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A Comparative Study of the Traditional and the Scott, Foresman Approaches to the Teaching of Addition and Subtraction of Fractions

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A COMPARATIVE STUDY OF [redacted]ADITIONAL AND THE SCOTT, FORESMAN APPROACHES TO THE TEACHING OF ADDITION AND SUBTRACTION OF FRACTIONS

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CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

The world conditions of recent years have given rise to the need for improvement of skills in the sciences, especially in the field of mathematics. This has been felt in the public schools even as early as the kindergarten level. Educators have been on the alert to improve the situation and rise to the demands of the times.

After much study, in 1962 the Ephrata School District adopted the Scott, Foresman series of arithmetic textbooks for elementary schools in an effort to improve instruction in that field. This series is considered to be in the forefront as an arithmetic text for elementary grades, and in certain presentations represents a noticeable departure from the traditional approach. In the fifth grade text, one notable area of departure is in the teaching of addition and subtraction of fractions. This deviation from the traditional became the impetus for this research.

I. THE PROBLEM

During the course of the teaching of this particular unit, interest arose in the mind of the writer as to the efficacy of the approach in fostering improvement in these skills. Certain questions arose. For instance, does this approach develop greater understanding of these processes in the study of fractions than does the traditional method? Does it foster greater ability to perform the basic operations? Is retention of understanding and of ability to perform these skills promoted to a greater degree?

This teaching experience and these questions gave rise to the research described in this thesis. The study was concerned with the hypothesis that, between the Scott, Foresman approach and the traditional method, there would be no significant difference in achievement in the performance of operations and the retention of skills in addition and subtraction of fractions.

II. DEFINITIONS OF TERMS USED

The Scott, Foresman method. The approach by which the study of addition and subtraction of fractions is taught through the use of the Scott, Foresman fifth grade arithmetic text is designated as the Scott, Foresman method. This method places emphasis on the development of understanding of the base-ten number system and on the discovery principle in life-like situations.

The traditional method. The traditional method places emphasis on the teacher telling and demonstrating the facts of operations, and the pupils practicing for mastery. Little emphasis is placed on concepts or personal experience. This approach is considered to mean the traditional method (13:3).

CHAPTER II

REVIEW OF THE LITERATURE

Examination of the literature concerning the teaching of fractions in the fifth grade revealed much in common among the various authorities on the approaches to teaching addition and subtraction of fractions and on the presentation of material. The most noticeable departure from the usual was that of Scott, Foresman (6:112-231). A brief review of the literature will serve to indicate certain likenesses and differences in the various procedures.

I. TRADITIONAL OVERVIEW

Howard and Dumas (7:5) recommended the starting of addition and subtraction of fractions on the fourth grade level, as did the authors of the McGraw-Hill arithmetic text (9:197). All other authorities started the study in the fifth grade. No authority, however, launched the study at this point without providing experiences in basic understandings about fractions during earlier grades. For instance, in discussion of the training in fractions which children received before reaching the fifth grade, Wheat and Heard stated that the concepts of unit fractions, parts of a whole, and parts of a group had been developed and that one-half, one-third, one-fourth, and one-eighth had received special attention (17:8T). A study of the table of contents of any of the references will prove this development of some previous understanding to be common to all programs (6; 8; 10; 11; 14; and 17).

Most references showed close agreement on sequence for presentation of the concepts of fraction. Some variation in sequence within the fifth grade was common, of course, since no two different texts would develop the program in the same manner.

A simple listing of concepts covered in logical order was indicated in the headings of the three sections on fractions as developed in The Scribner Arithmetic,--(1) Meaning of Fractions, (2) Adding and Subtracting Fractions, and (3) Using Mixed Numbers (8:108-235).

A more detailed listing from Arithmetic in My World is the following example:

1. Meaning.
2. Proper--improper.
3. Changing to lowest terms.
4. Changing to higher terms.
5. Groups as parts.
6. Changing improper fractions to mixed numbers.
7. Changing mixed numbers to proper fractions.
8. Like and unlike fractions.
9. Introduction of L. C. D. fractions. (Lowest Common Denominator).
10. Adding and subtracting fractions.
11. Whole number times a fraction.
12. A fraction times a whole number.
13. Adding and subtracting mixed numbers (14:5).

