.33	7.69
96	5.55	22.16	8.57	16.62		17.64		7.69
92	19.43	30.47	8.57	13.85	11.11	29.40	19.98	3.85
88	13.88	16.62	11.42	13.85	16.67	11.76	19.98	19.23
84	11 10	2.77	17.14	22.16			13.32	19.23
80	13.88	2.77	8.57	8.31		5.88	6.66	7.69
76	13.88	2.77	8.57	2.77	11.11		6.66	19.23
72	2.77	5.54		8.31	16.67	5.88	6.66	3.85
68	8.33		8.57		11.11		16.67	
64	5.55		7.42		16.67		3.33	3.85
60		2.77	2.85		11.11		3.33	
56	2.77		5.71					7.69
52					5.55			
48			5.71					
44	2.77							
40			2.85					
36								

Score	Building C Room 2 Oct.	Building C Room 2 Mar.	Building D Room 1 Oct.	Building D Room 1 Mar.	Building D Room 2 Oct.	Building D Room 2 Mar.	Building D Room 3 Oct.	Building D Room 3 Mar.
100		13.32	8.69	22.70		24.96		20.80
96		9.99	4.34	9.08	12.51	29.12	13.63	24.96
92		16.65	4.34	18.16	8.33	8.32	4.54	8.32
88	6.90	9.99	4.34	18.16	24.99	8.32	9.09	20.80
84	13.80	16.65	4.34	9.08	8.33	8.32	4.54	4.16
80	13.80		4.34	4.54	4.17	8.32	22.72	8.32
76	6.90	6.66	21.73	9.08	8.33	4.16	13.63	4.16
72	6.90	6.66	13.04	4.54	4.17	4.16	13.63	
68	6.90	6.66	8.69		8.33		4.54	
64	6.90	3.33	4.34		4.17	4.16		8.32
60	10.34	3.33	4.34	4.54	8.33		4.54	
56	10.34	3.33	4.34					
52	6.90	3.33	4.34		4.17			
43	3.44		4.34					
44	3.44						4.54	
40	3.44		4.34					
36								
32								
28					4.17		4.54	

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TABLE LXXVIII. (Continued) DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL FOURTH GRADES ON THE INITIAL AND FINAL A. P. TESTS

Score	Building E Room 1		Building F Room 1		Building G Room 1		Building G Room 2	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
100		35.53	13.32	16.65	5.00	54.48		4.76
96	11.76	25.00	6.66	3.33	10.00	9.08	4.54	23.80
92	17.64	9.68	6.66	33.30	5.00	27.24	9.09	23.80
88	14.70	9.68	13.32	6.66	15.00	4.54	13.63	14.28
84	5.88	6.45	23.31	19.98	15.00		13.63	14.28
80	8.82	6.45	3.33	6.66	5.00		4.54	4.76
76	2.94		13.32	9.99	15.00	4.54	18.16	9.52
72	14.70		13.32		5.00		18.16	
68	2.94	3.23	3.33	3.33	5.00		4.54	4.76
64	5.88							
60	8.82						4.54	
56	2.94				20.00		4.54	
52								
48							4.54	
44		3.23						
40			3.33					
36								
32								
28								
24	2.94							

	October	March
Range	24 - 100	44 - 100
Median	80	92
Mean	77.52	88.61

TABLE LXXIX. DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL FOURTH GRADES ON THE INITIAL AND FINAL S. P. TESTS

Score	Building A Room 1		Building A Room 2		Building B Room 1		Building C Room 1	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
100		28.60	2.77	28.56		38.89	3.33	40.73
96	8.10	31.46		8.57	11.11	5.56	6.66	11.10
92	2.70	11.44		17.14	11.11	11.11	16.67	14.81
88	5.40	8.58	2.77	11.42		22.22	3.33	11.10
84	5.40		2.77	5.72	11.11		3.33	7.41
80		2.86		5.72			9.99	
76	5.40		5.55	5.72		11.11	9.99	
72		8.58		2.86	5.55		9.99	3.70
68		5.71		8.57		5.56	9.99	
64	5.40		2.77		5.55	5.56	3.33	7.41
60	8.10		5.55	2.86				3.70
56	2.70						3.33	
52	5.40		2.77		5.55		3.33	
48			2.77				6.66	
44	5.40				11.11			
40	13.51		5.55		16.67		6.66	
36	5.40		2.77	2.86	5.55			
32	2.70							
28			5.55		5.55			
24	5.40		5.55					
20	10.80		2.77					
16			5.55				3.33	
12	5.40		16.66		5.55			
8		2.86	8.33		5.55			
4	2.70		11.10					
0			8.33					

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TABLE LXXIX. (Continued) DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL FOURTH GRADES ON THE INITIAL AND FINAL S. P. TESTS

Score	Building C Room 2		Room 1		Building D Room 2		Room 3	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
100	6.66	30.00		36.36		20.83		25.00
96	9.99	16.67	13.04	13.64		20.83	8.33	12.50
92	3.33	16.67	8.69	18.18	12.51	8.33	4.17	20.83
88	3.33		13.04	13.64	8.33	4.17		12.50
84	3.33			4.55	8.33	12.50	8.33	4.17
80	3.33		4.34	4.55		8.33		
76	9.99					4.17		
72		3.33	4.34	4.55	8.33	8.33	4.17	
68		3.33			8.33		8.33	
64			4.34		8.33		12.51	
60		3.33			8.33	4.17		4.17
56	13.32		8.69		8.33		4.17	4.17
52	3.33		4.34					
48	3.33		4.34		4.17			4.17
44	6.66	3.33	8.69		4.17	4.17		
40		3.33	4.34	4.55			4.17	
36	3.33	3.33	4.34		4.17			4.17
32	3.33	3.33						
28	9.99						16.67	
24	3.33	6.67	8.69		4.17			
20	3.33	3.33	4.34				4.17	
16							8.33	
12	3.33		4.34				8.33	4.17
8	3.33	3.33			4.17	4.17	8.33	4.17
4	3.33							
0					8.35			

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TABLE LXXIX. (Continued) DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL FOURTH GRADES ON THE INITIAL AND FINAL S. P. TESTS

Score	Building E Room 1		Building F Room 1		Building G Room 1		Building G Room 2	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
100		41.93		3.33		63.63	18.16	61.89
96		19.35		10.00	10.00	31.82	22.72	23.81
92	3.12		6.66	20.00	5.00	4.55	22.72	9.52
88	6.25		16.66	16.67	5.00		4.54	
84	3.12	3.23	3.33	3.33			13.63	
80	6.25	3.23	9.99		15.00		9.09	
76	6.25	9.68	3.33	10.00				4.76
72	3.12	3.23	3.33	10.00				
68	6.25	3.23	3.33		5.00			
64	3.12		3.33	3.33			4.54	
60	6.25		3.33	6.67	20.00			
56				3.33	5.00			
52	9.38	3.23	3.33		5.00			
48	3.12		13.32		5.00			
44		3.23						
40	3.12	3.23			10.00			
36	9.38	6.45		6.67				
32							4.54	
28	3.12		3.33					
24			16.66	3.33	5.00			
20			3.33					
16	18.75			3.33	5.00			
12	3.12		3.33		5.00			
8	3.12		3.33					
4								
0	3.12							

	October	March
Range	0 - 100	8 - 100
Median	60	96
Mean	56.01	86.18

TABLE LXXX. DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL SIXTH GRADES ON THE INITIAL AND FINAL A. P. TESTS

Score	Building A				Building C			
	Room 3		Room 4		Room 3		Room 4	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
100	12.89	29.03	6.66	25.00	8.34	11.43	18.75	25.90
96	22.56	19.35	19.98	17.86	38.89	17.14	31.25	14.80
92	29.00	9.68	19.98	17.86	15.90	17.14	18.75	22.20
88	16.11	19.35	13.32	10.81	5.55	25.71	15.62	29.60
84	9.67	12.90	13.32	14.28	13.90	11.43	6.25	3.70
80	3.23		9.99	7.14	5.55	2.86	9.38	
76	3.23	6.45		3.57	2.78	5.71		
72	3.23	3.23	9.99	3.57	5.55	5.71		3.70
68			3.33			2.86		
64			3.33					
60					2.78			
56					2.78			
52								
48								
44								
40								

Score	Building D							
	Room 4		Room 5		Room 6		Room 7	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
100	16.67	12.50	14.28	13.05	16.00		20.00	25.00
96	24.99	20.83	33.32	17.40	20.00	12.50	36.00	20.83
92	8.33	8.33	14.28	13.05	24.00	16.66	20.00	20.83
88	16.67	25.00	4.76	13.05	16.00	16.66	12.00	20.83
84	20.83	20.83	14.28	8.70	12.00	20.83	4.00	8.34
80	8.33	8.33	14.28	13.05	8.00	20.83	4.00	
76	4.17		4.76	17.40				
72		4.17				4.17		4.17
68						4.17		
64				4.35		4.17		
60								
56								
52								
48								
44							4.00	
40					4.00			

continued on next page

TABLE LXXX. (Continued) DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL SIXTH GRADES ON THE INITIAL AND FINAL A. P. TESTS

Score	Building E Room 2 Oct.	Building E Room 2 Mar.	Building E Room 3 Oct.	Building E Room 3 Mar.	Building F Room 2 Oct.	Building F Room 2 Mar.	Building G Room 3 Oct.	Building G Room 3 Mar.
100	11.11	23.08	10.34	25.90	26.47	39.96	3.70	22.20
96	22.22	15.37	13.80	33.30	11.76	16.65	7.40	22.20
92	25.93	23.08	20.70	14.80	20.58	16.65	22.21	7.40
88	18.51	19.23	24.13	11.10	11.76	13.32	33.32	18.50
84	7.37	11.54	10.34	3.70	5.88	3.33	7.40	18.50
80	3.70	7.69	20.70	3.70	8.82		7.40	
76	7.37			7.40	2.94	3.33	7.40	11.10
72					2.94	3.33		
68							7.40	
64							3.70	
60					2.94	3.33		
56	3.70							
52								
48								
44								
40					2.94			

	October	March
Range	40 - 100	60 - 100
Median	88	92
Mean	89.83	90.83

TABLE LXXXI. DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL SIXTH GRADES ON THE INITIAL AND FINAL S. P. TESTS

Score	Building A				Building C			
	Room 3		Room 4		Room 3		Room 4	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
100	16.15	48.38	16.66	32.14	11.10	37.14	41.92	65.55
96		19.35	19.98	42.85	24.99	31.43	35.47	13.79
92	22.71	9.68	23.31	17.86	27.77	20.00	9.68	20.70
88	6.46	9.68	9.99	3.57	16.66	5.71	6.45	
84	12.92	6.45	3.33		5.55	5.71	3.22	
80	9.68	3.23	9.99	3.57	5.55			
76		3.23	6.66		2.77			
72	9.68				2.77		3.22	
68	3.23		3.33					
64	6.46							
60	6.46				2.77			
56								
52	3.23							
48								
44	3.23							
40								
36								
32								
28								
24								
20								
16			3.33					
8								
4								
0			3.33					

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TABLE LXXXI.(Continued) DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL SIXTH GRADES ON THE INITIAL AND FINAL S. P. TESTS

Score	Building D Room 4 Oct.	Room 4 Mar.	Room 5 Oct.	Room 5 Mar.	Room 6 Oct.	Room 6 Mar.	Room 7 Oct.	Room 7 Mar.
100	12.51	29.16	17.38	47.82	4.00	29.16	24.99	54.21
96	20.85	33.33	13.04	30.43	28.00	20.83	20.85	12.50
92	12.51	16.66	39.12		28.00	33.33	24.99	16.66
88	16.68	4.17	13.04	8.69	8.00	12.50	8.33	8.33
84	12.51		8.69					
80	8.33	8.33			12.00		4.17	
76	8.33	4.17		4.35	4.00		8.33	4.17
72		4.17	8.69		4.00		4.17	4.17
68	4.17			4.35	8.00	4.17		
64	4.17						4.17	
60				4.35				
56								
52								
48								
44					4.00			

Score	Building E Room 2 Oct.	Room 2 Mar.	Room 3 Oct.	Room 3 Mar.	Building F Room 2 Oct.	Room 2 Mar.	Building G Room 3 Oct.	Room 3 Mar.
100	28.56	56.66	14.28	53.84	57.57	62.06	44.43	40.73
96	17.85	20.00	24.99	19.23	33.33	20.69	25.92	33.33
92	10.71	16.67	14.28	7.69	3.03	10.34	14.81	3.70
88	7.14	3.33	7.14	3.85		3.45	7.37	11.11
84	7.14	3.33	3.58	3.85			3.70	
80	7.14		7.14					3.70
76			14.28	7.69				7.41
72	10.71		7.14		6.06	3.45	3.70	
68	3.58							
64	3.58			3.85				
60			3.58					
56	3.58		3.58					
52								
48								
44								

