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A Study of the Effect of Teaching Specific Reading Skills Peculiar to Arithmetic at the Third Grade Level

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A STUDY OF THE EFFECT OF TEACHING SPECIFIC READING SKILLS PECULIAR TO ARITHMETIC AT THE THIRD GRADE LEVEL

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CHAPTER I

THE INTRODUCTION

Much has been written to the effect that reading in arithmetic is more highly specialized than conventional reading. Varied opinions are set forth as to how and where the teaching of this specific type of reading is to be done. It is toward this matter that the present study is directed.

I. THE PROBLEM

Statement of the problem. It was the purpose of this study to attempt to show the need for teaching specific reading skills to further arithmetic understanding and achievement.

In the effort to establish evidence relevant to the problem the following hypothesis was tested:

Pupils who have been instructed in reading study skills necessary for working in arithmetic will not attain a higher mean achievement in arithmetic than pupils who have not been introduced to these reading study skills.

In view of the hypothesis, several assumptions regarding third grade level arithmetic were made.

First it was assumed that arithmetic was a content subject, complicated by its own unique reading skills.

Second, it was assumed that specific reading skills were necessary for successful arithmetic understanding and achievement.

Third, it was assumed that specific reading skills peculiar to arithmetic are better taught through direct study techniques than through incidental or indirect procedure.

Importance of the study. Of late there has been a great upsurge in the interest of mathematics. One of the old and chronic troubles has been that pupils could not read arithmetic materials with understanding. For many years educators have shown interest in the connection reading instruction has with this difficulty.

Research on the role of reading in arithmetic may be classified into three overlapping areas: (1) arithmetic and general reading ability, (2) arithmetic and vocabulary, and (3) arithmetic and specific reading skills. Russell (25:211) states that the last two have yielded higher correlations between scores of measured arithmetic ability and reading achievement. He further reports that research findings in the third area cannot be considered adequate.

In the Harvard Report on Reading, Austin and her associates (1:223) recommends "that a carefully planned reading program be undertaken in the content areas that would include the teaching of specific reading and study skills unique to each area." As cited by Russell, mentioned above, research findings are not adequate on the relations of these skills to arithmetic. Specific skills identified were not

consistent from study to study. Contradictory and inconclusive evidence was noted. The development of reading skills to further understanding of specialized content is a frontier for exploration.

Reading skills need to be presented and reinforced in the materials to which they are applicable. Pupils must have an awareness of the skill being taught. Practice with the purpose in mind finally should be offered in a printed form. When McKee (21:319) expands on listening and practice to develop reading skills, he states:

> In most lessons, however the practice material used should be given in printed form, with the pupil applying the ability being taught to the reading matter.
>
> Only when the practice material is presented as reading matter does the pupil have the time and opportunity to do the analyzing--the scratching and clawing--that is essential to acquiring the ability being taught.

In the opportunities offered in the experimental teaching described in this study, an effort was made to provide practice of specific reading skills necessary to arithmetic.

II. DEFINITION OF TERMS

Mathematics. A science of numbers and space configurations. This term is used in the study as it denotes contemporary materials. Otherwise it is only used as other writers incorporate the word mathematics.

Arithmetic. A branch of mathematics that deals with real numbers and computations with them. This term is generally used throughout the study.

Content subject. Any subject other than reading.

Reading study skills peculiar to arithmetic. Those specific abilities that are necessary to use arithmetic knowledge effectively.

III. LIMITATIONS OF THE STUDY

Findings in this study are limited to the following:

1. The time spent in experimental teaching was only eight weeks.

2. There was no provision to measure long-range effects of the variables; i.e., the effect of the variables over a period of one or more years.

3. No attempt was made in securing data to control the Hawthorne effect.

IV. SCOPE AND PROCEDURE

This study involved testing and matching two similiar groups of third grade children in the Pasco schools. One class served as the experimental group receiving specific instruction in those reading skills essential to the area of

arithmetic. A matched pair control group was selected randomely from five other classes. A study was made of the achievement of both groups after testing.

The two groups were compared on the basis of a pre-test post-test situation. The experimental group received approximately eight weeks of instruction designed to improve their reading ability in arithmetic materials. Statistical techniques were applied to determine if the growth in arithmetic achievement was statistically significant.

CHAPTER II

REVIEW OF THE LITERATURE

Some writers believe that there exists a definite relationship between certain reading abilities and success in problem solving. Research has not clearly demonstrated how these skills affect understanding and achievement. Presented here are summaries of opinions and research that are related to the present study on the effect of teaching reading skills peculiar to arithmetic at the third grade level.

I. LITERATURE ON ARITHMETIC AND RELATED READING SKILLS

Authors of methods textbooks on both the teaching of reading and arithmetic, present different viewpoints. However, the majority of criteria substantiates the need for special handling of arithmetic content. Spitzer says:

> In the literature on problem solving there is frequent mention of the importance of teaching pupils to read problems. However the suggestions or lack of them in pupil textbooks, professional books, or in other written material on arithmetic teaching would indicate that there are no adequate procedures for the teaching of this desirable ability (31:258).

On the other hand, Spitzer itemizes specific abilities and generalized qualities that are mandatory for success in problem solving. They would require knowledge of specialized reading for development. In his plea for orally presented problems, he identifies one skill as reading comprehension and equates it with listening.

Grossnickle sets forth the need of inferior problem solvers for systematic instruction in "specific reading skills peculiar to arithmetic." (15:320) A detailed listing of reading skills that are used in a comprehensive program of elementary school mathematics, is included in his work. They include: (1) ability to read numbers and comprehend their meaning; (2) reading used in learning number operations; (3) knowledge of the vocabulary of arithmetic; (4) basic skills involved in reading and solving verbal textbook problems; (5) reading skills involved in using the quantitative aids and measuring devices; (6) reading and interpretation of statistical tables, graphs, and quantitative elements of descriptive figures; and (7) reading skills involved in securing information about assignments in the study of social applications of arithmetic. Grossnickle further explored the implementation of methods. He states that good and poor problem solvers are not significantly different in general reading skills used in literary reading but that they do differ significantly in special reading skills required in arithmetic; namely, in ability to follow steps in problem solving.

Reading authors identify compactness of material as a major factor in difficulty of arithmetic. By compactness it is meant that the context is written so that every word

is important to the meaning. Therefore, it is essential that the reader must recognize precise ideas, as well as words, and understand their relationships as he proceeds. Nila B. Smith (29:347-9) lists compactness, reading numerical symbols, and weighing relationships as factors that make arithmetic unique. Tinker and McCullough (33:233) expanded on compactness. They present the needs of successful problem solvers as careful reading, observing facts, and seeing relationships. Strang (32:ch vii) devotes a chapter to identifying specific reading skills in the areas of mathematics and science. Methods of how each one could be taught and reinforced as well as concrete helps for reading difficulty textbooks are offered. Strang further contends that maintenance of reading skills is only possible if they are constantly reinforced by every teacher in his own classroom.

Seldom has consideration been given to the necessity of suiting arithmetic material to the reader's level. Some authorities emphasize that there is need to publish texts geared to a variety of reading levels which incorporate "new" mathematics principles. Heddens and Smith (19:391-394) say that we should consider both the reading level of the users of the texts and the material. They suggest that printed matter be one level lower than where the material is to be used. In answer to letters regarding previous publications, Smith (28:355) indicated that only as reading difficulty in

mathematics text materials is "considered and adjusted will there be lessening of the confounding of reading achievement and proficiency." He further states that teachers need to train students in the efficient reading of mathematics materials.

Too much carry over from general reading instruction has been assumed. McKee (21:360), in commenting on the reading study-jobs, warns against incidental and haphazard teaching. He recommends: (1) that definite lessons be planned to teach how to use reading skills as well as providing practice in them; (2) that the content subjects be taught in a way that requires the pupil to use the skills, and (3) that the teaching of the lessons in the content area can tie the skill closely to the subject matter.