Still another slight change, yet with obvious similarity, is shown in this traditional sequence used in <u>Exploring Arithmetic</u>.

Sequence of learning fractions

Meaning
Adding: like fractions
mixed numbers
Changing fractions to equal fractions
Subtracting: like fractions
unlike
mixed numbers (11:vii).

No text other than Scott, Foresman varied far from this common traditional treatment.

The basic concepts of fractions are three or four in number, according to treatment that was given to them by the various authorities. Confusion seemed to arise over what designations to give them, and how to explain how they operate. Since the same group of two numbers may be viewed in several ways, this became a source of confusion. Marks divided the concepts into four categories and gave a simple example to clarify each.

> <u>As Part of a Whole</u>. A person may ask for one-half of a candy bar or one-sixth of a pie. These are expressions for parts of a whole.
>
> <u>As Part of a Group</u>. Three-fourths of a dozen eggs represents three of the four equal groups of twelve eggs.
>
> <u>As an Indicated Division</u>. . . . For example, dividing 3 inches into 4 equal parts calls for $3 \div 4$ with the quotient expressed as 3/4 inch.

<u>As a Ratio</u>. Another common use for fractions is to express comparisons. For example, in a class of thirty-six pupils there are sixteen boys; then the number of boys is to the number of pupils in the class as sixteen is to thirty-six. This comparison is written as 16/36, or 4/9 (9:194-195).

Overman stated them simply in three categories,--"(1) a <u>fraction</u> is one or more of the equal parts into which some whole has been divided; (2) a <u>fraction</u> is a comparison number which tells the ratio of one number to another; (3) a <u>fraction</u> is an indicated division (12:177)."

Again, Overman spoke of the first-mentioned category as being the ". . . simplest fraction meaning, and the one that is usually first met by children . . . (12:171)." This concept was practiced in every arithmetic text.

A difficult, perhaps the most difficult, concept seems to be that of ratio. Stokes expressed it this way:

> A fraction may be an abstract number. When we compare one measurement with another through a relationship called the ratio, the value of the comparison may be a fraction which is an abstraction . . . (15:106).

By means of an example he attempted to clarify the concept but ended the explanation by saying that the value of the particular ratio was an "abstraction" (15:106). The word <u>abstraction</u> is an indication of the difficulty mathematicians seem to have in explaining ratio to children.

Simply stated, ratio shows the "times as many" concept which makes it possible to compare one number with another. A child needs much meaningful experience with fractional parts of things, however, before he can reach deeper understanding of this concept (3:248). Brueckner and Grossnickle climaxed this understanding with the statement that if a pupil "can show by mathematical procedures that the weight of one person is five-sixths of the weight of another person, he demonstrated a high level of quantitative thinking (1:341)."

The concept of ratio is so difficult, in the opinion of Thorpe, that the study of it should be reserved for upper grades (16:186). Another indication of the difficulty with ratio is that the word itself was used in only one of the arithmetic texts, other than that of Scott, Foresman, and then only for the teacher's benefit (2:258).

One common means of trying to develop understanding and insight, of course, was the use of story problems. Also, every text employed geometric figures, measure lines, graphs, and/or illustrations of various kinds and in varying amounts.

II. SCOTT, FORESMAN OVERVIEW

In certain matters of method and procedure, appearance, and point of view, the Scott, Foresman text is unique in comparison with the other texts examined. This can be noted especially in three areas of approach.

> 1. The use of illustrations and diagrams in serial arrangement in an attempt to develop greater insight into story problem meaning.
>
> 2. Extensive use of simple equations as the basis of problem solving.
>
> 3. A "type of action" point of view as an approach to clarification of meaning in solving problems. According to Scott, Foresman, traditional instructional methods relied heavily on "cue" words. This particular text, however, relies on understanding of the "type of action" that takes place in a particular problem. Emphasis is laid upon the thought of the four arithmetical process symbols (+,−,×,÷) as being symbols of that action (6; 4:103-105).