	October	March
Range	0 - 100	60 - 100
Median	92	96
Mean	89.31	92.04

TABLE LXXXII. DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL SIXTH GRADES ON THE INITIAL AND FINAL M. P. TESTS

Score	Building A				Building C			
	Room 3		Room 4		Room 3		Room 4	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
100		23.33	3.45	14.28		11.43	3.12	16.67
96		16.67	3.45	35.71	5.55	17.14	3.12	16.67
92	6.44	10.00		14.28	2.78	14.29	6.25	23.33
88	3.23	13.33	10.34	3.57	5.55	20.00	9.38	16.67
84	3.23	16.67	13.79	7.14	16.68	11.43	12.50	10.00
80	12.89		6.89	3.57	16.68	8.57	21.85	6.67
76	22.56	16.67	13.79	7.14	8.34		6.25	3.33
72	19.33		6.89	10.71	13.90	11.43	12.50	6.67
68	6.44		3.45		2.78	2.86	9.38	
64	6.44	3.33	13.79	3.57	8.34		3.12	
60					13.90	2.86	6.25	
56	6.44		6.89				3.12	
52	3.23		3.45		2.78		3.12	
48	3.23		6.89		2.78			
44	3.23							
40	3.23							
36								
32								
28								
24			3.45					
20			3.45					
16								
8								
4								

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TABLE LXXXII. (Continued) DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL SIXTH GRADES ON THE INITIAL AND FINAL M. P. TESTS

Score	Building D							
	Room 4		Room 5		Room 6		Room 7	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
100		4.17		17.39		8.33		4.17
96	4.17	12.50	4.00	13.04		16.66		20.83
92		12.50	4.00	17.39	8.00	25.00	8.00	16.66
88		4.17	20.00	26.08	4.00	4.17	12.00	25.00
84	25.02	12.50	12.00		20.00	4.17	12.00	16.66
80	12.51	12.50	12.00	17.39	16.00	12.50	28.00	4.17
76	8.83	16.66	20.00	8.69	16.00	8.33	16.00	8.33
72	16.68	12.50	12.00		8.00	8.33	4.00	4.17
68	4.17	8.33	12.00		4.00		4.00	
64	4.17	4.17			12.00	12.50	4.00	
60	12.51				4.00		4.00	
56	12.51						8.00	
52			4.00		4.00			
48								
44								
40								
36								
32								
28								
24								
20								
16								
12								
8								
4					4.00			

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TABLE LXXXII. (Continued) DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL SIXTH GRADES ON THE INITIAL AND FINAL M. P. TESTS

Score	Building E Room 2 Oct.	Building E Room 2 Mar.	Building E Room 3 Oct.	Building E Room 3 Mar.	Building F Room 2 Oct.	Building F Room 2 Mar.	Building G Room 3 Oct.	Building G Room 3 Mar.
100		3.57		15.38		20.00		7.41
96		25.00		15.38	11.76	23.33	3.70	22.22
92		10.71		34.61	8.82	16.67		11.11
88	11.10	21.43	7.14	3.85	20.58	16.67	11.10	33.33
84	22.21	7.14	3.58	7.69	20.58	3.33	7.40	14.81
80	11.10	10.71	14.28	7.69	8.82	10.00	18.50	7.41
76	14.80	3.57	17.85	3.85	5.88	3.33	14.80	3.70
72	22.21	10.71	7.14		11.76		18.50	
68		3.57	21.42	11.54	5.88		3.70	
64	3.70	3.57	14.28				14.80	
60	3.70						3.70	
56	7.40					3.33	3.70	
52			3.58					
48	3.70		7.14		5.88			
44								
40			3.58					
36								
32								
28								
24								
20						3.33		

	October	March
Range	4 - 100	20 - 100
Median	76	92
Mean	75.15	88.24

TABLE LXXXIII. DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL EIGHTH GRADES ON THE INITIAL AND FINAL A. P. TESTS

Score	Building H							
	Room 1		Room 2		Room 3		Room 4	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
100	10.71	28.56	6.66	48.30	6.90	52.00	4.17	29.60
96	14.28	35.70	6.66	20.70	13.80	16.00	16.67	14.80
92	24.99	10.71	26.64	17.25	10.34	28.00	24.99	33.30
88	21.42	14.28	33.30	13.80	13.80	4.00	16.67	7.40
84	14.28	7.14	9.99		20.70		8.33	14.80
80	10.71	3.57	13.32		13.80		20.83	
76	3.58				3.44		4.17	
72			3.33				4.17	
68					10.34			
64								
60					3.44			
56					3.44			
52								

Score	Building H				Building I			
	Room 5		Room 6		Room 1		Room 2	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
100	19.98	51.68	14.81	44.40	36.63	16.65	13.80	15.15
96	23.31	22.61	11.11	11.10	23.33	29.97	10.34	12.12
92	23.31	12.92	33.30	22.20	13.32	13.32	17.20	24.24
88	13.32	3.23	11.11	14.80	3.33	16.65	20.70	12.12
84	9.99	6.46		7.40	6.66	6.66	6.88	9.09
80	6.66	3.23	18.51		3.33	6.66	10.34	12.12
76					6.66	3.33	3.44	3.03
72	3.33				3.33	3.33	3.44	
68			3.70		3.33		10.34	3.03
64			3.70				3.44	3.03
60								3.03
56								3.03
52						3.33		
48								
44			3.70					

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TABLE LXXXIII. (Continued) DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL EIGHTH GRADES ON THE INITIAL AND FINAL A. P. TESTS

Score	Building I					
	Room 3		Room 4		Room 5	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
100	19.98	10.35	8.82	15.65	12.50	15.65
96	9.99	13.80	38.22	28.17	18.75	15.65
92	23.31	13.80	8.82	21.91	9.38	25.04
88	13.32	13.80	20.58	18.78	15.62	18.78
84	9.99	13.80	8.82	9.39	18.75	12.52
80	6.66	17.25	5.88		9.38	3.13
76	9.99	3.45			6.25	
72		3.45	5.38	6.26	3.12	
68	3.33				3.12	3.13
64	3.33	6.90	2.94			3.13
60						
56					3.12	3.13
52		3.45				

	October	March
Range	44 - 100	52 - 100
Median	92	92
Mean	88.42	92.00

TABLE LXXXIV. DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL EIGHTH GRADES ON THE INITIAL AND FINAL S. P. TESTS

Score	Building H Room 1 Oct.	Room 1 Mar.	Room 2 Oct.	Room 2 Mar.	Room 3 Oct.	Room 3 Mar.	Room 4 Oct.	Room 4 Mar.
100	28.64	78.56	22.71	75.86	29.99	84.00	7.69	70.36
96	14.28	7.14	16.15	17.24	13.32	16.00	34.03	22.22
92	21.42	7.14	22.71	6.90	23.31		26.92	3.70
88	21.42	7.14	12.92		19.98		19.23	3.70
84	10.71		3.23		3.33		3.84	
80	3.58		3.23		9.99		7.69	
76			6.46					
72			9.68					
68			3.23					
64								
56								
52								

Score	Building H Room 5 Oct.	Room 5 Mar.	Room 6 Oct.	Room 6 Mar.	Building I Room 1 Oct.	Room 1 Mar.	Room 2 Oct.	Room 2 Mar.
100	27.58	90.30	29.62	66.65	37.50	43.33	15.62	12.12
96	31.03	9.70	22.21	25.92	34.37	26.66	21.87	37.39
92	20.68		14.81	7.41	9.37	16.67	25.00	9.09
88	6.90		7.40		12.50	10.00	18.75	18.18
84	3.44		3.70			3.33		6.06
80	10.34		14.81		6.25		12.50	9.09
76			3.70				3.12	6.06
72							3.12	
68								
64								
60								
56								
52			3.70					

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TABLE LXXXIV. (Continued) DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL EIGHTH GRADES ON THE INITIAL AND FINAL S. P. TESTS

Score	Building I					
	Room 3		Room 4		Room 5	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
100	29.06	27.58	34.28	28.13	20.60	18.75
96	16.14	27.58	19.99	25.00	14.70	15.63
92	19.37	6.90	25.71	34.38	20.60	28.13
88	16.14	10.34	5.71	3.13	14.70	21.38
84	3.22	17.24	5.71	3.13	8.82	6.26
80	6.44	3.45		3.13	8.82	
76	6.44	3.45	5.71		2.94	
72			2.85	3.13	2.94	6.26
68	3.22	3.45			2.94	
64						
60						
56					2.94	
52						
48						
44						
40						3.13

	October	March
Range	52 - 100	40 - 100
Median	92	100
Mean	91.87	92.98

TABLE LXXXV. DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL EIGHTH GRADES ON THE INITIAL AND FINAL M. P. TESTS

Score	Building H Room 1		Room 2		Room 3		Room 4	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
100	7.14	40.73		28.57		12.00	4.00	34.61
96	10.71	29.62	6.90	32.14		24.00	12.00	30.77
92	7.14	14.81	10.34	25.00	17.85	44.00	12.00	19.23
88	10.71	7.41	10.34	7.14	10.71	12.00	20.00	3.85
84	17.85		24.10	3.57	21.42	4.00	20.00	7.69
80	3.58	3.70	13.78		7.14	4.00	8.00	3.85
76	21.48		13.78	3.57	14.28		8.00	
72	10.71		6.90		7.14		12.00	
68		3.70	3.44		10.71			
64			3.44		7.14		4.00	
60	10.71		3.44					
56					3.58			
52			3.44					
48								
44								
40								

Score	Building H Room 5		Room 6		Building I Room 1		Room 2	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
100	3.45	35.48		18.52	6.44	6.67		3.03
96	6.89	25.80	10.71	33.33	16.11	16.67	3.03	3.03
92	3.45	12.90	10.71	7.41	22.56	3.33	15.15	15.15
88	17.24	6.45	7.14	11.11	9.67	16.67	3.03	12.12
84	17.24	12.90	21.42	22.22	12.89	26.66	18.18	21.21
80	10.34	3.23	3.58	3.70	16.11	10.00	18.18	18.18
76	10.34	3.23	21.42			13.33	9.09	6.06
72	17.24		3.58		6.44	3.33	9.09	12.12
68	3.45		10.71		3.23		9.09	
64	3.45		3.58			3.33	3.03	
60	3.45				3.23		9.09	3.03
56	3.45			3.70	3.23			3.03
52			3.58					3.03
48			3.58					
44							3.03	
40								

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TABLE LXXXV.(Continued) DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR ALL EIGHTH GRADES ON THE INITIAL AND FINAL M. P. TESTS

Score	Building I Room 3 Oct.	Room 3 Mar.	Room 4 Oct.	Room 4 Mar.	Room 5 Oct.	Room 5 Mar.
100	3.23					9.38
96	3.23	10.34		15.63	2.94	3.13
92	9.67	3.45	26.46	12.50	26.46	15.63
88	3.23	17.24	20.58	28.13	11.76	25.00
84	22.56	13.79	26.46	25.00	8.82	15.63
80	16.11	17.24	11.76	6.25	11.76	12.50
76	6.44	20.69	2.94	6.25	8.82	6.25
72	12.89	3.45	8.82	6.25	11.76	12.50
68	12.89				8.82	
64	6.44	6.90			2.94	
60		3.45	2.94			
56		3.45			2.94	
52						
48						
44						
40	3.23				2.94	

	October	March
Range	40 - 100	52- 100
Median	84	92
Mean	81.05	88.83

all processes for both the October and March tests. Table LXXVIII is read as follows: On the A. P. Test in Grade IV in Building A, Room 1 in October there were no perfect scores, in March 13.85% of the class achieved perfect scores; in October 5.55% of the class, and in March 22.16%, achieved a score of 96; in October 19.43%, and in March 30.47%, achieved a score of 92; in October 13.88%, and in March 16.62%, achieved a score of 88; and so on. The remainder of the Table is read in a similar manner, as are the following Tables.

Table LXXXVI shows the median and mean scores for all grades and processes for both the October and March testings. It is read as follows: In Grade IV on the A. P. Test the median score in October was 80, in March 92; the mean score in October was 77.52, in March 88.61. On the S. P. Test the median score in October was 60, in March 96; the mean score in October was 56.01, in March 86.18. The median and mean scores for Grade VI and Grade VIII are read similarly.