In the Harvard Report on Reading, (1:51) Austin and her associates state that some "teachers expected a transfer of training whereby the skills hopefully taught in the developmental reading lessons would be applied independently and efficiently to the content subject material." They recommend that children should be taught how to read in the content subjects. They also point out that reading materials in the content areas lend themselves to the effective teaching of certain reading skills.(1:224)

II. LITERATURE ON RESEARCH STUDIES THAT CONNECT NEED OF SPECIFIC READING INSTRUCTION IN ARITHMETIC

In 1944 two studies gave evidence regarding specific reading skills. Hanson (17:111-117) found no significant difference between good and poor problem solvers in reading comprehension abilities. He states that general vocabulary and general reading are not essential for verbal problem solving in arithmetic but that reading skills and vocabulary in arithmetic are specific in that field. The majority of his reading tests were lacking in quantitative content. A recommendation was made for further study using materials that would be definitely "mathematical in nature".

The clearest evidence of need for specific work in reading is that of Treacy (34:86-98). With the effects of mental age removed, he found significant differences between good and poor problem solvers in 9 out of 15 reading and language abilities. An implication from his study is that reading as related to arithmetic should be regarded as a composite of specific skills rather than a generalized ability.

A later study done by Fay (10:541-547) appears to conflict with Treacy until it is realized that he is not testing the same reading abilities. He finds that with the effects of chronological and mental age eliminated, arithmetic

was not specifically related to that group of reading abilities essential to the area of social studies. He expresses the view that training in reading skills more directly related to the demands of arithmetic would prove significant to achievement in that area.

III. LITERATURE ON RELATED STUDIES INVOLVING VERBAL PROBLEMS

This study attempted to show the need for teaching specific reading skills as they involve both verbal and symbolic materials in the area of mathematics. Several recent studies refer to verbal problems. The concern here was for problems of that nature as well as all of arithmetic.

Vanderlinde (35:148) showed significant gain on tests of arithmetic problem solving and concepts. His subjects studied quantitative vocabulary on an experimental basis and were compared with classes that left this instruction to chance.

Irish (20:169-180) tested results of teaching: (1) to develop ability to generalize the meanings of number operations and the relationships among the operations, and (2) to develop an ability to formulate original statements to express the generalizations as they are attained. This study continued for two years with 10 per cent of the arithmetic instructional time devoted to verbalizing. Both years showed

statistically significant growth for the experimental teaching. It was Irish's aim to develop teaching procedure to make computation skill more functional in solving verbal problems.

Six procedures for improving verbal problem solving were reported in Riedesel's study (24:312-316). His materials were designed on two reading levels with test presentations on tapes. Significant improvement was noted; however, there could be questions as to whether the specific procedures or the attempts to individualize the instruction contributed to the growth.

IV. LITERATURE ON OTHER RELATED RESEARCH

Scott (27:322-326) made a study to show the relationship of intelligence and reading achievement with arithmetic, social studies and science. She found a positive correlation, not attributable to intelligence, between reading gain and gain in arithmetic reasoning. One recommendation for the teaching of reading skills and its related practice was that it should be directly related to the curriculum area.

Grossnickle (16:12-17) in a recent article presents a view that problem solving is characterized by levels of maturity. A plan for discovering a pattern to use in solving problems should be offered as a standard form. Namely, his points are: (1) identify the question; (2) recognize the

operation; (3) write the mathematical sentence; (4) find the missing number; (5) check the solution; (6) label. Short cuts and different patterns are indicative of growth.

Flourney (11:214-217) reports the need for systematic guidance in using operational relationships as efficient ways to think. She reported: (1) 25.5 per cent of her subjects using appropriate operation; (2) 12.2 per cent having no meaningful approach; and (3) 62.3 per cent relying on trial and error. The latter group showed weak computation. As a corrective measure, she urges developing concretely those essential reading skills and the translation of them into mathematical terms at each grade level and furthermore that these skills should be stressed continually throughout the grades.

Balow (2:18-22) in a study on reading and computation ability as determinants of problem solving, reports that general reading ability does not have an effect on problem solving. The subjects studied were representative of all levels of achievement in arithmetic. (However, the intelligence was held constant.) An interesting observation was that reading difficulty and vocabulary, as they are controlled in standardized tests, minimize the effect of reading. If a more normal mathematical reading situation were employed, reading skill might be more important. For any given level of computation, problem solving increases as reading ability

increases. It is important to consider children's reading ability as well as their computation ability when teaching problem solving skills.

The final work that will likely have bearing on the current study is that reported by Begle, (3:388-89) Director of S.M.S.G., for the National Longitudinal Study of Mathematical Abilities. Because a study of the effectiveness of education needs to consider the development of the student, NLSMA is making a five-year study. They are inventorying variables which affect mathematical learning. They began in 1962 to store data on master tapes. At the present 59 variables have been listed with space left to add more during the remaining years of the study. It will be of interest to note any recommendations that will be made to the effect of teaching reading as an element in aiding mathematics.

V. SUMMARY OF LITERATURE

Findings in current writings corroborate the need for the present study. The literature reported in this chapter supports the following: (1) Certain relationships exist between arithmetic and reading. (2) Reports indicate need for specific reading instruction in the area of arithmetic. (3) Reading skill development directly affects measured arithmetic achievement.

CHAPTER III

COLLECTION OF DATA

In an attempt to show need for teaching specific reading skills to further arithmetic understanding and achievement, the matched-pairs technique was used. Two similiar groups of third grade children were selected in the Pasco schools. One class served as the experimental group receiving specific instruction designed to improve their reading ability in the area of arithmetic.

The subjects were matched on the basis of sex, mental maturity, and arithmetic achievement. Schools were selected that had populations with similiar socio-economic backgrounds. In November, 1964, the Lorge-Thorndike Intelligence Tests, Level 2, were administered to all third grade pupils in three buildings in the Pasco schools. It was determined before any further pre-testing to eliminate a classroom that was to have a teacher replacement and the classroom adjacent to the experimental group. Five groups remained from which to locate the control subjects for each matched pair.

No suitable standardized testing instrument was available to test the objectives of a modern arithmetic program at the third grade level. Kindergarten through Grade Three in the Pasco schools were all using the Greater Cleveland Mathematics program materials. All pupils had been

involved at least one year previously and the pilot classes two years. The pilot classes were not held intact after the 1962-1963 experimental year. The best measure of arithmetic understanding and achievement in the Pasco schools at the time of the study was the Greater Cleveland Mathematics Tests published by Science Research Associates, Inc. This test was the one used.

The Greater Cleveland Mathematics Tests Form 3-1A was administered in December, 1964. The results yielded scores for Part I: Concepts; Part IIA: Problem Solving Analysis; Part IIB: Problem Solving-Solution; and Part III: Computation. Scores secured from the mathematics tests and the intelligence test comprised the pre-test data used to determine the control group. Post-test data consisted of scores on the Greater Cleveland Mathematics Test Form 3-3A which were administered in April, 1965.

The teachers of the six classrooms were informed at the outset that the data were to be used in a study. The nature of the study was not disclosed. It was also ascertained that the six classes were moving at approximately the same rate through the arithmetic materials. Testing dates were arranged by school administrators. Otherwise, the teachers of classes containing control pupils were left to proceed as usual in their teaching.

The lessons planned and used in the instruction of the experimental group are found in the appendix of this

report. They are brief, containing samples of the kind of activity used for each lesson. It was not the purpose of this study to develop curriculum of reading skills, but to make a comparison to show the effect of the teaching of these reading skills.

The skills developed in lesson plans were selected from the outline of reading skills that are used in a well rounded program of elementary school mathematics as set forth by Grossnickle and Brueckner. (15:319) The final criterion for the selection of a specific topic was its appearance in the curriculum outline of the Greater Cleveland Mathematics Program. (14:1) This procedure resulted in the selection of the following 16 topics that were developed into lessons with activities that required two to three days for their completion.

1. Reading and Comprehending Numbers
2. Significance of 0 in Numerals
3. Reading Used in Learning Operational Symbols
4. Vocabulary of Arithmetic
5. Quantative Vocabulary and Social Application of Arithmetic Involving Money
6. Story Problems: Isolate the Facts
7. Story Problems: What Does the Problem Ask?
8. Facts in Problem--Other Needed Information
9. Is Answer Sensible?
10. Irrelevant Material
11. Estimating an Answer
12. Locating Information in Accompanying Table
13. Using Quantative Aids
14. Reading Graphs
15. Fractional Parts and Relationships
16. Securing Information about Assignments in the study of Social Applications of Arithmetic

These lessons were not to require more than twenty minutes daily. An attempt was made to reinforce the materials in later developed lessons and in the regular arithmetic period.