The use of visual materials is not limited, however, to story problems. The computational processes are "acted out" on the pages of the text. Pictures are used to help children understand quantities and groupings. The visual aids are employed to encourage discovery of the meaning of number. The teaching of fractions is treated in like manner. Computation of fractions waits upon the development of concepts concerning fractions (5).

Likewise, Scott, Foresman teaches fractions through the use of equations, and by training in understanding of a "type of action", both mentioned above. The authors describe the purpose of the plan as "a precise way of thinking about them (fractions)(5)."

The Scott, Foresman text presents the study of ratio in the form of equations and claims that the method is so simple that the question might be asked, "Why hasn't this been done before?" The teaching of the concept of ratio begins with training in recognition of rate and comparison situations, in expressing these in ratios, and in distinguishing between ratios and fraction numerals. Eventually the discovery is made by the pupil that the process learned in reducing fractions is the same one employed in the reduction of ratios (5).

These several deviations from traditional patterns should be examined in the Scott, Foresman text in order to understand the differences in point of view.

CHAPTER III

PROCEDURES

During the school year 1963-64, the Ephrata Public Schools, with school board sanction, sponsored a study of a comparison of the Scott, Foresman approach to teaching of addition and subtraction of fractions with that of the traditional method. To launch the project, a meeting was held to discuss the problem, formulate a hypothesis, and evolve a plan of procedure. The Ephrata Schools curriculum director, the principal of Grant School, and the writer, a fifth grade teacher at Grant School, constituted the personnel. The study was planned as an experiment based on the hypothesis that there is no significant difference between the Scott, Foresman approach and the traditional method in achievement in the performance of operations and the retention of skills in addition and subtraction of fractions.

The experiment was carried on in the classroom of the writer, with her fifth grade pupils as subjects. Although there were six fifth-grade classes in Ephrata, each teacher was in a self-contained classroom and did no exchange teaching in arithmetic. Therefore, in order to control the number of variables, it was considered necessary to use only the one teacher and her assigned class.

The subjects were matched as closely as possible, using IQ scores and a quantitative measure of total previous knowledge of fractions as the basic criteria. When possible, the subjects were paired on the bases of chronological age and sex.

Total fraction knowledge was determined by administering three tests--the Metropolitan Achievement Test, Form A, and the Scott, Foresman Seeing Through Arithmetic Tests for Books 4 and 5. Only the problems which dealt with fractions were used. The sum of the number of problems correct in all three tests was used as the score for matching purposes.

All but three of the children in the class had attended Ephrata schools during the previous year and had been taught with the use of the Scott, Foresman arithmetic text for grade four. The addition and subtraction of fractions was not touched upon in the fourth grade. However, because some children have greater experience with fractions, and/or develop deeper understanding of fraction concepts than the fourth grade curriculum provides, it was deemed advisable to administer Test 5 as well as Test 4 so as to determine as nearly as possible the full extent of each child's skill.

When tests were tabulated and the pairing was completed, two equivalent groups of subjects were formed. The group to be taught by the traditional method was designated as the control group, while the subjects to be instructed according to the Scott, Foresman method formed the experimental group.

For a number of years before the adoption of Scott, Foresman arithmetic texts, the Ephrata School District had used the Row-Peterson arithmetic texts. For this reason, Row-Peterson Arithmetic, Book Five was used in instructing the control group. The experimental group used the Scott, Foresman Seeing Through Arithmetic, Book 5. The teacher had had experience in using both texts; therefore, the variable of teacher familiarity with texts was not of major consequence.

Teaching was done in half-hour periods, with groups scheduled in such a way as to give the same number of days at a given time of day to each group. For instance, the control group studied fractions the first week at 12:45, the experimental group at 1:20. On alternate weeks the hours of study for each group were reversed. This arrangement was made to try to equalize and control any variable that might arise due to an arbitrary time schedule. Only one group was in the classroom at a time. The Grant School principal took the "free" group to a room elsewhere in the building for instruction in other phases of arithmetic. He agreed never to discuss or teach fractions in any way.

Various precautions were taken to control situations that might influence results. First, the parents were informed of the purpose and organization of the project, and were invited to ask questions or make comment before it started. Next, the cooperation of the pupils was solicited in not discussing anything about the fraction experiment program with members of the group of which they were not members. No work involving fractions was to be taken home; all work was to be done in the classroom under the supervision of the teacher. Finally, a "Please Do Not Enter" sign was placed on the classroom door at the beginning of each period to avoid interruptions.