Table LXXXVII shows the number and percentage of perfect scores for all grades and processes for both the October and March testings. It is read as follows: In Grade IV on the A.P. Test in October 8 pupils or 2.47% achieved perfect scores; in March 60 pupils or 18.78% achieved perfect scores. In Grade IV on the S. P. Test in October 8 or 2.44%, and in March, 107 or 33.53%, achieved perfect scores. The perfect scores in Grade VI on the A. P. Test in October were 47 or 13.77% of the group, and in March were 94 or 29.05%; on the S. P. Test in October 84 or 24.70%, in March 154 or 46.66%; and on the M. P. Test in October

TABLE LXXXVI. SCORE MEDIANS AND MEANS FOR ALL GRADES AND ALL PROCESSES ON THE INITIAL AND FINAL TESTINGS

Grade	A. P. Test Median Oct.	A. P. Test Median Mar.	A. P. Test Mean Oct.	A. P. Test Mean Mar.	S. P. Test Median Oct.	S. P. Test Median Mar.	S. P. Test Mean Oct.	S. P. Test Mean Mar.
IV	80	92	77.52	88.61	60	96	56.01	86.18
VI	92	92	89.83	90.83	92	96	89.31	92.04
VIII	92	92	88.42	92.00	92	100	91.87	92.98

Grade	M. P. Test Median Oct.	M. P. Test Median Mar.	M. P. Test Mean Oct.	M. P. Test Mean Mar.
VI	76	92	75.15	88.24
VIII	84	92	81.05	88.83

TABLE LXXXVII. NUMBER AND PERCENTAGE OF PERFECT SCORES FOR ALL GRADES AND ALL PROCESSES ON THE INITIAL AND FINAL TESTS

Grade	A. P. Test Number Oct.	A. P. Test Number Mar.	A. P. Test Percentage Oct.	A. P. Test Percentage Mar.	S. P. Test Number Oct.	S. P. Test Number Mar.	S. P. Test Percentage Oct.	S. P. Test Percentage Mar.
IV	8	60	2.47	18.78	8	107	2.44	33.53
VI	47	70	13.77	21.42	84	154	24.70	46.66
VIII	46	94	14.21	29.05	87	170	25.93	52.53

Grade	M. P. Test Number Oct.	M. P. Test Number Mar.	M. P. Test Percentage Oct.	M. P. Test Percentage Mar.
VI	2	70	0.58	21.42
VIII	7	94	2.12	29.05

2 or 0.58%, in March 41 or 12.46%. The number and percentages for Grade VIII are read similarly. In this Table the time factor is not considered.

TABLE LXXXVIII. CORRECTIVE LOAD FOR ALL GRADES AND ALL PROCESSES AT THE TIME OF THE INITIAL AND FINAL TESTS

Grade	A. P. Test Number		A. P. Test Percentage		S. P. Test Number		S. P. Test Percentage	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
IV	321	296	99.40	92.80	321	244	98.47	76.49
VI	316	280	92.68	85.92	287	214	84.42	64.85
VIII	297	249	91.94	77.06	174	200	81.77	61.80

Grade	M. P. Test Number		M. P. Test Percentage	
	Oct.	Mar.	Oct.	Mar.
VI	341	305	99.42	93.01
VIII	325	284	98.48	88.75

Table LXXXVIII shows the corrective load for all grades and processes both at the time of the October testing and at the time of the March testing. It is read as follows: The corrective load in Grade IV in addition in October was 321 or 99.40%, in March it was 296 or 92.80%; in subtraction in October it was 321 or 98.47% and in March, 244 or 76.49%. In Grade VI the corrective load in addition in October was 216 or 92.68%, in March, 280 or 85.92%; in subtraction in October it was 287 or 84.42% and in March, 214 or 64.85%; in multiplication in October it was 341 or 99.42%, in March, 305 or 93.01%. The corrective load for the eighth grade is read similarly.

In October there were just three pupils, eighth grade pupils, who achieved perfect scores in all three tests. In March there

TABLE LXXXIX. THE MEDIAN SCORES AND TIMES OF THE FINAL TESTING FOR THE EARLIER STUDIES AND FOR THE PRESENT STUDY

Grade	Test	Hanley 1938		Yar-brough 1938		Hough-ton 1939		Ridlon 1939		Ringer 1940		Present Study 1940	
		Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.
IV	A.P.	80	16									92	15
	S.P.	84	15									96	12
VI	A.P.	92	12	96	8	96	7	92	9			92	9
	S.P.	96	9	96	7	100	7	96	6			96	7
	M.P.	84	15	92	11	100	12	84	10			92	12
VIII	A.P.					100	6			100	9	92	7
	S.P.					100	5			100	7	100	5
	M.P.					100	8			100	10	92	8

TABLE XC. THE MEAN SCORES AND TIMES OF THE FINAL TESTING FOR THE EARLIER STUDIES AND FOR THE PRESENT STUDY

Grade	Test	Hanley 1938		Yar-brough 1938		Hough-ton 1939		Ridlon 1939		Ringer 1940		Present Study 1940	
		Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.	Sc.	T.
IV	A.P.	80	18									89	16
	S.P.	74	20									86	13
VI	A.P.	90	13	96	9	95	7	91	10			91	10
	S.P.	91	10	96	7	99	7	93	7			92	8
	M.P.	80	17	92	12	96	12	83	11			88	13
VIII	A.P.					99	6			99	9	92	7
	S.P.					99	4			99	7	93	5
	M.P.					99	9			96	10	89	9

were 28 eighth grade pupils and 8 sixth grade pupils, a total of 36, who achieved perfect scores in all three tests. Also, in Grade IV there were 29 children who achieved perfect scores in both the tests they were given.

In addition to reproducing Table V which showed the median scores and times of the final testing for the earlier studies, Table LXXXIX shows the median scores and times of the final testing for the present study. Table XC shows the mean scores and times for the same studies, including the present one. From this comparison it will be seen that the gains in mean scores in the present study compare favorably with those of the Hanley, Yarbrough, and Ridlon studies. They are not as great as those of the Houghton and Ringer studies. However, in the opinion of the writer this would be accounted for by the vast difference in the number of children involved, and thus, necessarily, in the amount of direct control possible in the corrective measures.

In arriving at a judgment in regard to the statistical significance of the gains in the present study the writer followed the procedures outlined by Holzinger.[1] The Holzinger formula for probable error of difference between two means is:

$$P.E._{M_1 - M_2} = \sqrt{(P.E._{M_1})^2 + (P.E._{M_2})^2}$$

$P.E._{M_1}$ is the probable error of the mean for the initial testing. $P.E._{M_2}$ is the probable error of the mean for the final (test-

1 Karl. J. Holzinger, Statistical Methods for Students in Education, p. 235.

ing.[1] The probable error of the mean was found by the formula:

$$P.E._M = \frac{.6745 \times S.D.}{\sqrt{N}}$$

S.D. means the standard deviation of the distribution of scores. N means the number of cases.

The formula used for computing the standard deviation was:[2]

$$S.D. = \sqrt{\frac{\Sigma fd^2}{N} - \left(\frac{\Sigma fd}{N}\right)^2} \times \text{step interval}$$

For example, in the case of the initial A. P. Test for the fourth grade, the total number of cases was 323. From the distribution table the sum of the frequencies times the deviation from the mean (Σfd) was found to be 108. The sum of the squared deviations (Σfd) was found to be 4198. The computation was as follows:

$$S.D. = \sqrt{\frac{\Sigma fd^2}{N} - \left(\frac{\Sigma fd}{N}\right)^2} \times \text{step interval}$$

$$= \sqrt{\frac{4198}{323} - \frac{108}{323}} \times 4$$

$$= \sqrt{13 - .112} \times 4$$

$$= \sqrt{12.888} \times 4$$

$$= 3.59 \times 4 = 14.36$$

Therefore, the S.D. for the initial testing is 14.36.

The probable error of the mean for the initial testing was computed in this manner:

$$P.E._M = \frac{.6745 \times S.D.}{\sqrt{N}}$$

$$= \frac{.6745 \times 14.36}{\sqrt{323}}$$

$$= \frac{9.69}{17.97} = .54$$

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1 Karl J. Holzinger, op.cit., p. 233.

2 Karl J. Holzinger, op.cit., p. 109.

Therefore, the mean of the fourth grade initial A. P. Test is $77.52 \pm .54$.

In the same way the probable error of the mean of the final test for the same grade was found to be .31.

The probable error of the difference between the means was computed as follows:

$$P.E._{M_1 - M_2} = \sqrt{(P.E._{M_1})^2 + (P.E._{M_2})^2}$$
$$= \sqrt{(.54)^2 + (.31)^2}$$
$$= \sqrt{.2916 + .0961}$$
$$\sqrt{.3877} = .62$$

Holzinger says, "The general rule is that a difference or a statistical constant of any sort is not significant unless it is at least four times its probable error."[1]

The actual difference between the initial mean, 77.52, and the final mean, 88.61, of the fourth grade A. P. Test was 11.09 which is fifteen times its probable error, and therefore, highly significant, statistically speaking.

In a similar manner the probable error of all of the tests for all of the grades was computed. The results were as follows: On the fourth grade S. P. Test the actual difference in the means was 86.18 - 56.01 or 30.17, which is 26 times its P.E. (1.12), and therefore highly significant.

On the sixth grade A. P. Test the actual difference in the means was 90.83 - 89.83 or 1.00, which is only twice its P.E.(.44)

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1 Karl J. Holzinger, op. cit., p. 237.

and therefore not significant.

On the sixth grade S. P. Test the actual difference in the means was 92.04 - 89.31 or 2.73, which is five times its P.E. (.52), and therefore significant.

On the sixth grade M.P. Test the actual difference in the means was 88.24 - 75.15 or 13.09, which is 27 times its P.E. (.53), and therefore highly significant.

On the eighth grade A. P. Test the actual difference in the means was 92.00 - 88.42 or 3.58, which is seven times its P.E. (.48), and therefore significant.

On the eighth grade S. P. Test the actual difference in the means was 92.98 - 91.87 or 1.11, which is 2.9 times its P.E. (.38), and therefore not significant.

On the eighth grade M. P. Test the actual difference in the means was 88.83 - 81.05 or 7.78, which is 14 times its P.E. (.53), and therefore highly significant.

This shows the mean gains to be statistically significant in six of the eight cases.

CHAPTER VI

ERRORS ON INITIAL AND FINAL TESTS COMPARED

Errors in Addition

Errors in Subtraction

Errors in Multiplication

CHAPTER VI

ERRORS ON INITIAL AND FINAL TESTS COMPARED

Each pupil's errors were analyzed for each test exactly as was done for the initial tests. The individual records of examples missed with the reasons analyzed as closely as possible were made for each child on the same sheet with the October record. The sample sheet appearing in Exhibit E appears in its completed form in Exhibit I. Each child's record was completed in a similar manner.

Errors in Addition

Table XCI shows the distribution by grades of the more common types of errors found on the A. P. Test on both the October and the March testings. It is read as follows: In October 119 errors on the primary facts were made by fourth grade pupils, 37 by sixth grade pupils, and 31 by eighth grade pupils. In contrast, in March the fourth grade made only 28 errors on the primary facts; the sixth grade, 34; and the eighth grade, 17. The decade facts still took a very large toll. There were 1238 errors on decade facts in Grade IV in October, and 576 such errors in March. In Grade VI decade facts caused errors in 676 cases in October and in 525 cases in March. In Grade VIII there were 503 such errors in October and 403 in March. Zeros or gaps caused errors in 32 cases in Grade IV in October, and in 18 in March; in 9 cases in Grade VI in October, and 12 in March; in 5 cases in Grade VIII in October, and in 3 in March. The remainder

EXHIBIT I. DIAGNOSIS OF ERRORS : A SAMPLE SHEET

Child's name - Eugene School _____ Gr. VI Teacher _____

Type of error	Examples missed October	Examples missed March
A. P. Test		
Primary facts		f
Decade facts	o v w x	v x
Zeros or gaps		
Carried when no need		
Carried too few		
Carried too many		g
Failed to carry	m r	
Decimal point		
Omitted whole example		
Omitted part example	y	
Jumped a decade		
Skipped a decade		
S. P. Test		
Subtraction facts		
Minuend from subtrahend		
Zeros or gaps	a q	
Forgot had borrowed	w	
Borrowed when no need	f	
Used wrong process		
Omitted whole example	b	
Omitted part example		
Borrowed too many		
M. P. Test		
Multiplication facts		
Addition facts	i	
Carrying difficulties	n	u
Zeros or gaps	e	
Faulty arrangement partial product		
Misread own figures		
Failed to use a part of multiplier		
Decimal point	t	
Omitted whole example		
Wrong process		

TABLE XCI. DISTRIBUTION OF CHIEF ERRORS MADE BY ALL GRADES ACCORDING TO THE TYPE OF ERROR ON THE INITIAL AND FINAL A. P. TESTS

Type of error	Grade IV		Grade VI		Grade VIII	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
Primary facts	119	28	37	34	31	17
Decade facts	1238	576	676	525	503	403
Zeros or gaps	32	18	9	12	5	3
Carried when no need	10	6	28	12	7	8
Carried too few	75	47	67	45	132	53
Carried too many	39	18	59	48	131	39
Failed to carry	13	53	58	30	63	23
Omitted decimal point	222	2	10	1	14	7
Omitted whole example	20	9	5	6	25	
Omitted part example	22	3	11	6	7	1
Miscellaneous						
Jumped a decade	12	6	18	10	17	10
Skipped a decade	17	11	4	8	1	2
Transposed answer		1			3	1
Wrong process		2				
Added 1 to answer			1			
Number of pupils taking the test	323	319	341	326	323	323

of the Table is read similarly. It will be seen that in Grade IV the number of errors on primary facts decreased from 119 to 28, on decade facts from 1238 to 576, and decimal point errors from 222 to 22. Grade VIII made some improvement in the number of errors due to carrying. With the exception of the decrease in decade fact errors Grade VI did not make the improvement that is noted in the other grades.