The lessons used in teaching reading skills peculiar to arithmetic were designed to draw upon experiences of the class and individual members. Problematical activities were personal to the pupils whenever possible. Teaching techniques were used to foster feelings of progress and success.

Post-test data used in determining if the growth in arithmetic achievement was statistically significant were the scores from the Greater Cleveland Mathematics Tests Form 3-3A. They were administered to the six classes in April, 1965 as a final step in the experiment.

Pre-test and post-test scores of the boys of both the experimental and control groups are given in Table I, located on page 20. The similar data for girls are given in Table II, located on page 22.

To facilitate the matching and analysis of the data in this study, the pupils were divided on the basis of sex. Tables I and II show the subjects in matched pairs. They were further matched on the basis of total arithmetic achievement, as given in the pre-test scores, and mental maturity. Pairs presented in Tables I and II are arranged from the lowest to the highest according to mental age.

The arithmetic scores on concepts, problem-solving

analysis, problem-solving solution, computation and the total scores on both pre-tests and post-tests are shown. Composite raw scores as well as subtest scores were tabulated and analyzed in the search for statistically significant differences in means. Means and standard deviations were determined for the composite and subtest raw scores for both groups and by-sex within each group. The t-test was applied to determine any statistically significant differences between means.

TABLE I

RESULTS FROM THE GREATER CLEVELAND MATHEMATICS TEST

BOYS--EXPERIMENTAL AND CONTROL*

	Pre-test Form 3-1A					Post-test Form 3-3A				
Code Number	Concepts	Problem Solving Analysis	Problem Solving Solution	Computation	Total Score	Concepts	Problem Solving Analysis	Problem Solving Solution	Computation	Total Score
1ME	10	5	4	10	29	6	2	4	9	21
1MC	8	5	4	11	28	9	2	3	6	20
2ME	8	4	5	9	26	10	2	4	7	23
2MC	9	2	3	11	25	9	2	3	7	21
3ME	10	4	5	11	30	11	4	5	9	29
3MC	10	4	5	12	31	8	3	3	7	21
4ME	9	1	2	9	21	5	4	3	7	19
4MC	6	3	2	9	20	8	2	4	6	20
5ME	11	5	5	12	33	11	5	5	10	31
5MC	11	4	5	12	32	11	5	3	10	29
6ME	9	2	3	7	21	5	4	3	8	20
6MC	9	3	1	7	20	5	2	2	6	15
7ME	11	4	5	12	32	11	5	5	10	31
7MC	10	4	5	12	31	8	5	5	10	28
8ME	8	3	3	12	26	8	4	5	8	25
8MC	11	4	2	11	28	8	3	2	5	18

TABLE I (continued)

9ME	9	4	5	11	29	11	3	4	9	27
9MC	10	2	4	12	28	10	2	2	10	24
10ME	10	5	5	12	32	11	5	5	10	31
10MC	11	5	5	12	33	7	4	4	8	23
11ME	11	4	4	12	31	11	5	3	8	27
11MC	11	4	5	11	31	10	5	5	8	28
12ME	9	5	4	12	30	11	5	3	9	28
12MC	9	3	5	8	25	9	4	3	8	24
13ME	10	5	5	12	32	10	5	5	9	29
13MC	10	5	5	12	32	10	5	5	9	29
14ME	10	4	4	11	29	9	5	5	9	28
14MC	10	2	5	11	28	11	4	4	8	27
*Correct Answers Possible:										
	11	5	5	12	33	11	5	5	10	31

TABLE II

RESULTS FROM THE GREATER CLEVELAND MATHEMATICS TEST

GIRLS--EXPERIMENTAL AND CONTROL*

	Pre-test Form 3-1A					Post-test Form 3-3A				
Code Number	Concepts	Problem Solving Analysis	Problem Solving Solution	Computation	Total Score	Concepts	Problem Solving Analysis	Problem Solving Solution	Computation	Total Score
1FE	3	1	1	0	5	3	4	0	6	13
1FC	2	1	2	7	12	4	1	0	5	10
2FE	6	1	4	11	22	6	3	3	9	21
2FC	8	2	1	10	21	4	2	1	7	14
3FE	7	3	2	7	19	4	2	1	8	15
3FC	4	0	3	11	18	3	3	2	4	12
4FE	2	0	1	7	10	6	2	0	9	17
4FC	6	1	1	9	17	5	1	1	6	13
5FE	6	2	1	10	19	5	3	2	7	17
5FC	5	4	3	7	19	4	2	3	3	12
6FE	6	3	3	11	23	8	2	1	8	19
6FC	8	4	3	8	23	7	1	1	5	14
7FE	9	4	2	12	27	10	5	4	9	28
7FC	9	2	4	11	26	8	1	3	8	20

TABLE II (continued)

8FE	11	4	5	11	31	9	3	5	8	25
8FC	9	4	5	12	30	8	3	4	7	22
9FE	7	4	5	9	25	5	2	3	8	18
9FC	7	0	5	12	30	6	2	3	8	19
10FE	9	4	4	11	28	8	5	2	9	24
10FC	10	4	4	11	29	9	3	2	7	21
11FE	10	5	4	12	31	8	3	4	9	24
11FC	11	4	4	9	28	7	2	4	8	21
12FE	9	0	1	8	18	6	2	3	8	19
12FC	7	1	3	7	18	7	4	1	4	16
13FE	9	2	1	9	21	3	4	3	6	16
13FC	7	1	3	9	20	6	3	4	4	17
14FE	11	4	4	9	28	9	3	3	9	24
14FC	10	4	4	11	29	9	4	4	10	27
15FE	8	3	2	8	21	8	5	3	8	24
15FC	7	3	4	11	25	9	2	1	7	19
16FE	7	2	4	11	24	8	3	4	8	23
16FC	9	3	1	11	24	6	2	3	8	19
*Correct Answers Possible:										
	11	5	5	12	33	11	5	5	10	31

CHAPTER IV

ANALYSIS OF DATA

The primary concern of the study was to attempt to show the need for teaching reading study skills to further arithmetic understanding and achievement. The t-test of significance was used to test the hypothesis that pupils who have been instructed in reading skills necessary for working in arithmetic would not attain a higher mean achievement in arithmetic than pupils who have not been introduced to these reading study skills.

Table III, found on page 25, presents the means and standard deviations for all pre-test and post-test scores of both the experimental and control groups.

A cursory survey of the pre-test data indicates that the means favored the control group on subtests of problem solving solution and computation, as well as composite raw score of arithmetic achievement. The means favored the experimental group on pre-test scores on problem solving analysis and arithmetic concepts. The difference in means on the pre-test composite raw scores of arithmetic achievement was .07.

In the post-test data the means of all subtests as well as that of the composite raw score favored the experimental group. The difference in means on the post-test composite raw scores of arithmetic achievement was 2.90.

TABLE III

MEANS AND STANDARD DEVIATION ON GREATER CLEVELAND MATHEMATICS TESTS

	Concepts	Problem Solving Analysis	Problem Solving Solution	Computation	Total Score	N
Total Experimental						
Pre-test Form 3-1A						
Mean	8.50	3.23	3.43	9.60	25.10	30
Standard Deviation	2.24	1.52	1.48	2.52	6.60	30
Post-test Form 3-3A						
Mean	7.87	3.63	3.33	8.37	23.20	30
Standard Deviation	2.56	1.19	1.48	1.03	5.11	30
Total Control						
Pre-test Form 3-1A						
Mean	8.47	2.93	3.53	10.23	25.17	30
Standard Deviation	2.24	1.57	1.41	1.76	5.37	30
Post-test Form 3-3A						
Mean	7.50	2.83	2.90	7.07	20.30	30
Standard Deviation	2.18	1.29	1.37	1.89	5.47	30

The data might lead the reader to think that all of the subjects had digressed in the interval between the testings without noting the following: (1) The total possible raw score on the pre-test was 33 while the total possible raw score on the post-test was 31. The pre-test had 12 items on the test of computation while the post-test had only 10. (2) The tests that were administered were a unit achievement type with the pre-test measuring teaching from previous years and a minimum of third grade objectives. The post-test measured the accumulated knowledge plus a majority of the specific objectives outlined for third grade.