The instrument used by the Ephrata Public Schools for the purpose of evaluating academic progress is the battery of tests entitled Metropolitan Achievement Tests, published by Harcourt, Brace, and World. The battery is comprised of four equivalent forms labeled A, B, C, and D. Three of these forms were used for this research project. The two arithmetic sections in each form contain twenty-five problems involving fractions. Each problem in any one form of the battery of tests is matched closely with a corresponding problem in each of the other three forms. Form A was utilized for pre-testing, Forms D and B for the two terminal evaluations.

The Scott, Foresman Company publishes an achievement test, based on national grade norms, for each book in its arithmetic series. They are called _Seeing Through Arithmetic Tests_. These tests favored the experimental group. However, it was necessary to use them as a means of determining extent of performance as a result of instruction according to the Scott, Foresman plan. This was of particular importance for the evaluation of rate and comparison problems. Since only one test is provided for each grade level, the probability that the Hawthorne, or "practice", effect might occur was possible. Nevertheless, it was imperative to use the test three times. It was hoped that the careful matching of groups would tend to equalize the effect.

In order to offset the advantage favoring the experimental group due to the use of _Seeing Through Arithmetic Tests_, two teacher-made tests, Forms A and B, were formulated. The tests were compiled in traditional form and followed closely the progression of skill-building steps presented in the Row-Peterson fifth grade text. Copies of these tests are located in the appendix.

The experiment started early in January. At the end of nine weeks, Form D of the _Metropolitan Achievement Tests_, the _Seeing Through Arithmetic Tests_ for Books 4 and 5, and

Form A of the teacher-made test were administered. These tests were left unchecked until the completion of the program so that the teacher would not be influenced by results.

The second nine-weeks period was organized and utilized for the maintenance of skills. Periods were limited to fifteen minutes twice a week. Usually there was the normal exchange of classrooms. On four occasions, however, due to pressure of time on the school principal, these practice periods were held within the regular classroom with the children divided into their two groups. At these times, the teacher worked with children individually, giving aid within each group for fifteen minutes at a time.

At the end of this nine-weeks skill maintenance period, the same testing procedure as that used at the end of the first nine-weeks period was followed, using Form B of the Metropolitan Achievement Tests, the same Seeing Through Arithmetic Tests, and Form B of the teacher-made tests.

All tests were administered by the school principal. At the end of the eighteen-weeks experiment, both sets of tests were checked, tabulated, and evaluated. Chapter IV will present the findings of this study.

CHAPTER IV

ANALYSIS OF DATA

In an endeavor to answer the questions set forth in this study, the collected data were analyzed through the application of the t-test to determine statistically significant differences which might have existed between the experimental and control groups. All statistical findings were reported at the .01 level of confidence.

Following the teaching of the two methods of addition and subtraction of fractions, as described in Chapter 3, quantitative tests were administered to the subjects to determine achievement. These tests were administered at the end of the nine week experiment and again at the end of eighteen weeks to check retention of skill.

Table I presents the difference between mean scores on the Metropolitan Achievement Test, Form D, administered at the ninth week.

It may be seen, upon examining Table I, page 18, that the experimental group excelled the control group in addition and subtraction of fractions at the end of nine weeks. However, the obtained t of .05 was not found to be statistically significant.

TABLE I

MEAN DIFFERENCES FOR
METROPOLITAN ACHIEVEMENT TEST, FORM D
(Ninth Week Test)

Group	N	Obtained Means	σ_m	σ_{Dm}	Obtained t	Required t
Experimental Group	15	11.80	2.97	1.30	.05	2.76
Control Group	15	11.73	4.04			

Table II shows the difference between mean scores on the Metropolitan Achievement Test, Form B, at the end of eighteen weeks.