Table XCII shows the distribution of errors on the A. P. Test[1] according to the specific examples in the test for both the October and March testings. It is read as follows: On example a in October 64 fourth grade pupils, 22 sixth grade pupils, and 17 eighth grade pupils failed. In March on the same example 20 fourth grade pupils, 14 sixth grade pupils, and 11 eighth grade pupils failed. The remainder of the Table is read similarly. It will be seen that in both testings example x had by far the greatest number of errors in each grade, with example v ranking second in both cases.

Errors in Subtraction

Table XCIII shows the distribution of errors made by all grades according to the type of error on the S. P. Test for both the October and March tests. It is read as follows: In October a lack of knowledge of the subtraction facts caused errors in 398 cases in Grade IV, in 176 cases in Grade VI, and 172 cases in Grade VIII. In March a similar difficulty caused errors

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1 Copies of the tests used appear in the Appendix.

TABLE XCII. THE NUMBER OF PUPILS IN ALL GRADES WHO MISSED EACH EXAMPLE OF THE INITIAL AND FINAL A. P. TESTS

Test example	Number of pupils					
	Grade IV		Grade VI		Grade VIII	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
a	64	20	22	14	17	11
b	24	8	17	6	19	7
c	27	8	14	17	30	9
d	17	9	14	3	13	9
e	21	2	4	4	4	3
f	12	4	5	7	9	3
g	14	6	6	10	11	6
h	23	7	20	8	17	7
i	23	3	6	4	3	1
j	11	7	9	7	8	2
k	16	9	19	5	13	3
l	38	15	11	10	19	10
m	41	14	20	16	21	13
n	59	26	28	16	44	18
o	74	26	37	32	42	29
p	123	53	51	59	55	35
q	108	48	52	48	59	27
r	97	50	43	38	49	21
s	85	35	49	35	47	25
t	102	35	50	26	43	33
u	143	75	67	74	72	48
v	188	76	97	83	94	66
w	134	50	52	42	67	45
x	232	129	145	113	130	95
y	147	67	63	53	58	37
Number of pupils taking the test	323	319	341	326	323	323

TABLE XCIII. DISTRIBUTION OF CHIEF ERRORS MADE BY ALL GRADES ACCORDING TO THE TYPE OF ERROR ON THE INITIAL AND FINAL S. P. TESTS

Type of error	Grade IV		Grade VI		Grade VIII	
	Oct.	Mar.	Oct.	Mar.	Oct.	Mar.
Subtraction facts	398	98	176	50	172	62
Took minuend from subtrahend	153	63	50	35	31	27
Zeros or gaps	1492	480	176	84	48	35
Forgot had borrowed	791	227	324	125	139	133
Borrowed when no need	92	59	67	72	91	63
Used wrong process	135	32	22	6	23	2
Omitted decimal point	27	1	21		6	2
Omitted whole example	33	9	7	9	4	4
Omitted part example		1	14		7	1
Miscellaneous						
Borrowed too many	9	1	1		4	5
Added the borrow	1	1				
Complete ignorance of the borrowing process	264	127				
Number of pupils taking the test	326	319	340	330	335	323

in 98 cases in Grade IV, in 50 cases in Grade VI, and in 62 cases in Grade VIII. In October in Grade IV there were 153 attempts to take the minuend from the subtrahend; there were 50 such attempts in Grade VI, and 31 in Grade VIII. In March in Grade IV there were 63 such attempts, 35 in Grade VI, and 27 in Grade VIII. The remainder of the Table is read in a similar manner. It will be seen that at the time of both tests zeros caused the most errors in Grade IV, with the second largest cause of error being forgetting that one had borrowed. In both tests this was the largest cause for errors in both Grade VI and Grade VIII. In October there were 13 fourth grade children who showed a complete lack of knowledge of the borrowing process, causing 264 examples to be missed for this reason. In March there were 6 such children, causing 127 examples to be missed.

Table XCIV shows the distribution of errors made by all grades according to the specific examples of the S. P. Test for both the October and the March tests. It is read thus: In October on example a 83 fourth grade pupils, 37 sixth grade pupils, and 14 eighth grade pupils made errors. In March on the same example 29 fourth grade pupils, 10 sixth grade pupils, and 4 eighth grade pupils made errors. On example b in October errors were made by 62 fourth grade pupils, 28 sixth grade pupils, and 24 eighth grade pupils. In March errors were made on this example by 12 fourth grade pupils, 2 sixth grade pupils, and by 4 eighth grade pupils. The remainder of the Table is read in a similar manner. It will be seen that on both tests Grade IV made the most errors on example s, while both Grade VI and Grade

TABLE XCIV. THE NUMBER OF PUPILS IN ALL GRADES WHO MISSED EACH EXAMPLE OF THE INITIAL AND FINAL S. P. TESTS

Test example	Number of pupils Grade IV Oct.	Grade IV Mar.	Grade VI Oct.	Grade VI Mar.	Grade VIII Oct.	Grade VIII Mar.
a	83	29	37	10	14	4
b	62	12	28	2	24	4
c	61	13	26	5	29	8
d	173	38	45	20	45	21
e	98	14	20	4	6	2
f	158	68	50	36	40	24
g	114	36	31	10	7	5
h	117	34	19	15	25	8
i	203	67	34	17	30	10
j	152	39	40	24	29	10
k	135	26	22	9	15	11
l	136	42	35	15	27	16
m	106	29	26	8	32	14
n	166	60	25	4	24	5
o	174	63	51	9	41	19
p	100	39	30	17	20	14
q	141	40	29	13	13	6
r	148	45	39	34	38	23
s	232	92	67	34	38	29
t	144	35	28	7	21	7
u	172	64	28	10	13	7
v	141	34	20	6	12	10
w	160	51	43	12	20	8
x	179	45	34	13	33	29
y	205	89	72	46	72	41
Number of pupils taking the test	326	319	340	330	335	323

VIII made the most errors on example y.

Errors in Multiplication

Table XCV shows the distribution of errors according to the type of error on the M. P. Test for both the October and the March testings. It is read as follows: In October in Grade VI 522 errors were caused by a lack of knowledge of multiplication facts while in Grade VIII 525 errors had the same cause. In March this cause was responsible for 213 errors in Grade VI and for 209 errors in Grade VIII. In October a lack of knowledge of addition facts caused 221 errors in Grade VI and 124 errors in Grade VIII. In March this cause was responsible for 96 errors in Grade VI and for 120 in Grade VIII. The remainder of the Table is read similarly. In March as in October in both grades addition fact ignorance and carrying difficulties caused a large percentage of multiplication errors. The decimal point caused more trouble in multiplication than in either addition or subtraction.

Table XCVI shows the distribution of errors on the M. P. Test according to the specific examples in the test, for both the October and the March testings. It is read as follows: In October on example a 20 errors were made by sixth grade pupils and 30 by eighth grade pupils. In March on the same example 2 errors were made by sixth grade pupils and 2 by eighth grade pupils. On example b in October 20 errors were made by sixth grade pupils and 16 by eighth grade pupils; in March, 3 errors by sixth grade pupils and 4 by eighth grade pupils were made on this

TABLE XCV. DISTRIBUTION OF CHIEF ERRORS MADE BY ALL GRADES ACCORDING TO THE TYPE OF ERROR ON THE INITIAL AND FINAL M. P. TESTS

Type of error	Grade VI		Grade VIII	
	Oct.	Mar.	Oct.	Mar.
Multiplication facts	522	213	525	209
Addition facts	221	96	124	120
Carrying difficulties	198	171	181	177
Zeros or gaps	222	97	232	156
Faulty arrangement of the partial product	161	142	118	76
Misread own figures	16	19	24	22
Failed to use a part of multiplier	145	92	57	41
Decimal point	531	173	203	80
Miscellaneous				
Omitted whole example	13	16	5	3
Used wrong process		4	7	5
Multiplier not always multiplier	4		5	
Number of pupils taking the test	343	329	330	320

TABLE XCVI. THE NUMBER OF PUPILS IN ALL GRADES WHO MISSED EACH EXAMPLE OF THE INITIAL AND FINAL M. P. TESTS

Test example	Number of pupils Grade VI Oct.	Mar.	Grade VIII Oct.	Mar.
a	20	2	30	2
b	20	3	16	4
c	16	1	12	3
d	24	9	21	7
e	175	44	204	128
f	35	14	25	8
g	205	64	56	14
h	65	16	34	5
i	51	19	30	26
j	42	12	32	16
k	51	29	52	29
l	42	19	33	26
m	44	23	43	23
n	115	51	97	45
o	84	66	75	68
p	36	16	40	21
q	91	57	84	45
r	106	56	60	42
s	89	47	60	29
t	290	126	140	61
u	74	41	43	33
v	70	30	50	43
w	119	72	78	54
x	188	126	150	120
y	70	51	52	28
Number of pupils taking the test	343	329	330	320

example. The remainder of the Table is read similarly. In both testings Grade VIII made its largest number of errors on example e. This was caused by the examples $\frac{6}{9}$ and $\frac{0}{3}$, the isolated zeros giving much more trouble than zeros in larger examples.

CHAPTER VII

THE EXPERIMENTAL AND CONTROL GROUPS COMPARED

Composition and Selection of the Groups

The Groups Considered as Wholes

The Groups as Paired Pupils

CHAPTER VII

THE EXPERIMENTAL AND CONTROL GROUPS COMPARED

Composition and Selection of the Groups

The experimental group consisted of six eighth grades or 168 pupils, eleven sixth grades or 296 pupils, and eleven fourth grades or 293 pupils. The teachers of these grades were asked to give corrective work in addition, subtraction, and multiplication, based on pupil needs as revealed by the October tests.

The control group consisted of five eighth grades or 162 pupils, one sixth grade of 34 pupils, and one fourth grade of 30 pupils. The teachers of these rooms were not shown the corrected October tests, and were requested merely to carry on their class work in their usual manner.

The control group was selected for the writer by the Superintendent of Schools. It so happened that the teacher of the sixth grade control group was one of the very best teachers in the system. This fact helps to explain why the results of her "ordinary class work" were more telling than the results of specific corrective measures in the hands of some others of the teachers. It also happened that this particular sixth grade made the best showing on the initial tests, from the standpoint of having the highest percentage of perfect scores on the A. P. and S. P. Tests, and of having the highest means on the S. P. and M. P. Tests.

It is to be regretted that in the case of the sixth and fourth grades the size of the control and experimental groups was not more nearly equal. It is possible that had the writer realized the disadvantage of this in time other arrangements might have been made. To offset this difference in size of groups, and to make any conclusions drawn more valid, pairs were matched by the writer as carefully as possible. This will be explained more fully later in this chapter.

The Groups Considered as Wholes

Table XCVII shows a comparison of the gains in mean scores obtained on the final tests by the experimental and control groups taken as wholes. The mean scores for both the October and March tests for both groups are given, the differences noted, and the differences between groups computed. It will be noted that with the exception of the case of the sixth grade on the A. P. Test the differences in mean gains were all in favor of the experimental group. The minimum mean gain of the experimental group over the control group was in the case of the fourth grade on the A. P. Test when the gain was 6.65. The maximum mean gain was in the case of the fourth grade on the S. P. Test when the gain was 12.77.

The Groups as Paired Pupils

To render conclusions more valid, and to offset any differences due to difference in size of groups, pupils from the control group were very carefully matched with pupils from the experi-

TABLE XCVII. COMPARISON OF GAINS IN MEAN SCORES OBTAINED IN FINAL TESTS BY EXPERIMENTAL AND CONTROL GROUPS TAKEN AS WHOLES

Grade	Group	No. Pupils	Oct. Test	Mar. Test	Difference	Difference between groups
A. P. Test						
IV	Experimental	293	76.86	88.64	11.78	6.65
	Control	30	83.20	88.13	4.93	
VI	Experimental	307	87.09	90.30	3.21	0.91
	Control	34	88.41	92.53	4.12	
VIII	Experimental	168	88.12	95.21	7.09	7.33
	Control	154	88.75	88.51	-0.24	
S. P. Test						
IV	Experimental	294	56.54	87.31	30.77	12.77
	Control	30	57.33	75.33	18.00	
VI	Experimental	307	86.23	95.12	8.89	8.04
	Control	33	96.12	96.97	.85	
VIII	Experimental	170	90.71	98.80	8.09	7.51
	Control	162	91.93	92.51	.58	
M. P. Test						
VI	Experimental	309	74.22	87.67	13.45	6.83
	Control	34	81.65	88.27	6.62	
VIII	Experimental	167	80.24	93.54	13.30	10.74
	Control	162	81.31	83.87	2.56	

mental group. This was done on the basis of age, grade, and of initial test scores. As has already been stated intelligence ratings for the pupils was not available. A pair consists of two pupils in the same grade with identical initial test scores, whose ages do not vary more than two months in any case. In only a few cases do the ages vary as much as two months. Usually they are identical, or vary one month. Exhibit J is a sample sheet showing how the pairs were matched. In Grade VIII, from a total of 320 pupils, it was possible to thus match only some sixty pairs. In Grades IV and VI with the much larger experimental group to choose from, it was possible to match a larger percentage of the smaller control groups. Even in these cases, however, it was by no means possible to match every child from the control groups. The matching was, of course, done separately for each test.