Table IV, found on page 28, gives the means and standard deviations for all pre-test and post-test scores of both experimental and control girls and experimental and control boys.

The means on pre-test scores favored the control girls on sub-tests of problem solving solution and computation as well as the composite raw score of arithmetic achievement. The experimental girls show higher mean scores on problem solving analysis and arithmetic concepts.

The difference in means on pre-test composite score of arithmetic achievement was .69 in favor of the control girls.

The post-test scores yielded means that favored the

experimental girls on all sub-tests as well as the composite raw score. The difference in means of post-test composite scores of arithmetic achievement was 3.25 in favor of the experimental girls.

The means on pre-test scores were identical on arithmetic concepts for the experimental and control boys. The means favored the experimental boys on the subtests of problem solving analysis, problem solving solution, and computation as well as the composite raw score. The difference in means on the score of arithmetic achievement was .68 in favor of the experimental boys.

The post-test scores produced means that favored the experimental boys on all sub-tests as well as the composite raw score. The difference in means of post-test composite scores of arithmetic achievement was 2.50.

Table V, found on page 29, includes results on the t-test of significance of differences between the means of the post-test scores for the experimental and control groups.

As indicated in Table V, the following findings are evident:

1. The difference on a post-test of arithmetic achievement was found to be statistically significant at the .05 level of confidence in favor of the experimental group.

TABLE IV

MEANS AND STANDARD DEVIATIONS ON GREATER CLEVELAND MATHEMATICS TESTS

	Concepts	Problem Solving Analysis	Problem Solving Solution	Computation	Total Score	N
Experimental Girls						
Pre-test Form 3-1A						
Mean	7.50	2.63	2.75	9.13	22.00	16
Standard Deviation	2.56	1.67	1.53	2.94	7.03	16
Post-test Form 3-3A						
Mean	6.63	3.19	2.56	8.06	20.44	16
Standard Deviation	2.09	1.11	1.46	1.00	4.27	16
Control Girls						
Pre-test Form 3-1A						
Mean	7.44	2.38	3.13	9.75	22.69	16
Standard Deviation	2.37	1.41	1.72	1.77	5.11	16
Post-test Form 3-3A						
Mean	6.38	2.25	2.25	6.31	17.19	16
Standard Deviation	2.00	1.00	1.29	1.96	4.56	16
Experimental Boys						
Pre-test Form 3-1A						
Mean	9.64	3.93	4.21	10.86	28.64	14
Standard Deviation	1.01	1.21	.98	1.56	3.90	14
Post-test Form 3-3A						
Mean	9.29	4.14	4.21	8.71	26.36	14
Standard Deviation	2.33	1.10	.89	.99	4.13	14
Control Boys						
Pre-test Form 3-1A						
Mean	9.64	3.57	4.00	10.79	28.00	14
Standard Deviation	1.40	1.08	1.41	1.63	4.21	14
Post-test Form 3-3A						
Mean	8.79	3.50	3.64	7.93	23.86	14
Standard Deviation	1.63	1.29	1.08	1.44	4.16	14

TABLE V

RESULTS FROM THE t-TEST OF SIGNIFICANCE
(TOTAL GROUP)

	Group	N	Obtained Means	S	S Dm	Obtained t	Required t
Concepts	Experimental	30	7.87	2.56	.61	.61	2.01(.05)
	Control	30	7.50	2.18			
Problem Solving Analysis	Experimental	30	3.63	1.19	.32	2.50	2.01(.05)*
	Control	30	2.83	1.29			
Problem Solving Solution	Experimental	30	3.33	1.48	.37	1.16	2.01(.05)
	Control	30	2.90	1.37			
Computation	Experimental	30	8.37	1.03	.39	3.33	2.68(.01)**
	Control	30	7.07	1.89			
Total Score	Experimental	30	23.20	5.11	1.37	2.12	2.01(.05)*
	Control	30	20.30	5.47			

*Significant at the .05 level of confidence
**Significant at the .01 level of confidence

2. The difference in mean scores on the post-test of problem solving analysis was statistically significant at the .05 level of confidence. The difference in mean score for computation was statistically significant at the .01 level.

3. The difference in mean scores on the post-test of problem solving solution and concepts were not statistically significant, although the higher means in both instances favored the experimental group.

Table VI, found on page 31, gives the results of the t-test applied to the post-test data for the boys.

No statistically significant differences between the means were found. The trend was strongly in favor of the experimental group.

Table VII, found on page 32, presents the results of the t-test applied to the data for the girls.

From Table VII, the following findings are indicated:

1. The difference in means on a post-test of arithmetic achievement was found to be statistically significant at the .05 level of confidence in favor of the experimental group.

2. The difference in mean scores on the post-test of problem solving analysis was statistically significant at the .05 level of confidence. The difference in mean score for computation was statistically significant at the .01 level.

3. The difference in means on a post-test of problem solving solution and concepts were not statistically

significant, although the higher means in both cases favored the experimental group.

TABLE VI

RESULTS FROM THE t-TEST OF SIGNIFICANCE
(BOYS)

	Group	N	Obtained Means	S	S Dm	Obtained t	Required t
Concepts	Experimental	14	9.29	2.33	.76	.66	2.06(.05)
	Control	14	8.79	1.63			
Problem Solving Analysis	Experimental	14	4.14	1.10	.45	1.42	2.06(.05)
	Control	14	3.50	1.29			
Problem Solving Solution	Experimental	14	4.21	.89	.37	1.54	2.06(.05)
	Control	14	3.64	1.08			
Computation	Experimental	14	8.71	.99	.47	1.66	2.06(.05)
	Control	14	7.93	1.44			
Total Score	Experimental	14	26.36	4.13	1.57	1.59	2.06(.05)
	Control	14	23.86	4.16			

TABLE VII

RESULTS FROM THE t-TEST OF SIGNIFICANCE
(GIRLS)

	Group	N	Obtained Means	S	S Dm	Obtained t	Required t
Concepts	Experimental	16	6.62	2.09	.72	.33	2.04(.05)
	Control	16	6.38	2.00			
Problem Solving Analysis	Experimental	16	3.19	1.11	.37	2.54	2.04(.05)*
	Control	16	2.25	1.00			
Problem Solving Solution	Experimental	16	2.56	1.46	.48	.65	2.04(.05)
	Control	16	2.25	1.29			
Computation	Experimental	16	8.06	1.00	.55	3.18	2.75(.01)**
	Control	16	6.31	1.96			
Total Score	Experimental	16	20.44	4.27	1.56	2.08	2.04(.05)*
	Control	16	17.19	4.56			

*Significant at the .05 level of confidence
**Significant at the .01 level of confidence

Table VIII shows results of the t-test of significance of differences in means of experimental boys against experimental girls.

TABLE VIII

RESULTS FROM THE t-TEST OF SIGNIFICANCE
(EXPERIMENTAL BOYS AGAINST EXPERIMENTAL GIRLS)
(CONTROL BOYS AGAINST CONTROL GIRLS)

	Group	N	Obtained Means	S	S Dm	Obtained t	Required t
Total Score	Experimental Boys	14	26.36	4.13	1.54	3.84	2.76(.01)**
	Experimental Girls	16	20.44	4.27			
Total Score	Control Boys	14	23.86	4.16	1.59	4.19	2.76(.01)**
	Control Girls	16	17.19	4.56			

**Statistically significant at the .01 level of confidence

The difference in means of the composite scores was statistically significant for the boys at the .01 level of confidence. Testing for differences in means of the control boys against the control girls finds the mean scores of the control boys also statistically significant at the .01 level.

Findings in Table VIII led the investigator to analyze the pre-test data to ascertain if the boys were statistically

superior to the girls at the outset of the study. Table IX shows the difference between means for boys and girls for both the experimental and control groups.