TABLE II

MEAN DIFFERENCES FOR
METROPOLITAN ACHIEVEMENT TEST, FORM B
(Eighteenth Week Test)

Group	N	Obtained Means	σ_m	σ_{Dm}	Obtained t	Required t
Experimental Group	14	12.64	5.24	2.00	.61	2.76
Control Group	14	13.86	5.37			

By examining Table II, page 18, it may be noted that the control group excelled the experimental group in addition and subtraction of fractions at eighteen weeks. The obtained t of .61 was not found to be statistically significant.

Table III shows the mean scores for achievement on the Seeing Through Arithmetic Tests 4 and 5, addition and subtraction of fractions only, administered at the nine weeks period.

TABLE III

MEAN DIFFERENCES FOR
SEEING THROUGH ARITHMETIC, TESTS 4 AND 5:
ADDITION AND SUBTRACTION ONLY
(Ninth Week Test)

Group	N	Obtained Means	σ_m	σ_{Dm}	Obtained t	Required t
Experimental Group	15	20.60	5.60	2.58	.34	2.76
Control Group	15	19.73	8.32			

It may be seen from Table III that the experimental group excelled the control group in mean scores. However, the obtained t of .34 was not found to be statistically significant.

Table IV indicates the mean scores for achievement of the *Seeing Through Arithmetic Tests* 4 and 5, addition and subtraction of fractions only, administered at the eighteen weeks period.

TABLE IV

MEAN DIFFERENCES FOR
SEEING THROUGH ARITHMETIC, TESTS 4 AND 5:
ADDITION AND SUBTRACTION ONLY
(Eighteenth Week Test)

Group	N	Obtained Means	σ_m	σ_{Dm}	Obtained t	Required t
Experimental Group	14	21.43	5.33	2.33	.09	2.78
Control Group	14	21.21	6.86			

As indicated in Table IV, the experimental group again excelled the control group, although there was no statistically significant difference between the groups.

Table V indicates mean achievement for addition and subtraction of fractions plus rate and comparison at the ninth week.

By referring to Table V, page 21, it may be seen that the experimental group excelled the control group in the addition and subtraction of fractions plus rate and comparison problems. The obtained t of 1.37 was not found to be statistically significant.

TABLE V

MEAN DIFFERENCES FOR
SEEING THROUGH ARITHMETIC, TESTS 4 AND 5:
ADDITION AND SUBTRACTION OF FRACTIONS
PLUS RATE AND COMPARISON
(Ninth Week Test)

Group	N	Obtained Means	σ_m	σ_{Dm}	Obtained t	Required t
Experimental Group	15	25.07	5.95	2.59	1.37	2.76
Control Group	15	21.53	8.05			

Table VI shows results of the same test at eighteen weeks.

TABLE VI

MEAN DIFFERENCES FOR
SEEING THROUGH ARITHMETIC, TESTS 4 AND 5:
ADDITION AND SUBTRACTION OF FRACTIONS
PLUS RATE AND COMPARISON
(Eighteenth Week Test)

Group	N	Obtained Means	σ_m	σ_{Dm}	Obtained t	Required t
Experimental Group	14	26.57	6.08	2.66	1.02	2.78
Control Group	14	23.86	7.90			

It may be noted in Table VI, page 21, that the experimental group again excelled the control group, although the difference was not statistically significant.

Table VII presents the mean differences for rate and comparison problems only, tested at the ninth week.

TABLE VII

MEAN DIFFERENCES FOR
SEEING THROUGH ARITHMETIC, TESTS 4 AND 5:
RATE AND COMPARISON ONLY
(Ninth Week Test)

Group	N	Obtained Means	σ_m	σ_{Dm}	Obtained t	Required t
Experimental Group	15	4.53	2.03	.73	3.84	2.76
Control Group	15	1.73	2.01			

It may be seen, upon examining Table VII, that the experimental group excelled the control group in rate and comparison problems only. The required t score was 2.76 while the obtained t was 3.84. Therefore, this difference between means was found to be statistically significant.

Table VIII, located on page 23, presents the mean differences for rate and comparison problems only, tested at the eighteenth week.