Tables XCVIII - CV show comparisons of the gains made by the paired pupils for every test and grade. In each case, pupil a is the experimental group pupil, and pupil b the control group pupil. It will be seen that while in occasional instances the difference in gains was in favor of the control group pupil, in the majority of instances the difference in gain was in favor of the experimental group pupil, the difference in the mean gain in every instance being in favor of the experimental group.

Table CVI summarizes the material of Tables XCVIII - CV, relating to the paired groups. The mean gains for both groups for all grades and processes are shown, with the difference noted. In every instance the difference in mean gain was in

EXHIBIT J. SAMPLE SHEET OF PAIRED FOURTH GRADE PUPILS ON THE INITIAL A. P. TEST

Pair	Pupil	Age	Test score	Time
	a	9-1	88	12 minutes
1	b	9-1	88	16 "
	a	10-1	84	16 minutes
2	b	10-1	84	11 "
	a	8-11	96	23 minutes
3	b	8-11	96	22 "
	a	8-9	84	30 minutes
4	b	8-9	84	26 "
	a	9-6	96	21 minutes
5	b	9-6	96	21 "
	a	9-7	72	13 minutes
6	b	9-7	72	13 "
	a	8-5	88	17 minutes
7	b	8-5	88	16 "
	a	9-7	92	16 minutes
8	b	9-7	92	20 "
	a	9-5	84	23 minutes
9	b	9-5	84	23 "
	a	8-9	72	20 minutes
10	b	8-9	72	16 "
	a	10-0	72	20 minutes
11	b	9-11	72	25 "
	a	9-6	68	28 minutes
12	b	9-7	68	36 "
	a	10-9	72	28 minutes
13	b	10-9	72	9 "
	a	9-4	84	18 minutes
14	b	9-4	84	17 "
	a	11-4	84	13 minutes
15	b	11-4	84	17 "

TABLE XCVIII. COMPARISON OF GAINS MADE ON FINAL A. P. TEST BY PAIRED FOURTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
	a	88	92	4	12	
1	b	88	80	- 8		
	a	84	84	0		
2	b	84	92	8		8
	a	96	96	0	4	
3	b	96	92	- 4		
	a	84	100	16	8	
4	b	84	92	8		
	a	96	100	4		
5	b	96	100	4		
	a	72	100	28	8	
6	b	72	92	20		
	a	88	100	12		
7	b	88	100	12		
	a	92	96	4	4	
8	b	92	92	0		
	a	84	92	8		
9	b	84	92	8		
	a	72	92	20	16	
10	b	72	76	4		
	a	72	96	24	12	
11	b	72	84	12		
	a	68	88	20	4	
12	b	68	84	16		
	a	72	100	28	16	
13	b	72	84	12		
	a	84	96	12	12	
14	b	84	84	0		

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TABLE XCVIII. (Continued) COMPARISON OF GAINS MADE ON FINAL A. P. TEST BY PAIRED FOURTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
	a	84	84	0		
15	b	84	92	8		8
	a	88	96	8	12	
16	b	88	84	-4		
	a	88	92	4		
17	b	88	92	4		
	a	84	92	8	8	
18	b	84	84	0		
	a	76	92	16	12	
19	b	76	80	4		
	a	92	96	4	8	
20	b	92	88	-4		
	a	84	92	8	16	
21	b	84	76	-8		
	a	80	96	16	20	
22	b	80	76	-4		
	a	76	88	12		
23	b	76	88	12		

Mean gains

Experimental group - 11.13
Control group - 4.35

TABLE XCIX. COMPARISON OF GAINS MADE ON FINAL S. P. TEST BY PAIRED FOURTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
	a	48	96	48	8	
1	b	48	88	40		
	a	24	92	68	28	
2	b	24	64	40		
	a	88	100	12	4	
3	b	88	96	8		
	a	24	100	76	40	
4	b	24	60	36		
	a	80	96	16	4	
5	b	80	92	12		
	a	88	96	8	4	
6	b	88	92	4		
	a	48	100	52		
7	b	48	100	52		
	a	88	92	4		
8	b	88	92	4		
	a	72	100	28	8	
9	b	72	92	20		
	a	20	80	60	8	
10	b	20	72	52		
	a	76	100	24	24	
11	b	76	76	0		
	a	24	92	68		
12	b	24	96	72		4
	a	52	100	48	12	
13	b	52	88	36		

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TABLE XCIX. (Continued) COMPARISON OF GAINS MADE ON FINAL S. P. TEST BY PAIRED FOURTH GRADE PUPILS

Pair no.	Pupil	Oxt. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
	a	88	40	-48		
14	b	88	92	4		52
	a	8	100	92	64	
15	b	8	36	28		
	a	12	16	4		
16	b	12	16	4		
	a	24	100	76	12	
17	b	24	88	64		
	a	48	84	36	28	
18	b	48	56	8		
	a	60	84	24	8	
19	b	60	76	16		
	a	92	92	0	4	
20	b	92	88	- 4		
	a	84	100	16	24	
21	b	84	72	- 8		
	a	80	100	20	16	
22	b	80	84	4		
	a	80	100	20	8	
23	b	80	92	12		
	a	64	100	36	4	
24	b	64	96	32		
	a	92	100	8	24	
25	b	92	76	-16		
	a	68	96	28	72	
26	b	68	24	-44		

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TABLE (Continued) COMPARISON OF GAINS MADE ON FINAL S. P. TEST BY PAIRED FOURTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Control group
27	a	48	72	24	12	
	b	48	60	12		
28	a	88	100	12	12	
	b	88	88	0		

Mean gain

Experimental group - 30.71
Control group - 17.43

TABLE C. COMPARISON OF GAINS MADE ON FINAL A. P. TEST BY PAIRED SIXTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
1	a	92	92	0	4	
	b	92	88	-4		
2	a	92	96	4	8	
	b	92	88	-4		
3	a	68	84	16	8	
	b	68	76	8		
4	a	96	96	0	4	
	b	96	92	-4		
5	a	96	100	4	8	
	b	96	92	-4		
6	a	88	100	12		
	b	88	100	12		
7	a	88	100	12	4	
	b	88	96	8		
8	a	92	100	8		
	b	92	100	8		
9	a	84	96	12	24	
	b	84	72	-12		
10	a	96	100	4	4	
	b	96	96	0		
11	a	92	96	4		
	b	92	100	8		4
12	a	80	96	16		
	b	80	96	16		
13	a	84	92	8	4	
	b	84	88	4		

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TABLE C. (Continued) COMPARISON OF GAINS MADE ON FINAL A. P. TEST BY PAIRED SIXTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Control group
14	a	76	100	24	12	
	b	76	88	12		
15	a	92	100	8	8	
	b	92	92	0		
16	a	92	96	4	8	
	b	92	88	-4		
17	a	96	100	4		
	b	96	100	4		
18	a	88	100	12	8	
	b	88	92	4		
19	a	92	100	8	16	
	b	92	84	-8		

Mean gains

Experimental group - 8.42
Control group - 2.32

TABLE CI. COMPARISON OF GAINS MADE ON FINAL S. P. TEST BY PAIRED SIXTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
	a	96	96	0	4	
1	b	96	92	-4		
	a	96	96	0		
2	b	96	100	4		4
	a	96	96	4	4	
3	b	96	92	-4		
	a	96	96	0		
4	b	96	100	4		4
	a	96	100	4	8	
5	b	96	92	-4		
	a	96	100	4		
6	b	96	100	4		
	a	96	96	0		
7	b	96	96	0		
	a	96	96	0	4	
8	b	96	92	-4		
	a	96	100	4		
9	b	96	100	4		
	a	92	100	8		
10	b	92	100	8		
	a	96	100	4		
11	b	96	100	4		
	a	96	96	0		
12	b	96	96	0		
	a	72	92	20		
13	b	72	92	20		

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TABLE CI. (Continued) COMPARISON OF GAINS MADE ON FINAL S. P. TEST BY PAIRED SIXTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Control group
14	a	100	100	0	4	
	b	100	96	-4		
15	a	100	100	0	12	
	b	100	88	-12		

Mean gains

Experimental group - 3.20
Control group - 1.07

TABLE CII. COMPARISON OF GAINS MADE ON FINAL M. P. TEST BY PAIRED SIXTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
	a	80	96	16	8	
1	b	80	88	8		
	a	92	96	4	4	
2	b	92	92	0		
	a	72	80	8	4	
3	b	72	76	4		
	a	84	92	8	8	
4	b	84	84	0		
	a	84	92	8		
5	b	84	96	12		4
	a	80	96	16	16	
6	b	80	80	0		
	a	48	76	28	56	
7	b	48	20	-28		
	a	76	96	20	8	
8	b	76	88	12		
	a	96	92	- 4		4
9	b	96	96	0		
	a	92	100	8	8	
10	b	92	92	0		
	a	72	92	20		
11	b	72	96	24		4
	a	96	84	-12		
12	b	96	88	- 8		4
	a	68	68	0		
13	b	68	72	4		4

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TABLE CII. (Continued) COMPARISON OF GAINS MADE ON FINAL M. P. TEST BY PAIRED SIXTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
14	a	84	100	16	8	
	b	84	92	8		
15	a	76	96	20	4	
	b	76	92	16		
16	a	88	96	8		
	b	88	100	12		4
17	a	88	100	12	4	
	b	88	96	8		
18	a	84	92	8	4	
	b	84	88	4		
19	a	72	92	20		
	b	72	92	20		
20	a	68	92	24		
	b	68	96	28		4
21	a	88	100	12		
	b	88	100	12		
22	a	92	88	- 4		
	b	92	100	8		12
23	a	76	88	12	8	
	b	76	80	4		
24	a	88	76	-12		
	b	88	88	0		12
25	a	84	96	12	16	
	b	84	80	- 4		
26	a	84	96	12		
	b	84	96	12		

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TABLE CII. (Continued) COMPARISON OF GAINS MADE ON FINAL M. P. TEST BY PAIRED SIXTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
27	a	88	92	4		
	b	88	100	12		8
28	a	88	96	8		
	b	88	96	8		

Mean gains

Experimental group - 9.72
Control group - 6.29

TABLE CIII. COMPARISON OF GAINS MADE ON FINAL A. P. TEST BY PAIRED EIGHTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Control group
	a	88	100	12		
1	b	88	100	12		
	a	88	100	12	16	
2	b	88	84	- 4		
	a	92	100	8	12	
3	b	92	88	- 4		
	a	96	92	- 4		
4	b	96	92	- 4		
	a	92	100	8	12	
5	b	92	88	- 4		
	a	80	92	12	4	
6	b	80	88	8		
	a	72	96	24	28	
7	b	72	68	- 4		
	a	88	100	12	4	
8	b	88	96	8		
	a	84	100	16	12	
9	b	84	88	4		
	a	80	96	16		
10	b	80	96	16		
	a	76	100	24	46	
11	b	76	56	-20		
	a	96	100	4	8	
12	b	96	92	- 4		
	a	84	92	8	4	
13	b	84	88	4		
	a	84	96	12	4	
14	b	84	92	8		

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TABLE CIII. (Continued) COMPARISON OF GAINS MADE ON FINAL A. P. TEST BY PAIRED EIGHTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
	a	92	96	4	4	
15	b	92	92	0		
	a	96	100	4		
16	b	96	100	4		
	a	88	100	12	8	
17	b	88	92	4		
	a	88	100	12	8	
18	b	88	92	4		
	a	80	100	20	16	
19	b	80	84	4		
	a	68	92	24	24	
20	b	68	68	0		
	a	92	100	8		
21	b	92	100	8		
	a	88	92	4		
22	b	88	92	4		
	a	88	100	12	12	
23	b	88	88	0		
	a	96	96	0	4	
24	b	96	92	-4		
	a	88	96	8	12	
25	b	88	92	-4		
	a	92	92	0	8	
26	b	92	84	-8		
	a	96	100	4	4	
27	b	96	96	0		
	a	84	100	16		
28	b	84	92	8		