TABLE IX

RESULTS FROM THE t-TEST OF SIGNIFICANCE
(EXPERIMENTAL BOYS AGAINST EXPERIMENTAL GIRLS)
(CONTROL BOYS AGAINST CONTROL GIRLS)

	Group	N	Obtained Means	S	S Dm	Obtained t	Required t
Total Score	Experimental Boys	14	28.64	3.90	1.54	3.21	2.76(.01)**
	Experimental Girls	16	22.00	7.03			
Total Score	Control Boys	14	28.00	4.21	1.70	3.12	2.76(.01)**
	Control Girls	16	22.69	5.11			

**Statistically significant at the .01 level of confidence

As indicated in Table IX, the difference between the means favored the experimental boys and was statistically significant at the .01 level of confidence. The control data gives a statistically significant difference in mean scores that also favored the boys at the .01 level.

In the pre-test data a greater statistically significant

difference between means of experimental boys and experimental girls existed than that of the control boys against control girls. Comparison of experimental pre-test means shows a difference of 6.64 favoring the boys while the difference in control means show 5.31 favoring the boys.

Comparison of Tables VIII and IX shows both experimental boys and control boys were statistically superior to the girls in their respective groups. On post-test scores the difference in mean scores between sexes shows a lesser t-score for experimental boys than control boys. The experimental boys degree of statistical significance had advanced .63. The control boys had advanced 1.07.

The difference in mean scores between experimental boys and experimental girls on the post-test scores was 5.92. The difference in post-test scores between control boys and control girls was 6.67. Comparison of the differences of the means between the pre-test and post-test indicated that the experimental group had reduced the spread between the boys and girls by .72. A similar comparison for the control group showed the difference between means for the two sexes had increased by 1.36.

As shown in Table V, found on page 29, the difference in means of composite raw scores were statistically significant in favor of the experimental group at the .05 level of

confidence. The mean of the experimental girls more closely approximated the mean of the experimental boys, while the gap in the arithmetic achievement of the control group widened.

This analysis tends to indicate that the experimental instruction was more effective with girls than boys. The subjects were paired on the basis of mental age; however, the mean mental age in months of the experimental girls was 107 and that of the boys was 121.7. The mean score of arithmetic achievement on the pre-test was 22 for experimental girls as compared to 28.6 for the boys. The girls were a less able group both in measured mental ability and arithmetic achievement.

CHAPTER V

SUMMARIES AND CONCLUSIONS

Summary of the Study. A matched-pairs technique was used to locate similar groups of children in the third grade in the Pasco schools. Purposeful instruction in reading skills essential to the area of arithmetic was listed by topic in Chapter III of this study. Outlines for lesson plans are given in the Appendix. The arithmetic achievement of both groups was studied following the final testing which was conducted after an approximate eight-week period of teaching.

Summary of Findings. On the basis of the previously described comparison of the findings in this study, it was indicated that when intelligence and arithmetic achievement were similar, significant growth followed as a result of direct study of reading skills. Statistically significant mean scores in arithmetic achievement at the .05 level of confidence were shown when an experimental class that had received this instruction was compared with a group that had not studied in this way.

Conclusions. In the present study the following hypothesis was tested:

Pupils who have been instructed in reading study

skills necessary for working in arithmetic will not attain a higher mean achievement in arithmetic than pupils who have not been introduced to these reading study skills.

The difference in means on a post-test of arithmetic achievement was found to be statistically significant in favor of the experimental group at the .05 level of confidence. On the basis of these findings the investigator rejected the hypothesis.

This study demonstrated that the teaching of reading skills peculiar to arithmetic was accompanied by significantly higher mean scores on post-tests in arithmetic achievement. From these findings one may not assume that a causal relationship exists between the experimental teaching and the significantly higher achievement in the experimental group. A statistical relationship has been shown to exist and has implications for further study.

On the basis of the statistical analysis of the data obtained in this study, the following conclusions appear to be warranted.

Pupils who received instruction in the reading skills described in this study achieved significantly higher scores on an arithmetic achievement test than pupils who did not receive similar teaching.

Pupils who received instruction in the reading skills

described in this study achieved significantly higher scores on tests in problem solving analysis and computation but did not achieve significantly higher scores on tests in concepts and problem solving solution.

There is a definite trend throughout the data that the experimental group achieved higher in all categories measured in the post-test.

Effective work on reading skills peculiar to arithmetic can be made a part of the arithmetic program without sacrificing pupil achievement in arithmetic.

The experimental lessons were more effective with girls than with boys.

The experimental lessons were more effective with lower ability individuals.

Noticeable gains were apparent to the investigator that were not measured. Certain generalized qualities necessary for success in arithmetic appeared to strengthen as the lessons progressed.

The experimental class developed a better orientation for arithmetic. Some individuals gained more confidence. They became eager to respond in group activities. Others learned to value their own efforts as they grew in persistence after failure. A timid few began to surrender the idea that arithmetic was too difficult. More girls showed

evidences of growth in confidence and perserverence. Their significant gains bear out the observation.

Throughout and following the presentation of the experimental lessons more individuals tried the supplemental work provided to challenge in the regular arithmetic program. Some were observed working problems by unorthodox means, probably as a direct result of our working on making estimates.

Parents were unaware of the experimental procedure. Some conferences included a voiced approval of pupil improvement particularly in verbal problems.

Enthusiasm soared as the personalized problems appeared in the practice materials. Games and visual materials were gainfully enjoyed by the class likely contributing to their excellent attendance. The appearance of a child's experience or those of his family or club in our work inspired him to do better. None of these activities could likely have been as rewarding had not reading matter material been given as opportunity to attain greater skills.

The investigator does not wish to imply that the Greater Cleveland Mathematics Program materials do not provide exercises in their teacher's guides for reading skills peculiar to arithmetic. Their guides are very complete. However, unless the user is aware that he is teaching distinct reading skills and their importance, he might neglect this

area. Help could be provided to orient teachers on how to implement the guides. In-service sessions could be held to make suggestions.

Time is believed to have been a factor in the lack of significance in mean score in problem solving solution on the post-test. The gain in mean scores in problem solving analysis and computation suggests if further instruction were given, a greater mean gain in problem solving solution might follow.

Mathematical concepts tested were those that were a vital part of the Pasco curriculum. The guides are very specific as to their presentation. The study tends to show that the groups were similarly instructed in this respect with similiar growth. Identical materials and the same rate of coverage might produce such results.

Certainly the work as described in the lessons in the appendix did not result in a sacrifice to the arithmetic program. The findings show the class who experienced the designated materials could analyze problems and compute much better.

The findings from this experiment suggest a number of implications for arithmetic instruction within the classroom and for arithmetic curriculum development in general.

1. Reading skills peculiar to arithmetic should be made an integral part of the arithmetic program.

2. The study of reading skills peculiar to arithmetic should be begun early in the elementary school certainly in third grade, preferably as early as grade one.

3. Pupils should be provided with opportunities to utilize their special reading skills in other areas such as social studies or science.

4. Use should be made of personal experiences framed into problems to provide stimulating activities to teach reading skills peculiar to arithmetic.

5. Materials used in exercises to develop reading skills in arithmetic should be interesting yet easy enough to insure success.

6. Pupils who do not have knowledge of reading skills peculiar to arithmetic will be less likely to solve arithmetic problems with understanding. They may resort to haphazard manipulating of numbers. The teaching of these reading skills cannot be left to chance.

In conclusion the following recommendations for further research are offered.

1. A longitudinal study of teaching and testing reading skills peculiar to arithmetic would be most valuable for analization. A minimum of three years time might be appropriate.

2. Experimentation and comparison after a longer period of instruction is indicated. Six to seven months

teaching would permit the teacher to have an inventory of the class and would stop experimentation prior to the terminal period of school.

3. A study on loss and retention of reading skills peculiar to arithmetic could prove rewarding. Concentrated instruction for two weeks followed by two weeks without special teaching could be evaluated by teacher-made tests. This should be carried on for several months.

4. A curriculum guide for an indicated grade level could be perfected. Extensive amounts of practice material to be utilized by the investigator and to serve as guide-posts for other teachers.

5. In-service programs for particular school systems are needed to acquaint faculty with the need for teaching reading skills peculiar to arithmetic. This should include explicit methods for applications within their current curriculums.

6. Studies similar to the present one, but of a longer instructional time, might prove fruitful in other areas such as social studies, science, art, or any content subject.

BIBLIOGRAPHY

1. Austin, Mary, et al. The First R. The Harvard Report on Reading in the Elementary Schools. New York: The Macmillan Company, 1963. 263 pp.