TABLE VIII

MEAN DIFFERENCES FOR
SEEING THROUGH ARITHMETIC, TESTS 4 AND 5:
RATE AND COMPARISON ONLY
(Eighteenth Week Test)

Group	N	Obtained Means	σ_m	σ_{Dm}	Obtained t	Required t
Experimental Group	14	5.14	1.88	.90	2.78	2.78
Control Group	14	2.64	2.99			

By studying Table VIII, it may be noted that the experimental group excelled the control group in rate and comparison problems. The t score was 2.78, which was statistically significant.

Table IX records the findings for Teacher-made Test, Form A, at nine weeks.

TABLE IX

MEAN DIFFERENCES FOR
TEACHER-MADE TEST, FORM A
(Ninth Week Test)

Group	N	Obtained Means	σ_m	σ_{Dm}	Obtained t	Required t
Experimental Group	15	21.27	6.97	2.83	.52	2.76
Control Group	15	19.80	8.46			

As indicated in Table IX, the obtained t of .52 was not found to be statistically significant.

Table X records the findings of an equivalent teacher-made test administered at eighteen weeks.

TABLE X

MEAN DIFFERENCES FOR
TEACHER-MADE TEST, FORM B
(Eighteenth Week Test)

Group	N	Obtained Means	σ_m	σ_{Dm}	Obtained t	Required t
Experimental Group	14	23.21	7.18	2.66	.24	2.78
Control Group	14	23.57	6.92			

Table X shows an obtained t of .24 which was not found to be statistically significant. In this test the control group excelled the experimental group in obtained means.

Conclusions reached as a result of the study of the data presented in this chapter will be discussed in Chapter V.

CHAPTER V

SUMMARY AND CONCLUSIONS

I. SUMMARY

The purpose of this study was to compare the achievement of a control group of children taught addition and subtraction of fractions in the traditional way with that of an experimental group taught by the Scott, Foresman approach. The factors under consideration were the ability to perform the basic operations required in adding and subtracting fractions, and the retention of ability to perform these skills.

To accomplish this, the writer's fifth grade class of thirty pupils was divided into two equivalent groups by using intelligence quotients and fraction test results as basic matching criteria. Tests were administered at the end of nine weeks of study and again after eighteen weeks.

Five different categories of test results were determined from the tests administered. Only addition and subtraction of fractions and rate and comparison problems were measured. The categories and their sources were: (1) all fraction problems from Metropolitan Achievement Tests, Forms D and B; (2) addition and subtraction problems only, from Seeing Through Arithmetic, Tests 4 and 5, published by the

Scott, Foresman Company; (3) addition and subtraction plus rate and comparison problems, from the same Scott, Foresman tests; (4) rate and comparison problems only, again from the Scott, Foresman tests; and (5) traditional tests formulated by the teacher and based on the Row-Peterson fifth grade unit of study in addition and subtraction of fractions.

In every category, the experimental group excelled the control group to some degree at the end of nine weeks. At the end of eighteen weeks it was found that the experimental group had maintained a slight lead over the control group in all categories except addition and subtraction of fractions, as determined in the Metropolitan Achievement Test, Form B, and addition and subtraction of fractions, as shown in the teacher-made traditional test.

Although the experimental group tended to excel the control group in most aspects of this study, the only statistically significant differences appeared in the tests of rate and comparison only.

II. CONCLUSIONS

Upon examining the analysis of data for this experimental research project, several conclusions may be reached. First, by considering the lack of statistically significant differences, with the exception mentioned above, it could be concluded that there is no apparent advantage for the Scott, Foresman approach over the traditional method. Therefore, the null hypothesis may be accepted.

The statistically significant results, concerning skill in rate and comparison problems only, were expected because the experimental group was taught rate and comparison whereas the control group was not. The second conclusion is therefore obvious--children learn about rate and comparison in the Scott, Foresman unit of study whereas they learn little about these concepts through traditional teaching.

Two other factors should be considered. First, the experimental group was taught more subject matter--specifically rate and comparison--in the same time interval as the control group. From this it would seem that the Scott, Foresman approach fosters understanding that makes it possible to learn more in a given length of time.

A second factor may be seen by examining the obtained means. In all cases except those shown in traditional tests of achievement in addition and subtraction of fractions, administered at eighteen weeks, the experimental group scored higher than the control group. However, the results indicated in the traditional tests mentioned above indicate that retention of skills in traditional addition and subtraction problems was greater for the control group than for the experimental group. This may possibly suggest that traditional methods foster retention to a greater extent. At the same time, however, since the Scott, Foresman method gives priority to discovery and understanding of concepts rather than to mastery of processes, it may be conjectured that an extension of time for skill mastery might overcome or equalize this trend.