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TABLE CIII. (Continued) COMPARISON OF GAINS MADE ON FINAL A. P. TEST BY PAIRED EIGHTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
	a	84	88	4		
29	b	84	96	12		8
	a	96	100	4	16	
30	b	96	84	-12		
	a	92	100	8	4	
31	b	92	96	4		
	a	92	96	4		
32	b	92	96	4		
	a	96	100	4	4	
33	b	96	96	0		
	a	72	100	28	28	
34	b	72	72	0		
	a	96	100	4	8	
35	b	96	92	- 4		
	a	88	100	12	16	
36	b	88	84	- 4		
	a	96	100	4	12	
37	b	96	88	- 8		
	a	88	92	4	8	
38	b	88	84	- 4		
	a	96	100	4	12	
39	b	96	88	- 8		
	a	72	96	24	8	
40	b	72	88	16		
	a	84	96	12		
41	b	84	96	12		
	a	80	80	0		
42	b	80	80	0		

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TABLE CIII. (Continued) COMPARISON OF GAINS MADE ON FINAL A. P. TEST BY PAIRED EIGHTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
	a	96	100	4	8	
43	b	96	92	- 4		
	a	96	100	4		
44	b	96	100	4		
	a	88	100	12	12	
45	b	88	88	0		
	a	92	100	8	20	
46	b	92	80	-12		
	a	80	96	16	16	
47	b	80	80	0		
	a	80	96	16	16	
48	b	80	80	0		
	a	96	100	4		
49	b	96	100	4		
	a	88	100	12	16	
50	b	88	84	- 4		
	a	96	100	4	16	
51	b	96	84	-12		
	a	76	84	8	12	
52	b	76	72	- 4		
	a	92	100	8	8	
53	b	92	92	0		
	a	92	100	8	4	
54	b	92	96	4		
	a	84	96	12		
55	b	84	96	12		
	a	88	96	8	8	
56	b	88	88	0		

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TABLE CIII. (Continued) COMPARISON OF GAINS MADE ON FINAL A. P. TEST BY PAIRED EIGHTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Control group
	a	92	92	0		
57	b	92	92	0		
	a	84	88	4	36	
58	b	84	52	-32		
	a	96	100	4	28	
59	b	96	72	-24		
	a	92	92	0	4	
60	b	92	88	- 4		
	a	96	100	4		
61	b	96	100	4		
	a	68	92	24	40	
62	b	68	52	-16		
	a	84	100	16	8	
63	b	84	92	8		

Mean gains

Experimental group - 9.27
Control group - - .508

TABLE CIV. COMPARISON OF GAINS MADE ON FINAL S. P. TEST BY PAIRED EIGHTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Control group
	a	92	100	8	4	
1	b	92	96	4		
	a	80	100	20	16	
2	b	80	84	4		
	a	92	100	8	12	
3	b	92	88	- 4		
	a	92	96	4		
4	b	92	96	4		
	a	88	96	8	8	
5	b	88	88	0		
	a	96	100	4	20	
6	b	96	80	-16		
	a	88	100	12		
7	b	88	100	12		
	a	88	100	12	4	
8	b	88	96	8		
	a	92	100	8	4	
9	b	92	96	4		
	a	92	100	8		
10	b	92	100	8		
	a	96	96	0	4	
11	b	96	92	- 4		
	a	88	100	12	8	
12	b	88	92	4		
	a	84	96	12	8	
13	b	84	88	4		
	a	92	100	8	28	
14	b	92	72	-20		

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TABLE CIV. (Continued) COMPARISON OF GAINS MADE ON FINAL S. P. TEST BY PAIRED EIGHTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
15	a	92	96	4	8	
	b	92	88	- 4		
16	a	96	100	4	8	
	b	96	92	- 4		
17	a	92	92	0	4	
	b	92	88	- 4		
18	a	88	100	12	12	
	b	88	88	0		
19	a	92	100	8	8	
	b	92	92	0		
20	a	92	100	8	20	
	b	92	80	-12		
21	a	92	92	0		
	b	92	100	8		8
22	a	96	100	4		
	b	96	100	4		
23	a	96	100	4	4	
	b	96	96	0		
24	a	92	100	8	8	
	b	92	92	0		
25	a	96	96	0		
	b	96	100	4		4
26	a	96	96	0	16	
	b	96	80	-16		
27	a	92	100	8	8	
	b	92	92	0		
28	a	80	100	20	8	
	b	80	92	12		

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TABLE CIV. (Continued) COMPARISON OF GAINS MADE ON FINAL S. P. TEST BY PAIRED EIGHTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
29	a	92	100	8		
	b	92	100	8		
30	a	96	92	- 4		
	b	96	96	0		4
31	a	96	96	0	8	
	b	96	88	- 8		
32	a	96	96	0		
	b	96	100	4		4
33	a	96	100	4	4	
	b	96	96	0		
34	a	96	100	4	4	
	b	96	96	0		
35	a	96	96	0		
	b	96	96	0		
36	a	96	100	4	8	
	b	96	92	- 4		
37	a	96	100	4		
	b	96	100	4		
38	a	88	100	12		
	b	88	100	12		
39	a	88	100	12	8	
	b	88	92	4		
40	a	96	100	4	4	
	b	96	96	0		
41	a	88	96	8	16	
	b	88	80	- 8		
42	a	96	100	4	12	
	b	96	88	- 8		

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TABLE CIV. (Continued) COMPARISON OF GAINS MADE ON FINAL S. P. TEST BY PAIRED EIGHTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
43	a	92	96	4		
	b	92	96	4		
44	a	72	92	20	8	
	b	72	84	12		
45	a	92	96	4		
	b	92	96	4		
46	a	96	96	0	4	
	b	96	92	- 4		
47	a	92	100	8	4	
	b	92	96	4		
48	a	96	100	4	4	
	b	96	96	0		
49	a	88	96	8	16	
	b	88	80	- 8		
50	a	92	100	8		
	b	92	100	8		
51	a	88	96	8		
	b	88	96	8		
52	a	92	100	8	4	
	b	92	96	4		
53	a	88	100	12		
	b	88	100	12		
54	a	76	100	24	4	
	b	76	96	20		
55	a	92	100	8		
	b	92	100	8		
56	a	96	96	0	12	
	b	96	84	-12		

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TABLE CIV. (Continued) COMPARISON OF GAINS MADE ON FINAL S. P. TEST BY PAIRED EIGHTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Control group
57	a	88	100	12	12	
	b	88	88	0		
58	a	96	100	4	8	
	b	96	92	- 4		
59	a	76	100	24	8	
	b	76	92	16		
60	a	84	100	16	4	
	b	84	96	12		
61	a	88	100	12	12	
	b	88	88	0		

Mean gains

Experimental group - 7.02
Control group - 1.36

TABLE CV. COMPARISON OF GAINS MADE ON FINAL M. P. TEST BY PAIRED EIGHTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
1	a	92	96	4	12	
	b	92	84	- 8		
2	a	92	100	8	8	
	b	92	92	0		
3	a	84	96	12	16	
	b	84	80	- 4		
4	a	80	92	12	8	
	b	80	84	4		
5	a	84	100	16	12	
	b	84	88	4		
6	a	84	76	- 8		
	b	84	84	0		8
7	a	80	92	12	8	
	b	80	84	4		
8	a	88	100	12	12	
	b	88	88	0		
9	a	92	96	4	8	
	b	92	88	- 4		
10	a	88	92	4	4	
	b	88	88	0		
11	a	88	100	12	28	
	b	88	72	- 16		
12	a	88	96	8		
	b	88	96	8		
13	a	80	100	20	12	
	b	80	88	8		
14	a	92	100	8	16	
	b	92	84	- 8		

continued on next page

TABLE CV. (Continued) COMPARISON OF GAINS MADE ON FINAL M. P. TEST BY PAIRED EIGHTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
15	a	84	92	8		
	b	84	100	16		8
16	a	72	96	24	20	
	b	72	76	4		
17	a	76	100	24	24	
	b	76	76	0		
18	a	84	100	16	20	
	b	84	80	- 4		
19	a	84	96	12	8	
	b	84	88	4		
20	a	84	100	16	20	
	b	84	80	- 4		
21	a	72	96	24	20	
	b	72	76	4		
22	a	68	84	16		
	b	68	84	16		
23	a	76	92	16	8	
	b	76	84	8		
24	a	84	88	4	4	
	b	84	84	0		
25	a	84	100	16	12	
	b	84	88	4		
26	a	80	96	16	16	
	b	80	80	0		
27	a	84	92	8	4	
	b	84	88	4		
28	a	88	84	- 4		
	b	83	92	4		8

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TABLE CV. (Continued) COMPARISON OF GAINS MADE ON FINAL M. P. TEST BY PAIRED EIGHTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
	a	80	100	20	12	
29	b	80	88	8		
	a	92	92	0	4	
30	b	92	88	- 4		
	a	84	100	16	40	
31	b	84	60	-24		
	a	84	96	12	4	
32	b	84	92	8		
	a	96	100	4	36	
33	b	96	64	-32		
	a	72	96	24	12	
34	b	72	84	12		
	a	84	92	8	16	
35	b	84	76	- 8		
	a	84	96	12	16	
36	b	84	80	- 4		
	a	92	80	-12	4	
37	b	92	76	-16		
	a	88	100	12	20	
38	b	88	80	- 8		
	a	68	92	24	36	
39	b	68	56	-12		
	a	76	88	12	4	
40	b	76	84	8		
	a	64	96	32	24	
41	b	64	72	8		
	a	76	80	4		
42	b	76	84	8		4

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TABLE CV. (Continued) COMPARISON OF GAINS MADE ON FINAL M. P. TEST BY PAIRED EIGHTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Difference in favor of Control group
43	a	92	100	8	16	
	b	92	84	- 8		
44	a	84	96	12	8	
	b	84	88	4		
45	a	76	88	12		
	b	76	92	16		4
46	a	84	100	16	8	
	b	84	92	8		
47	a	92	96	4	8	
	b	92	88	- 4		
48	a	76	100	24	8	
	b	76	92	16		
49	a	92	88	- 4	12	
	b	92	76	-16		
50	a	76	84	8		
	b	76	84	8		
51	a	92	100	8		
	b	92	80	-12	20	
52	a	76	100	24	16	
	b	76	84	8		
53	a	84	84	0	8	
	b	84	76	- 8		
54	a	92	96	4	8	
	b	92	88	- 4		
55	a	72	92	20	4	
	b	72	88	16		
56	a	96	96	0		
	b	96	96	0		

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TABLE CV. (Continued) COMPARISON OF GAINS MADE ON FINAL M. P. TEST BY PAIRED EIGHTH GRADE PUPILS

Pair no.	Pupil	Oct. Test	Mar. Test	Gains	Difference in favor of Experimental group	Control group
	a	72	96	24	8	
57	b	72	88	16		
	a	88	96	8	20	
58	b	88	76	-12		
	a	92	100	8	4	
59	b	92	96	4		
	a	96	100	4		
60	b	96	100	4		
	a	80	92	12		
61	b	80	96	16		4
	a	80	96	16	20	
62	b	80	76	- 4		
	a	80	100	20	20	
63	b	80	80	0		
	a	96	92	- 4	4	
64	b	96	88	- 8		
	a	92	100	8	4	
65	b	92	96	4		
	a	96	92	- 4		
66	b	96	92	- 4		
	a	84	92	8	8	
67	b	84	84	0		

Mean gains

Experimental group - 10.81
Control group - .42

TABLE CVI. COMPARISON OF MEAN GAINS OBTAINED ON FINAL TESTS BY PAIRED PUPILS

Grade	No. Pairs	Experimental group	Control group	Difference	Dif. in favor of Experimental group	Dif. in favor of Control group
A. P. Test						
IV	23	11.13	4.35	6.78	X	
VI	19	8.42	2.32	6.10	X	
VIII	63	9.27	-0.51	9.78	X	
S. P. Test						
IV	28	30.71	17.43	13.28	X	
VI	15	3.20	1.07	2.13	X	
VIII	61	7.02	1.36	5.66	X	
M. P. Test						
VI	28	9.72	6.29	3.43	X	
VIII	67	10.81	.42	10.39	X	

favor of the experimental group. The number of pairs in each grade for each test appears at the left in the Table.

The statistical significance of the difference in mean gains for each group of pairs for each grade and process was ascertained by using the Holzinger formula.[1]

In the case of the fourth grade on the A. P. Test the difference in mean gains between the pairs was 11.13(experimental) - 4.35(control) or 6.78, which is four times its P.E.(1.54), and therefore statistically significant.

On the fourth grade S. P. Test the difference in mean gains between the pairs was 30.71(experimental) - 17.43(control) or 13.28 which is twice its P.E.(4.89) and therefore not significant.

On the sixth grade A. P. Test the difference in mean gains between the pairs was 8.42(experimental) - 2.32(control) or 6.10, which is four times its P.E.(1.37), and therefore significant.