2. Balow, Irving H. "Reading and Computation Ability As Determinants of Problem Solving," The Arithmetic Teacher, 11:18-22, January, 1964.

3. Begle, E. G. "National Longitudinal Study of Mathematics Abilities," The Arithmetic Teacher, 9: 388-89, November, 1962.

4. Begle, E. G. "National Longitudinal Study of Mathematical Abilities Information Bulletin" No. 2. Stanford, California: Stanford University, March, 1964.

5. Bond, Guy and Eva Bond Wagner. Teaching the Child to Read. Third Edition. New York: The Macmillan Company, 1960. pp. 415

6. Bracken, Dorothy Kendall. "Appraising Competence in Reading in Content Areas," Evaluation of Reading, Supplementary Educational Monographs, No. 88. Chicago: The University of Chicago Press, 1958.

7. Corle, Clyde G. "In Answer to Your Questions. Why Do Children Have Difficulty with Verbal Problems?" The Arithmetic Teacher 12:87 January, 1965.

8. Deboer, John J. and Gertrude Whipple. "Reading Development in Other Content Areas," pp. 54-63. Development in and Through Reading, Sixteenth Yearbook of the National Society for the Study of Education, Part I Chicago: N. S. S. E., 1961.

9. Faulk, Charles J. and Thomas R. Landry. "An Approach to Problem Solving." The Arithmetic Teacher 8:157-60, April, 1961.

10. Fay, Leo C. "The Relationship Between Specific Reading Skills and Selected Areas of Sixth Grade Achievement," Journal of Educational Research, 43:541-47, March, 1950.

11. Flournoy, Frances. "Understanding Relationships: An Essential for Solving Equations," The Elementary School Journal, 65:214-17, January, 1964.

12. Gainsburg, Joseph C. and Lillian G. Gordon. Building Reading Confidence Maplewood, New Jersey: C. S. Hammond and Company, 1962. 220 pp.

13. Gates, Arthur. Teaching Reading. What Research Says to the Teacher No. 2. Department of Classroom Teachers. American Educational Research Association. National Education Association, (Washington D.C.: 1953), 32 pp.

14. Greater Cleveland Mathematics Program, Teacher's Guide for Third Grade. Chicago: Science Research Associates, 1962. 250 pp.

15. Grossnickle, Foster E. and Leo J. Brueckner. Discovering Meanings in Arithmetic. Fourth edition. New York: Holt, Rinehart and Winston, 1963. 467 pp.

16. Grossnickle, Foster E. "Verbal Problem Solving," The Arithmetic Teacher, 11:12-17, January, 1964.

17. Hanson, C. W. "Factor Associated With Successful Achievement in Problem Solving in Sixth Grade Arithmetic," Journal of Educational Research, 38:111-18, October, 1944.

18. Heddens, James W. and Kenneth J. Smith. "The Readability of Elementary Mathematics Books," The Arithmetic Teacher, 11:466-68, November, 1964.

19. Heddens, James W. and Kenneth J. Smith. "The Readability of Experimental Mathematics Materials," The Arithmetic Teacher, 11:391-94, October, 1964.

20. Irish, Elizabeth H. "Improving Problem Solving by Improving Verbal Generalization," The Arithmetic Teacher, 11:69-180, March, 1964.

21. McKee, Paul. The Teaching of Reading. Boston, Houghton Mifflin Company, 1948. 622 pp.

22. Olander, Herbert. "Developing Competence in the Reading of Arithmetic and Mathematics Materials," Reading in the Content Areas, pp. 107-116. A Report of the Fifteenth Annual Conference and Course on Reading Pittsburg: University of Pittsburg, June 29- July 10, 1959.

23. Rappaport, David. "Historical Factors That Have Influenced the Mathematics Program for the Primary Grades," School Science and Mathematics, 65:570, January, 1965.

24. Riedesel, C. Alan. "Verbal Problem Solving: Suggestions for Improving Instruction," The Arithmetic Teacher, 11:312-316, May, 1964.

25. Russell, David H. "Arithmetic Power Through Reading" Instruction in Arithmetic, pp. 208-220 Twenty-Fifth Year Book, Washington D.C.: The National Council of Teachers of Mathematics, 1960.

26. Schubert, Delwyn G. "Formulas for Better Reading in Mathematics," School Science and Mathematics, 55: 650-52, November, 1955.

27. Scott, Carrie M. "The Relationship Between Intelligence Quotients and Gain in Reading Achivement with Arithmetic Reasoning, Social Studies and Science," The Journal of Educational Research, 56:322-26, February, 1963.

28. Smith, Kenneth J. "The Application of Readability Formulae to Mathematical Text Materials: A Note," The Arithmetic Teacher, 12:355, May, 1965.

29. Smith, Nila B. Reading Instruction for Today's Children Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1963.

30. Spencer, Peter L. "Perspective in Mathematical Reading" Instruction in Arithmetic, pp.202-08. Twenty-Fifth Year Book, Washington, D.C.: The National Council of Teachers of Mathematics, 1960.

31. Spitzer, Herbert F. The Teaching of Arithmetic. Third Edition. Cambridge: The Riverside Press, 1961. 352 pp.

32. Strang, Ruth, Constance M. McCullough, and Arthur E. Traxler. The Improvement of Reading. New York: McGraw-Hill Book Company, Inc., 1961. 480 pp.

33. Tinker, Miles A. and Constance M. McCullough. Teaching Elementary Reading. Second edition. New York: Appleton-Century-Crofts, Inc., 1962. 615 pp.

34. Treacy, John P. "The Relationship of Reading Skills to the Ability to Solve Problems," Journal of Educational Research, 38: 86-98, October, 1944.

35. Vanderlinde, Lomis F. "Does the Study of Quantitative Vocabulary Improve Problem Solving," The Elementary School Journal, 65: 143-152, December, 1964.

APPENDIX

Lessons Designed to Teach Reading Skills Peculiar to Arithmetic

Lesson One

Title: Reading and Comprehending Numbers

Objective: To review reading numbers and to re-emphasize the quantities that digits represent.

Procedure:

A. Use blackboard to look at groups of numerals:

273
732
372
237
723
327

Which numerals does the digit 3 mean three hundred?

546 is less than 465
464
445
564

685 is greater than 586
856
865
658

Write in expanded notation:

685 = _____+_____+

355 = 300 + _____+ 5

425 = ____+ 20 + 5

279 = 200 + 70 + _____

B. Game--Pass out two sets of cards to competing rows--900, 800, etc.
90, 80, etc.
9, 8, etc.

Flash a numeral such as 753 and see which group can stand in a line showing the numeral in expanded notation. (700 + 50 + 3)

Practice:

456 = 400 + 50 + 6

352 = 300 + _____ + 2

277 = _____ + 70 + 7

598 = 500 + 90 + _____

651 = _____ + 50 +1

378 = 300 + 70 + _____

622 = 600 + _____ + 2

154 = _____ + 50 + 4

Circle the numeral where the digit 4 means four hundred

346
643
436
364

867 is less than 678
876
786

685 is greater than 658
856
865

Another name for 52

5 + 2
50 + 12
40 + 12

Another name for 965

600 + 50 + 6
900 + 50 + 6
900 + 50 + 15

Lesson Two

Title: Significane of Zero in Numerals

Objective: To build on Lesson One and to include the significane of 0 as being "not any" in numbers

Procedure:

A. Examine many groups of numerals such as

503
530
305 State what 0 represents.
350

B. Use magnetic numerals to arrange greatest number represented by digits 5, 8, 0, 6--the smallest. Continue with others.

C. Review:

70 = 60 + 10
570 = 560 + 10
600 = 590 + 10
605 = 500 + 90 + 15

D. Game--Prepare cards (5021, 5121, 5200, 5102) in groups as shown. Pass out face down. Designate two groups to circle up and arrange themselves in sequential order.

Practice:

Expand
7640 = 7000 + 600 + 40 + 0
3056 = ____ + ___ + __ + _
2507 = ____ + ___ + __ + _
3970 = ____ + ___ + __ + _
1001 = ____ + ___ + __ + _

Complete equation
3870 = 3000 + 800 + 70 + _
2087 = 2000 + 0 + __ + 7
4506 = ____ + 500 + 0 + 6
3008 = 3000 + ___ + 0 + 8

Which numeral stands for 8 thousands, 3 tens, and 5 ones.