Although a quantitative measure of pupil interest was not feasible, nevertheless certain evidences of this interest were observed. The teacher was aware of greater enthusiasm and confidence among the members of the experimental group. It is probable that increased interest could have been enhanced because the Scott, Foresman method offered wider variety in its approach than the traditional, and gave opportunity for meaningful experiences and critical thinking through the process of discovery.

In summary, since the experimental group evidenced slightly higher achievement while learning more subject matter within a given time than the control group, and since the probability of interest and understanding was greater for the experimental group, it appears likely that the Scott, Foresman approach to the teaching of addition and subtraction of fractions offers a more vital approach to the development of understanding and improvement of skills than the traditional method.

III. RECOMMENDATIONS

Recommended further research needed in this area would include a similar study in which a period longer than one-half hour--perhaps forty or forty-five minutes--would be allowed for teaching time. It was difficult to schedule concept presentation and adequate skill practice within this short period. It is intriguing to wonder what bearing this increase of time might have had on retention of skills.

It might also be advantageous to schedule teaching and testing during the fraction review period early in the sixth year, following the same plan of action used in this study, to test retention of understandings and skills.

It is also recommended that an effort be made to locate more adequate instruments for measurement of achievement and understanding in addition and subtraction of fractions.

The teacher and the principal agreed that it would be much wiser to schedule a different subject, rather than another phase of the same subject, during the study session away from the classroom. They concluded that the study of more arithmetic taught by another person tended to be confusing for the children.

BIBLIOGRAPHY

BIBLIOGRAPHY

1. Brueckner, Leo J., and Foster E. Grossnickle. Making Arithmetic Meaningful. Philadelphia: The John C. Winston Company, 1953.

2. Buswell, Guy T., William A. Brownell, and Irene Sauble. Teaching Arithmetic We Need. Boston: Ginn and Company, 1961.

3. Grossnickle, Foster E., and Leo J. Brueckner. Discovering Meanings in Arithmetic. Philadelphia: The John C. Winston Company, 1959.

4. Hartung, Maurice L., and others. Charting the Course for Arithmetic. Chicago: Scott, Foresman and Company, 1960.

5. __________. Innovations that Help More Children Succeed in Arithmetic. Chicago: Scott, Foresman and Company, 1963. Booklet.

6. __________. Teaching Guide, Seeing Through Arithmetic, Book 5. Chicago: Scott, Foresman and Company, 1957.

7. Howard, Charles F., and Enoch Dumas. Basic Procedures in Teaching Arithmetic. Boston: C. C. Heath and Company, 1963.

8. Madden, Richard, Leslie S. Beatty, and William A. Gager. The Scribner Arithmetic. New York: Charles Scribner's Sons, 1955.

9. Marks, John L., D. Richard Purdy, and Lucien B. Kinney. Teaching Arithmetic for Understanding. New York: McGraw-Hill Book Company, Inc., 1958.

10. Morton, Robert Lee, and others. Making Sure of Arithmetic. Teacher's Edition. Morristown: Silver Burdett Company, 1957.

11. Osborn, Jesse, Adline Riefling, and Herbert F. Spitzer. Exploring Arithmetic. Teacher's Edition. St. Louis: Webster Publishing Company, 1962.

12. Overman, James Robert. The Teaching of Arithmetic. Chicago: Lyons and Carnahan, 1961.

13. Pflueger, Evalyn B. "A Comparative Study of Two Methods of Teaching Arithmetic." Unpublished Master's thesis, Central Washington State College, Ellensburg, 1962.

14. Stokes, C. Newton, Belle Adams, and Esther R. Unkel. Arithmetic in My World. Teacher's Edition. Boston: Allyn and Bacon, 1958.

15. __________. Teaching the Meanings of Arithmetic. New York: Appleton-Century-Crofts, Inc., 1951.