On the sixth grade S. P. Test the difference in mean gains between the pairs was 3.20(experimental) - 1.07(control) or 2.13, which is almost the same as its P.E.(2.15), and therefore not significant.

On the sixth grade M. P. Test the difference in mean gains between the pairs was 9.72(experimental) - 6.29(control) or 3.43, which is 1.9 times its P.E.(1.8.), and therefore not significant.

On the eighth grade A. P. Test the difference in mean gains between the pairs was 9.27(experimental) - -0.51(control) or 9.78,

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1 Karl J. Holzinger, Statistical Methods for Students in Education, p. 235.

which is ten times its P.E.(.95), and therefore highly significant.

On the eighth grade S. P. Test the difference in mean gains between the pairs was 7.02(experimental) - 1.36(control) or 5.66, which is six times its P.E.(.89) and therefore significant.

On the eighth grade M. P. Test the difference in mean gains between the pairs was 10.81(experimental)- .42(control) or 10.39, which is eight times its P.E.(1.07), and therefore statistically significant.

In five out of eight cases the difference in the mean gains was significant. In two of the instances where the difference in mean gains was not significant, the pairs involved were in the sixth grade. This lack of significance has been partially accounted for in the first section of this chapter. The other instance where the difference in mean gains was not significant was on the fourth grade S. P. Test. Here the obtained difference in means was exceptionally large. However, in this case not only was there a very small number of pairs, but a very wide spread of gains and losses, which made for a very large standard deviation, and therefore a large probable error, for "the reliability of an obtained difference is dependent only upon its standard error, and is independent of the magnitude of the obtained difference or of the ration between the difference and its standard error."[1]

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1. E. F. Linquist, A First Course in Statistics, p. 122.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

Summary

Conclusions

CHAPTER VIII

SUMMARY AND CONCLUSIONS

Summary

In October the Wilson A. P., S. P., and M. P. Tests were administered in all the sixth and eighth grades in the Newport public schools, and the A. P. and S. P. Tests in all of the fourth grades. A total of 1026 children was tested. The tests were administerd by the classroom teachers and scored by the writer.

In five eighth grades, eleven sixth grades, and ten fourth grades the teachers were asked to give corrective work based on pupil needs as revealed by these tests. In one eighth grade and in one fourth grade the writer did similar corrective work three fifteen-minute periods per week.

In the remaining five eighth grades, one sixth grade, and one fourth grade the teachers were not shown the corrected tests, nor asked to do any special corrective work.

In March the same Wilson Tests were administered to the same children. The results of the March tests were compared with the results of the October tests in the following manner:

1. Each grade with its own previous record,

2. The entire fourth grade, the entire sixth grade, and the entire eighth grade with the similar previous records.

3. The gains made by the experimental and control groups considered as wholes.

4. The gains made by the paired pupils of the experimental and control groups.

Conclusions

The conclusions arising from this study seem to the writer to be as follows:

1. There is an appalling need for corrective work in the fundamental processes of arithmetic beginning as early as the fourth grade and extending through the eighth.

2. Pupils respond to corrective procedures.

3. The gains resulting from corrective procedures may be expected to be significant.

4. Many eighth grade teachers apparently feel no obligation to do any corrective work in the arithmetic fundamentals. Few sixth grade teachers seem to feel any such obligation. Most fourth grade teachers seem to take it for granted that corrective procedures are a part of their routine class work.

5. The amount of time necessary to devote to corrective procedures varies inversely with the age of the pupil.

6. In the limited amount of time available to class room teachers it is possible to do effective corrective work.

7. Judging from the differences found in the results of the control and experimental groups, classes who deliberately take time for corrective procedures make greater gains in the arithmetic fundamentals than those who do not practice such procedures. Such gains are usually statistically significant.

BIBLIOGRAPHY

BIBLIOGRAPHY

1. Allen, Blanche. "Subtraction: Current Methods of Instruction in the United States." Unpublished Master's thesis, Boston University, 1932. 42 pp.

2. Baker, Harry J. "Mathematics and Intellectual Abilities." Mathematics Teacher, XXX (October, 1937), pp.259-264.

3. Baldwin, George H., et al. "A Study of the Schools of Newport, Rhode Island." (Mimeographed). Conducted by The New England School Survey Association, October, 1939. 118 pp.

4. Ballenger, H. L. "Overcoming Some Addition Difficulties." Journal of Educational Research, XIII (February, 1926), pp. 111-117.

5. Bowdren, Marion. "Five Case Studies of Arithmetic Failures." Unpublished Master's thesis, Boston University, 1934. 82 pp.

6. Breed, Frederick S. "Our General Outlook on Arithmetic." Journal of Educational Research, XXXII (December, 1938), pp. 241-254.

7. Brown, Joseph C., and Coffman, L. D. How To Teach Arithmetic. Chicago: Row, Peterson and Company, 1914. viii + 375pp.

8. Brownell, William A. "Remedial Cases in Arithmetic." Peabody Journal of Education, VII (September, 1929), pp. 100-107.

9. Brueckner, Leo J. Diagnostic and Remedial Teaching in Arithmetic. Chicago: John C. Winston Company, 1930. ix + 341 pp.

10. _____. "Diagnosing Pupil Difficulties." Journal of the National Education Association, XXI (April, 1932), pp. 123-125.

11. Burge, Lofton V. "Types of Errors and Questionable Habits of Work in Multiplication." Elementary School Journal, XXXIII (November, 1932), pp. 185-194.

12. Burgess, Bliss M. "How Nearly Can We Approach 100% Results in the Fundamentals of Addition and Multiplication in Grades Four and Five?" Unpublished Master's thesis, Boston University, 1930. 122 pp.

13. Buswell, Guy Thomas, and Judd, Charles Hubbard. Summary of Educational Investigations Relating to Arithmetic. Chicago: University of Chicago, 1925.

14. Caton, Anne Josephine. "How Much Time is Needed to Take an Average Fifth or Sixth Grade Pupil from Inaccuracy to 100% Accuracy in a Fundamental Process of Arithmetic,- Multiplication for Example?" Unpublished Master's thesis, Boston University, 1936. 64 pp.

15. Clark, John R., and Vincent, E. Leona. "A Study of the Effect of Checking upon Accuracy in Addition." Mathematics Teacher, XIX (February, 1926), pp. 65-71.

16. Clemens, Paul B., and Neubauer, Paul F. "A Supervision Project in Multiplication." Journal of Educational Research, XVIII (December, 1928), pp. 387-396.

17. Cole, Luella. Psychology of the Elementary School Subjects, pp. 193-246. New York: Farrar and Rinehart, 1934.

18. Edwards, William Herbert. "Bridging the Gap Between Theory and Practice in Ninth Grade Mathematics." School Science and Mathematics, XXVIII (November, 1928), pp. 864-866.

19. Foote, Lewis F. "The Need and Value of Remedial Arithmetic." Unpublished Master's thesis, University of New Hampshire, 1933. 83 pp.

20. France, O. C., and Stevenson, P. R. "Remedial Instruction in Arithmetic." Educational Research Bulletin, Ohio State University, Vol.VII (1923), pp. 291-297.

21. Gillmore, Ralph Harold. "Corrective Arithmetic in Senior High School." Unpublished Master's thesis, Boston University, 1939. 135 pp.

22. Gist, Arthur S. "Errors in the Fundamentals of Arithmetic." School and Society, VI (August 11, 1917), pp. 175-177.

23. Greene, C. E., and Buswell, G. T. Testing, Diagnosis, and Remedial Work in Arithmetic. Report of the Committee on Arithmetic of the National Society for the Study of Education. Bloomington, Illinois: Public School Publishing Company, 1930. pp. 535-549.

24. Greene, Harry A. "A Critique of Remedial and Drill Materials in Arithmetic." Journal of Educational Research, XXI (April, 1930), pp. 262-276.

25. Grossnickle, Foster E. "To Check or not to Check?" Elementary School Journal, XXXVI (September, 1935), pp. 35-39.

26. _____, and Snyder, John H. "Constancy of Errors to Basic Facts in the Fundamental Operations in Arithmetic." Journal of Educational Research, XXXII (January, 1939), pp. 336-344.

27. Guiler, Walter Scribner. "Improving Computational Ability." Elementary School Journal, XXX (October, 1929), pp.111-116.

28. Hammond, W. E. "Securing 100% Accuracy in the Fundamentals of Arithmetic." Unpublished Master's thesis, Boston University, 1929. 22 pp.

29. Hanley, Gertrude Louise. "Corrective Load in the Fundamentals of Arithmetic in Grades 4, 5, and 6." Unpublished Master's thesis, Boston University, 1938. 123 pp.

30. Holzinger, Karl J. Statistical Methods for Students in Education, pp. 243-244. Boston: Ginn and Company, 1928.

31. Houghton, Leroy K. "To Study the Thesis that there is a Use for a Corrective Program in the Fundamentals of Arithmetic in the Grammar School Curriculum." Unpublished Master's thesis, Boston University, 1939. 104 pp.

32. Kelley, Anna A. "Teaching Remedial Arithmetic." American School Board Journal, XCI (August, 1935), pp. 44-47.

33. Klapper, Paul. The Teaching of Arithmetic. New York: D. Appleton and Company, 1916. vii + 387 pp.

34. Knight, F. B., and Ford, E. "Temporary Lapses in Ability and Error in Arithmetic." Elementary School Journal, XXXII (October, 1931), pp. 111-124.

35. _____, Ruch, G. M., and Lutes, O. S. "How Shall Subtraction be Taught?" Journal of Educational Research, XI (March, 1925), pp. 157-168.

36. Lazar, May. Diagnostic and Remedial Work in Arithmetic Fundamentals for Intermediate Grades. New York:Board of Education of City of New York Bureau of Reference, Research, and Statistics, Publication No. 21, 1928. 203 pp.

37. Lindquist, E. F. A First Course in Statistics, pp. 102-128. Boston: Houghton Mifflin Company, 1938.

38. Mann, Rubie. "The Need of Junior High School Pupils for Stronger Elementary Bonds in Arithmetic." Unpublished Master's thesis, University of Southern California, 1929. Abstract in N.E.A. Department of Secondary School Principals XXXIV (January, 1931), pp. 36-38.

39. McCall, William A. How to Measure in Education. New York: The MacMillan Company, 1922. xiii + 416 pp.

40. Merton, Elda L., et al. "Remedial Work in Arithmetic." Second Yearbook of the Department of Elementary School Principals, pp. 395-429. Washington: National Education Association, 1923.

41. Mossman, Lois C. Principles of Teaching and Learning in the Elementary School, pp. 232-250. Boston: Houghton Mifflin Company, 1929. x + 292 pp.

42. Myers, Garry Cleveland. "Arrested for Speeding: A Hundred Million Americans." Journal of Educational Method, III (March, 1924), pp. 299-302.

43. _____. "Corrective Work in Arithmetic." Grade Teacher, LI (February, 1934), pp. 36, 66, 67.

44. _____. "Persistence of Errors in Arithmetic." Journal of Educational Research, XI (June, 1924), pp. 19-28.

45. _____, and Myers, Caroline. "Finding Mistakes Versus Correct Associations in Simple Number Learning." Journal of Educational Research, XVIII (June, 1928), pp. 25-31.

46. Neal, E. A., and Foster, Inez. "An Experiment in Remedial Work in Common Fractions." Elementary School Journal, XXIX (December, 1928), pp. 280-283.

47. Nelson, Helen G. "The Corrective Load in Arithmetic in a Junior High School." Unpublished Master's thesis, Boston University, 1938. 80 pp.

48. Newcomb, Ralph S. Modern Methods of Teaching Arithmetic. Boston: Houghton Mifflin Company, 1926. xv + 353 pp.

49. Nygaard, P. H. "Accuracy in Addition." Mathematics Teacher, XXVII (March, 1934), pp. 152-155.

50. O Brien, F. P. Improvement of Instruction in Arithmetic. Bulletin of Education, Vol. I, No. 4. Lawrence, Kansas: University of Kansas, October, 1927. 42 pp.

51. Osburn, Worth J. Corrective Arithmetic. Boston: Houghton Mifflin Company, 1924. x + 182 pp.

52. Otto, Henry J. "Remedial Instruction in Arithmetic." Elementary School Journal, XXVIII (October, 1927), pp. 124-133.

53. Peters, Charles C. "An Example of Replication of an Experiment for Increased Reliability." Journal of Educational Research, XXXII (September, 1938), pp. 3-9.

54. Pucko, Roman F. "Five Case Studies of Arithmetic Failures." Unpublished Master's thesis, Boston University, 1935. 94 pp.

55. Randall, Joseph H. "Corrective Arithmetic in Junior High School." Unpublished Master's thesis, Boston University, 1936. 129 pp.