835
8035
8305
80305

In the numeral 6507 the 0 means

0 thousands
0 hundreds
0 tens
0 ones

Another name for 600

6 + 0 + 0
500 + 90 + 10
500 + 100 + 9
60 + 100 + 10

Another name for 705

7 + 0 + 5
700 + 15
690 + 15
500 + 7

*Extra work--Sequence 6, 15, 15, 24, 24, _____, _____, 42
_____ (Begin with 6 add 9 + or - 0)

Lesson Three

Title: Reading Used in Learning Operational Symbols

Objective: To review meaning and relation of operational symbols.

Procedure:

A. Place on the magnetic board the symbols for

x + - ÷ = > <

Use these types of questions and ask pupils to give a problem to illustrate.

1. Which signs mean for us to arrive at a greater amount when we operate? (x, +) Lesser amount? (÷, -)

2. Which signs mean that they undo one another?

(+, -) (x, ÷)

3. Which are commutattive? (+, x)

4. Which when operated on a number and zero do we get the same number? (+, -)

5. Where do we arrive when we operate by one?

(+1) (-1)
(x1) (÷1)

B. Throw the following problems on the overhead. Respond but do not compute. Are these equations sensible? Tell why or why not.

526 + 234 = 292
537 - 296 = 241
130 x 5 = 250
450 ÷ 5 = 850
600 ÷ 6 > 50 + 50
10 x 7 = 100 - 30

72 + 27<100 + 2
9 ÷ 3 = 15 ÷ 5
3 x 1 = 6 x 2
4 ÷ 2 = 88
8 ÷ 4 = 6 x 3

Practice:

Fill in signs to make equations.

1 x 3 = 12 _ 4
2 _ 5 = 10 - 3
8 _ 4 = 4 ÷ 2

5_ 3 = 3 _ 5
9_ 3 = 3 _ 1
10_ 2 =15 _ 3

Urge pupils to look for problems with more than one answer. Fast workers might add some equations that they form.

Lesson Four

Title: Vocabulary of Arithmetic

Objective: To review the vocabulary used in arithmetic--to reteach items that seem unmeaningful to the pupils.

Procedure:

A. Set up the following word list on a chart.

odd	greater than	place holder
even	less than	number
divide	column	numeral
division	row	equation
repeat	parentheses	ten
repeated	amount	twenty
subtract	digit	thirty
subtraction	carry	forty
commute	estimate	fifty
missing factor	borrowing	sixty
factor	addend	seventy
product	sum	eighty
expanded notation	plus	ninety
fractional part	total	hundred
compare	equal	thousand

B. Practice pronouncing the words. Give illustrations on board.

C. Prepare cards with the word and matching cards with symbols or examples. Use a pocket chart and have pupils match them to show their understanding.

Lesson Five

Title: Quantative Vocabulary and Social Applications of Arithmetic Involving Money

Objective: To reinforce meaning of words related to money. To organize items as to their cost. To give practice in totaling costs and making change.

Procedure:

A. Use the following list of terms that are developed in our curriculum.

Amount	Change	Dime	Quarter
Price	Tax	Nickel	Half-dollar
Cost	Cent	Dollar	$ ¢

B. Use problems made concerning lunch tickets, milk and ice cream money as real school experiences.

C. Show two large charts made with pictures and prices of boys and girls clothing from a catalog.

1. List garments from most expensive to least expensive.

2. You have $15.00 to spend. Select items that you would like. Do not go over your amount of money.

Lesson Six

Title: Story Problems: Isolate the Facts

Objective: To visualize the situation presented in a story problem.

Procedure:

A. Look at a group of story problems to tell what is given.

Check to see if we are given a sum or a product or if we are looking for it. Are we given a missing factor or an addend?

Discuss. Do not solve!

B. Give sheets and have pupils circle numerals or words representing numbers that they would use to solve problem.

Note: Incorporate extra numbers not needed but leave mention of this until further lesson on irrelevant material.

Practice:

1. Cub Scout Pack 132 are taking swimming lessons. Twenty-five boys are beginners and 17 are advanced swimmers. _____ boys are taking lessons.

2. Brownie Troup 3 met to make gifts for the children's hospital. The 8 girls each made three gifts. They made _____ gifts in all.

3. Our milkman left 16 quarts of milk one week, 24 quarts the next week, and 19 quarts of milk last week. He left us _____ quarts altogether in the 3 weeks.

4. Six workmen planted threes around our school last Thursday. They planted 17 sycamore and 36 locust. They planted _____ trees in all.

Lesson Seven

Title: Story Problems: What Does the Problem Ask?

Objective: To formulate the question in the problem or to set up the number sentence necessary to solve the problem.

Procedure:

A. Look at a group of story problems. Does the problem state a question? Can you state what the problem asks you to find? Are there clue words that help you to formulate your question? Set up number sentence or equation. Work problems as a group.

B. Give a sheet similiar to the above mentioned one. Set up equation and solve problems. Give half credit for equation and half credit for correct solutions.

Practice:

1. Our library has 578 new books. 192 books are about science. _____ books are not about science.

2. On Thursday 5 boxes each containing 9 books arrived.

_____ books arrived on Thursday.

3. The librarian displayed 32 books on the glass shelves. She placed them evenly on the 4 shelves. _____ books were placed on each shelf.

4. Last week the students checked out 367 books. This week they checked out 411 books. _____books were checked out during the two weeks.

Lesson Eight

Title: Facts in Problem--Other Needed Information

Objective: To give practice in solving problems that require pupil to look elsewhere for some of the necessary information.

Procedure:

A. Show a sheet of problems where some of the information is eliminated. Have pupils supply appropriate information and all work each problem on their practice paper.

B. Give two examples where the solution to the second problem depends on getting information from the first.

C. Give two similiar problems for the class to work alone for practice.

Practice:

A. 1. The blackboard is 24 feet long. The bulletin board is _____ shorter than the blackboard.

2. We had cookies and ice cream for our Valentine Party. Ice cream cost $3.10. The total spent for our party was _____.

3. Our class scored 29 points in the dodge ball game. Both third grade classes scored _____.

4. The helpers arranged our chairs in four rows. There were _____ in the room.

B. 1. Tommy has 147 shells in one box and 125 shells in another box. He has _____ shells altogether.

2. Tommy gave 36 of his shells for a display at the museum. He now has _____ shells.

C. 1. Mike has 172 stamps mounted in a book and 91 in a box. He has _____ stamps.

2. David gave Mike a package of 19 stamps. Mike now has _____ stamps.

Lesson Nine

Title: Is Answer Sensible

Objective: To give practice in visualizing if the quantity found is sensible. To read and evaluate if we have moved in the right direction.

Procedure:

A. Give a sheet with problems already solved for class to consider. Have volunteers express opinions about sensibility of answers. Be sure that they have opportunity to tell why they think as they do.

B. Give a practice sheet where they are given answers and ask to mark True or Not True.

Practice:

1. In June, Robert Frost School had 397 children. During the summer 28 children moved away. In the fall, 435 returned to Robert Frost School.

2. The first grade had 53 pupils, the second grade had 62 pupils, and the third grade had 57 pupils. There were 172 pupils in the first three grades.

3. Of the 369 pupils attending Robert Frost School, 181 rode the bus. 188 children did not ride the bus.

4. The children helped Mrs. Brown count books for third grade. They counted 32 science books, 29 spellers, 31 arithmetics. They counted 211 books.

Lesson Ten

Title: Irrelevant Material

Objective: To give practice in locating data in problems that is not needed for their solution.

Procedure:

Use groups of problems on mimeographed sheets or on overlays to make students aware that often numerals appear in the text of problems that are not needed for the solution. At this time do not solve the problems, simply locate the pertinent items. Re-use practice problems listed in Lesson Six for this skill.

Practice:

Circle numeral or word for numeral not necessary in the problem.

1. Den 9 has seven boys selling tickets to the Boy Scout Circus. Each boy sold 7 tickets. They sold _____ tickets in all.

2. Kirk and three boy friends went to Room Six to set up chairs for our skit. Each boy arranged 9 chairs. There were _____ chairs in the room.