16. Thorpe, Cleata B. Teaching Elementary Arithmetic. New York: Harper and Brothers, 1962.

17. Wheat, Harry Grove, and Ida Mae Heard. Row-Peterson Arithmetic. Teacher's Edition, Book 5. Evanston: Row, Peterson and Company, 1959.

APPENDIX

FIRST TEACHER-MADE TEST, FORM A
(Ninth Week Test)

1. $\frac{5}{12} + \frac{2}{12} =$

2. $\frac{5}{8} + \frac{3}{8} =$

3. $\frac{7}{10} - \frac{3}{10} =$

4. $\frac{9}{16} - \frac{1}{2} =$

5. $\frac{3}{4} + \frac{3}{4} =$

6. $8\frac{1}{4} - 6 =$

7. $\frac{1}{4} + \frac{9}{10} =$

8. $33 - 3\frac{3}{5} =$

9. $1\frac{1}{2} + 9 =$

10. $6\frac{3}{4} - \frac{3}{8} =$

11. $14 + 8\frac{3}{4} =$

12. $1\frac{2}{5} - \frac{1}{2} =$

13. $\frac{3}{5}$ of $35 =$

14. $\frac{3}{4} = \frac{?}{12}$

15. $7\frac{1}{4} + 8\frac{3}{4} =$

16. $\frac{4}{8} - \frac{1}{8} =$

17. $\frac{5}{16} + \frac{3}{16} =$

18. $1 - \frac{5}{6} =$

19. $\frac{4}{5} + \frac{4}{5} =$

20. $1\frac{5}{8} - \frac{3}{8} =$

21. $\frac{3}{8} + \frac{5}{16} =$

22. $5 + \frac{1}{8} =$

23. $15\frac{3}{4} - 6\frac{3}{4} =$

24. $16\frac{1}{6} - 8\frac{5}{6} =$

25. $2\frac{2}{3} + \frac{1}{3} =$

26. $7\frac{7}{10} - \frac{9}{10} =$

27. $4\frac{3}{4} + \frac{1}{6} =$

28. $18\frac{3}{5} - 5\frac{7}{10} =$

29. $4\frac{5}{6} + 5\frac{1}{4} =$

30. Which is less, $\frac{3}{4}$ or $\frac{4}{3}$?

SECOND TEACHER-MADE TEST, FORM B
(Eighteenth Week Test)

1. $\frac{5}{16} + \frac{4}{16} =$

2. $\frac{1}{6} + \frac{5}{6} =$

3. $\frac{7}{12} - \frac{5}{12} =$

4. $\frac{7}{8} - \frac{1}{2} =$

5. $\frac{5}{8} + \frac{5}{8} =$

6. $9\frac{2}{3} - 3 =$

7. $\frac{3}{4} + \frac{7}{10} =$

8. $22 - 2\frac{5}{8} =$

9. $3\frac{3}{8} + 9 =$

10. $5\frac{3}{4} - \frac{5}{12} =$

11. $16 + 5\frac{3}{5} =$

12. $1\frac{2}{3} - \frac{3}{4} =$

13. $\frac{5}{6}$ of $48 =$

14. $\frac{4}{5} = \frac{?}{15}$

15. $6\frac{3}{4} + 10\frac{1}{8} =$

16. $\frac{7}{8} - \frac{4}{8} =$

17. $\frac{5}{12} + \frac{1}{12} =$

18. $1 - \frac{7}{8} =$

19. $\frac{7}{10} + \frac{6}{10} =$

20. $1\frac{7}{8} - \frac{3}{8} =$

21. $\frac{5}{8} + \frac{1}{4} =$

22. $16 + \frac{7}{8} =$

23. $12\frac{5}{6} - 8\frac{5}{6} =$

24. $19\frac{1}{10} - 3\frac{7}{10} =$

25. $6\frac{1}{2} + \frac{1}{2} =$

26. $8\frac{1}{6} - \frac{5}{6} =$

27. $10\frac{2}{3} + \frac{1}{5} =$

28. $29\frac{3}{4} - 6\frac{7}{8} =$

29. $2\frac{3}{4} + 5\frac{5}{6} =$

30. Which is more, $\frac{5}{7}$ or $\frac{7}{5}$?