56. Reed, Homer B. Psychology of Elementary School Subjects, pp. 302-397. Boston: Ginn and Company, 1938.

57. Rice, J. M. "Educational Research." Forum, XXXIV (July - September, 1902), pp. 117-130.

58. _____. "Educational Research: A Test in Arithmetic." Forum, XXXIV (October - December, 1902), pp. 281-297.

59. _____. "Educational Research: Causes of Success and Failure in Arithmetic." Forum, XXXIV (January - March, 1903), pp. 437-452.

60. Ridlon, Florence. "What Need is there for Corrective Arithmetic, and What Progress is it Possible to Achieve in a Limited Time?" Unpublished Master's thesis, Boston University, 1939. 197 pp.

61. Ringer, Alberta Rae. "A Two Year Diagnostic and Corrective Study in the Four Fundamentals of Arithmetic with a Group of Children through Grades Seven and Eight." Unpublished Master's thesis, Boston University, 1940. 108 pp.

62. Sister M. Kathleen. "Some Results of Remedial Instruction Following the Use of Diagnostic Arithmetic Tests." Catholic Educational Review, XXIV (January, 1926), pp. 19-27.

63. Smith, Arthur J. "The Value of a Diagnostic and Remedial Program in Arithmetic." Unpublished Master's thesis, University of Chicago, 1936. 76 pp.

64. Smith, James H. "Individual Variations in Arithmetic." Elementary School Journal, XVII(November,1916),pp. 195-200.

65. Soles, Edward. "Diagnostic and Corrective Measures in Addition." Unpublished Master's thesis, Boston University, 1935. 102 pp.

66. Stone, C. W. "An Experimental Study in Improving Ability to Reason in Arithmetic." Twenty-ninth Yearbook of the National Society for the Study of Education, pp. 589-599. Bloomington, Illinois: Public School Publishing Company, 1930.

67. Stull, J. Milton. "A Survey of the Arithmetic Achievement of the Seventh and Eighth Grades of the Hornell Junior High School." Unpublished Master's thesis, New York State College for Teachers, 1936. 39 pp.

68. Sweeney, Margaret E. "One Hundred Per Cent in the Fundamentals." Educational Method, XVI (January, 1937), pp. 170-174.

69. Uhl, W. L. "The Use of Standardized Materials in Arithmetic for Diagnosing Pupils' Methods of Work." Elementary School Journal, XVIII (November, 1917), pp. 215-218.

70. West, R. L., Greene, C. E., and Brownell, W. A. "The Arithmetic Curriculum." Twenty-Ninth Year Book of the National Society for the Study of Education, pp. 65-142. Bloomington, Illinois: Public School Publishing Company, 1930.

71. Wheat, Harry Grove. The Psychology and Teaching of Arithmetic. Boston: D.C.Heath and Company, 1937. x + 590 pp.

72. Williams, Claude L., and Whitaker, Ruth L. "Diagnosis of Arithmetic Difficulties." Elementary School Journal, XXXVII (April, 1937), pp. 592-600.

73. Wilson, Guy M. "Arithmetic and the Taxpayer." Journal of the National Educational Association, XX (1931), pp. 221-222.

74. _____. A Survey of the Social and Business Usage of Arithmetic. Teachers College Contributions to Education, No. 100. New York: Teachers College, Columbia University, 1919.

75. _____. Motivation of Arithmetic. Bureau of Education Bulletin No. 43, 1926. Washington: Government Printing Office.

76. _____. "New Standards in Arithmetic: A Controlled Experiment in Supervision." Journal of Educational Research, XXII (December, 1930), pp. 351-360.

77. _____. "Paying for Useless Arithmetic." Education, LV (March, 1935), pp. 428-430.

78. _____. Teaching the New Arithmetic. New York: McGraw - Hill Book Company, 1939. xi + 458 pp.

79. _____. "The Challenge of 100% Accuracy in the Fundamentals of Arithmetic." Educational Method, XV (November, 1935), pp. 92-96.

80. _____. "The Present Impasse in Arithmetic." Educational Method, XI (November, 1931), pp. 65-72.

81. Wilson, Guy M. "Corrective Load in the Fundamentals of Arithmetic in Grades 6, 7, and 8." The Role of Research in Educational Progress, pp. 234-241. Official Report of the American Educational Research Association, 1937.

82. _____. "Why Children Fail in Arithmetic." American Childhood, XXI (October, 1935), pp. 18,47,48.

83. _____. 100% Arithmetic Drill Book Series. New York: MacMillan Company, 1932.

84. _____, and Hanley, Gertrude L. "For Basic Drill in Arithmetic, What Norm or Average is Satisfactory?" Mathematics Teacher, XXXII (April, 1939), pp. 175-178.

85. _____, and Porter, Everett R. "In the Useful Fundamentals of Arithmetic is it Possible to Overcome Temporary Lapses in Ability Leading to Steady Increase in Error?" Journal of Experimental Education, V (September, 1936), pp. 71-74.

86. Yarbrough, Dorothy. "A Diagnosis of Pupils' Errors in Arithmetic with a View to Corrective Work Carried on Through the Cooperation of the Teachers." Unpublished Master's thesis, Boston University, 1938. 116 pp.

APPENDIX A

COPIES OF THE TESTS USED

THE WILSON INVENTORY AND DIAGNOSTIC TESTS IN ARITHMETIC

Score_____

Time_____

Test A P Addition Process Step Difficulties

(Form 2. Cooperation of Edward Soles, Gertrude Hanley, and Dorothy Yarbrough)

Name_____ Age_____ Grade_____ Building_____ City_____

To the Pupil: Add throughout this test.
If you hesitate, place a check (√).
If you count, double check (√√).
Note time when you start_____: when you stop_____

Directions for Scoring:
Each set counts for four points. The total score is 100.
All parts of (a) must be correct to merit the five points.

(a)	(b)	(c)	(d)
6 8 7 3 9 4 8 5 7 9 8 9 5 9 7 8 0 8 0 6	4 3 2 6 3	2 6 4 2 4	2 5 6 0 3

(e)	(f)	(g)	(h)	(i)	(j)	(k)
2 0 7 1 0 5 3	1 0 3 3 5 6 1 0	2 1 3 2 2 3 1 3	1 3 3 1 1 2 2 1 1 2	5 0 7 4 0 7 0 1	1 3 3 5 2 0 3 0 0	2 0 4 8 1 3 1 4 0 0

(l)	(m)	(n)	(o)	(p)	(q)	(r)
3 5 4 7 3 4 6 8	5 6 2 2 7 3 9 4	1 4 2 9 7 6 8	3 6 7 2 9 8 1 9 8	7 8 6 4 9 7 9 7 8	7 6 9 8 7 3 4 6 7 4	6 0 7 8 8 4 5 5 8 5

(s)	(t)	(u)	(v)	(w)	(x)	(y)
7 8 9 6 8 7 0 4 6	$1.2 0 .5 4 6.6 5 9.5 0 2.1 7	$3.7 9 8.9 4 3.4 8 .8 6 3.9 5	$5 6.5 4 4 9.5 3 4 4.8 6 6 4.0 2 8 1.3 2 4 4.0 5	$ .1 7 5.3 7 2.3 7 6.7 5 4.8 6	$7 6.4 5 8 1.8 7 5 8.4 6 5 6.5 8 4 6.7 9 3 7.4 9 8 8.0 0	$ .5 5 5.3 9 4.8 7 2.0 9 9.7 5

THE WILSON INVENTORY AND DIAGNOSTIC TESTS IN ARITHMETIC

Test S P Subtraction Process Step Difficulties

Name_____ Age_____ Grade_____ Building_____ City_____

To the Pupil: Subtract in this test.

If you hesitate, place a check (✓).
If you count, double check (✓✓).

Note time when you start_____: when you stop_____

(a)

8	7	9	5	8	7	9	7	6	9
7	0	3	0	5	4	6	7	0	8

(b)

10	14	17	10	13	15	12	11	13
6	5	8	4	5	7	3	2	7

(c)

67	837	37	864	58	98	425
51	426	22	632	31	58	325

(d)

84	736	92	1322	1133
34	336	62	997	766

(e)

1189
453

(f)

7558
3009

(g)

4282
120

(h)

715
236

(i)

6003
1400

(j)

4544
916

(k)

829
57

(l)

9261
4780

(m)

5341
2186

(n)

1400
1254

(o)

4700
1432

(p)

7849
1991

(q)

15098
8020

(r)

1491
843

(s)

1302
804

(t)

1276
897

(u)

$5.00
1.51

(v)

$55.40
42.25

(w)

$8.10
5.98

(x)

$25.10
17.05

(y)

$14.00
9.98

The score is the number right times 4. Score_____

Time_____

THE WILSON INVENTORY AND DIAGNOSTIC TESTS IN ARITHMETIC

Test M P Multiplication Process Step Difficulties

Name_____ Age_____ Grade_____ Building_____ City_____

To the Pupil: In this test, multiply.

If you hesitate, place a check (✓).
If you count or say the tables, double check (✓✓).

Note time when you start_____: when you finish_____

(a)	8 6	7 3	4 9	2 7	6 4	7 5	3 3	2 3	8 4	6 7	(b)	$3.65 × 6	(c)	501 × 6	(d)	$8.05 × 7
(e)	6 0	4 5	7 8	4 4	1 1	3 4	9 2	0 3	8 9	1 8	(f)	$7.40 × 6	(g)	$5.90 × 10	(h)	$700.95 × 4
(i)	71 × 17				(j)	362 × 21			(k)	93 × 47			(l)	92 × 56	(m)	93 × 89	(n)	$7.30 × 29
(o)	896 × 83				(p)	693 × 600			(q)	445 × 308			(r)	154 × 270	(s)	7081 × 509	(t)	$680. × 120
(u)	915 × 504				(v)	506 × 159			(w)	8302 × 805			(x)	1784 × 367	(y)	842 × 2100		

The score is the number right times 4.

Score_____

Time_____

APPENDIX B

COPY OF THE QUESTIONNAIRE SENT TO TEACHERS

A COPY OF THE QUESTIONNAIRE SENT TO THE TEACHERS OF THE EXPERIMENTAL GROUP

Dear Miss _____,

It will be very much appreciated if you will fill out the following concerning your work in connection with the remedial measures you are using in the arithmetic fundamentals.

Please place a check (✓) on the line below the word or phrase which indicates the extent to which you have used, or are using, a given method.

1. Self-diagnosis of their own faulty habits by pupils working aloud at the blackboard. Remedial questioning by the teacher to correct faults indicated in such self-analysis.

Very much	Considerable	Some	Very little	None
____	____	____	____	____

2. Discussion with each pupil of the most common errors that he made in each process.

Very much	Considerable	Some	Very little	None
____	____	____	____	____

3. Cooperative class work at the blackboard. One child works while others observe and check, or all pupils work and exchange observations and checking. The teacher present as a guide.

Very much	Considerable	Some	Very little	None
____	____	____	____	____

4. Teaching of, and insistence upon, checking, as an aid to accuracy.

Very much	Considerable	Some	Very little	None
____	____	____	____	____

5. Special daily drill exercises to eliminate errors and establish correct facts or processes.

Very much	Considerable	Some	Very little	None
____	____	____	____	____

6. Careful and detailed explanation of difficult processes in an effort to have children rationalize techniques as far as possible.

Very much	Considerable	Some	Very little	None
____	____	____	____	____

____	____	____	____	____

14. Note pupils' answers in regular work or in tests and make inference as to why such results were secured.

Very much	Considerable	Some	Very little	None
____	____	____	____	____

7. The use of individual graphs that the pupil may see his progress and strive to beat his own record.

Very much ____ Considerable ____ Some ____ Very little ____ None ____

8. Correction of common difficulties through general class instruction followed by exercises to establish correct fact or concept.

Very much ____ Considerable ____ Some ____ Very little ____ None ____

9. Games or devices to stimulate interest.

Very much ____ Considerable ____ Some ____ Very little ____ None ____

10. Incentive provided for correction of difficulties through a progress chart.

Very much ____ Considerable ____ Some ____ Very little ____ None ____

11. Pupil's name and difficulties catalogued in a teacher's class record of individual difficulties for the teacher's reference and study.

Very much ____ Considerable ____ Some ____ Very little ____ None ____

12. A record of errors made kept by each child for individual study.

Very much ____ Considerable ____ Some ____ Very little ____ None ____

13. Pupils having some difficulty come early in the morning or devote some other "private" time to the correction of their difficulties.

Very much ____ Considerable ____ Some ____ Very little ____ None ____

14. Note pupils' answers in regular work or in tests and make inference as to why such results were secured.

Very much ____ Considerable ____ Some ____ Very little ____ None ____

15. Have the pupils work orally and "think aloud" thus giving significant facts about the pupils' methods of work.

Very much	Considerable	Some	Very little	None
____	____	____	____	____

16. Have the pupil tell how he thought out a certain process, after the answer has been obtained.

Very much	Considerable	Some	Very little	None
____	____	____	____	____