3. Last Thursday our three cooks served hot lunches to 59 girls and 78 boys. They served _____ children in all.

Lesson Eleven

Title: Estimating an Answer

Objective: To give some special practice estimating answers using different operations.

Procedure:

A. State problems with three possibilities posted for discussion.

1. Kellie has 40 crayons to put into 5 boxes. If she puts the same number in each box, how many will be in each one? Is the answer between?

5 and 10? 40 and 50? 30 and 40?

2. Miss Kirk folded paper for Music booklets. If she folded 8 sheets for each of the 25 pupils, how many sheets did she fold? Is the answer between:

190 and 210? 25 and 33? 3 and 5?

B. Give a mimeographed sheet with problems with multiple choice answers. Have approximate answer selected.

C. Discuss answers and explain why some are wise selections and others not. Let pupils share their thinking.

Practice:

Circle One

456 - 265 is about	100	(3 + 1) x 9 is about	200
	150		40
	250		79
	200		13
63 ÷ 3 is about	20	8 x (4 ÷ 1) is about	13
	10		12
	2		50
	30		100
567 + 132 is about	600	(4 x 5) x 3 is about	300
	700		30
	130		12
	99		60
31 x 5 is about	36		
	150		
	26		
	300		

Lesson Twelve

Title: Locating Information in Accompanying Table

Objective: To give practice in reading and interpreting tables.

Procedure:

Use local TV schedule with times and programs that are significant for students. Throw a section on the screen and question students about channels, programs, and the length of programs. Guide them to make statements of their observations.

Practice:

This TV schedule is from a newspaper. Numbers on the left tell the time of day. The other numbers tell the TV channels.

7:00---(2) News--Walter Cronkite
(4) Huntley-Brinkley Report
(5) Mickey Mouse Club
7:30---(2) The Munsters
(4) Daniel Boone
8:00---(2) Perry Mason
(13) Pathfinders

1. Perry Mason is on Channel
   A. 13 C. 5
   B. 2 D. 4

2. Daniel Boone comes on at
   A. 7:00 C. 7:30
   B. 8:30 D. 7:15

3. Huntley-Brinkley Report is on the same channel as
   A. The Munsters C. Pathfinders
   B. Daniel Boone D. Walter Cronkite

4. Perry Mason is on at the same time as
   A. Mickey Mouse Club C. The Munsters
   B. Huntley-Brinkley Report D. Pathfinders

Lesson Thirteen

Title: Using Quantative Aids

Objective: To give practice in reading and interpretating the following: Calendar--Clock--Thermometer

Procedure:

A. Display a calendar of the entire year. Discuss and review.

B. Display a large calendar of current month. Note months begin on any day of the week.

C. Name the day of the week represented by the third, first, twenty-third, and so forth.

Practice:

Answer the following from the calendar of the current month.

1. Each week has _____ days.

2. The name of the first day of the week is _____.

3. The name of the day that follows Monday is _____.

4. _____ is the name of the day that comes after Friday.

5. The name of the second day of this month is _____.

6. There are _____ days in this month.

7. Write numeral names of all the Mondays of this month.

_____ _____ _____ _____

8. Ten days from today will be _____.

9. Write numeral names for all of the Fridays of this month.

_____ _____ _____ _____

10. _____ is the name of the last day of this month.

Procedure:

A. Use a large demonstration clock.

B. Use small individual clocks.

C. Review 5 o'clock is the same as 5:00. Review hour, half-hour, quarter-hour.

D. 11:35
35 minutes past 11
25 minutes to 12

E. earlier--later

Practice:

Using printed cards with directions show 30 minutes later
show 15 minutes earlier
show 5 minutes earlier
show 10 minutes later

Set the large clock. The class sets individual clocks after following directions on cards.

Procedure:

A. Use a large demonstration thermometer. Have class read temperatures on the tens. Notice the 2^{o} intervals and show their meaning.

B. Practice counting upward by 10's and 2's and backward by both 10's and 2's.

C. Practice counting from 0^{o} to -50 by 10's and by 2's.

Practice:

Have students number a paper and write temperatures as teacher moves tape on demonstration thermometer.

Lesson Fourteen

Title: Reading Graphs

Objective: To develop understandings of the mechanical features and interpretations of the data represented in graphs.

Procedure:

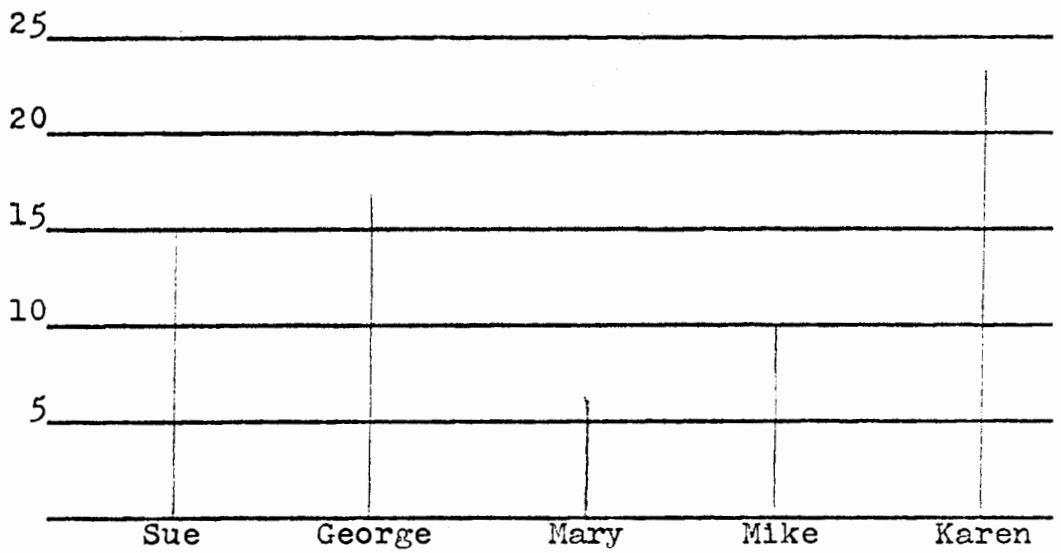
A. Present simples areas showing pupil participation in current activities such as social studies committees. Make sure the class understands that the area represents a group. Have small groups stand and compare their size with each other and with the entire class.

B. Construct and color graphs showing "Games The Class Likes Best" and "Our Favorite Food". Limit the number of items to three or four.

Question the class to guide their thinking and interpretation. Lead them to make further observations of their own.

C. Proceed from simple areas to circle and bar graphs showing information of high interest to theclass.

Practice:



This graph shows how many books were read in six months by some third-graders.

1. The child who read the fewest books was
   A. Mary C. George
   B. Sue D. Mike

2. Ten books were read by
   A. Sue C. George
   B. Mike D. Karen

3. Sue read five more books than
   A. Mary C. Karen
   B. George D. Mike

4. The one in this group who is most interested in reading is probably
   A. Mary C. Karen
   B. Toren D. Mike

Lesson Fifteen

Title: Fractional Parts and Relationships

Objective: To read and interpret fractional numbers--relationships.

Procedure:

Start work on this lesson by using rods and allowing students to make discoveries and tell about them. Fold and cut strips of paper. Label and match similar fractional parts. Give mimeographed sheets of different sized objects with parts shaded--halves, thirds, fourths, etc. Have class cut out objects and group them according to name of fractional part and arrange from smallest to greatest.

Practice:

Fold three strips into halves, fourths, and eighths. Label and past on top of a page followed by these sentences.

There are _____ halves in 1 whole.

There are _____ fourths in 1 whole.

There are _____ eighths in 1 whole.

In one-half there are _____ fourths.

In one-half there are _____ eighths.

Lesson Sixteen

Title: Securing Information About Assignments

Objective: To give instruction in locating and selecting information pertinent to assignments in the study of social application of arithmetic.

Procedure:

A. Prepare simplified excerpts from the encyclopedia such as the leading states for apple production. Use this information on the overhead projector for class to read and discuss.

B. Use the opaque projector to show sections in easy reference books. Look for sizes of animals, countries, cities, etc.

Practice:

Find the population of London, Paris, Bombay, Tokyo, Washington D.C., and New York. Arrange the cities from the largest to the smallest.

Find lengths of three different whales. Can you find one that could fit in our classroom?