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THE EFFECTS OF PEER TUTORS AND INDIVIDUAL SKILL KITS ON ARITHMETIC ACHIEVEMENT AND ATTITUDE IN GRADE SEVEN

by

Larry Dean Crandall

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Education
(Education)
in The University of Michigan
1973

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CHAPTER I

INTRODUCTION TO THE PROBLEM

The past twelve years has been a time of great change in the mathematics curriculum of the public school. The Revolution In School Mathematics [1961], a publication of the National Council of Teachers of Mathematics, gives indication that the early changes seemed concerned primarily with upgrading the content materials for the college bound and the mathematical training of their teachers. Little attention was paid to methodology with the exception of what was called "teaching by discovery." The basic classroom organization followed Conant's [1959] recommendations of homogeneous ability grouping along with a 'tracking program' of some sort at the secondary level. The research division of the National Education Association [1968] reported approximately one-half of the schools were carefully grouping all children in the elementary grades and that most teachers favored ability grouping.

By the middle 1960's programs were being developed and tested for the average and below average students. However, the view was prevalent that these students could be taught using the same basic content and methodology that had been successful with high achieving students by varying the rate of presentation and giving many more examples. Whatever the situation, Shulte and Wells viewed the provisions as inadequate. In The Continuing Revolution In Mathematics [1968], they stated,

> Not only have the colleges neglected the preparation for teaching slow learners in mathematics, but the "modern

> mathematics" movement has until recently paid little attention to them. (p. 153)

By the late 1960's some educators began to doubt the success of the new mathematics programs in regard to achievement gains. Moray [1968] and Norland [1969] were among those who found achievement better under traditional programs. Tyron and Horn [1969], Romberg [1969], and Beckman [1970] were among those who found no differences or, differences favoring the newer programs. That everyone was not pleased with the accomplishments of the "new math" programs became even more clear when school systems began employing outside firms to teach their students basic skills. The school boards and administrations of these schools were obviously less than satisfied with the learning of their students, at least that learning which is assumed to be evaluated by standardized tests. The schools entered into what were called 'Performance Contracts' with outside educational firms, where the firms' profits were based on student achievement. These ventures usually employed linearly programmed learning sequences with limited and easily tested computational goals. Westby-Gibson [1971] reports that the highly recommended practice of ability grouping was beginning to lose support as were tracking programs.

The late 1960's was also a time of renewed attention to the concept of individualized instruction. It seems that while almost everyone is in favor of some sort of individualized instruction it remains a difficult concept to implement in the average public school classroom. One obvious reason is that in the average classroom, one teacher is responsible for the learning of thirty to forty students. At the junior high level for example, a single teacher will usually average over thirty pupils per

fifty minute class for five classes each day. In addition, regardless of the grouping procedure used, many different levels and types of learning ability will be manifest.

Many of the recently developed programs for individualizing instruction tend to make the teacher's role one of a learning task manager, with the actual instruction coming from some sort of prepared or programmed materials in written form or from a computer terminal. Two often cited criticisms of these programs are their high initial cost and their appearance of being too dehumanized. An excellent documentation of recently developed programs that attempt to provide for individual differences and involve varying degrees of innovation is given in Run, Computer, Run - The Mythology of Educational Innovation by Oettinger and Marks [1969]. One thing held in common by all of these programs is their high initial cost. One of the least expensive is known as Individually Prescribed Instruction, yet we find Carl Fehrle writing in Educational Leadership stating that, "As I have watched IPI unfold I firmly believe, as stated in my first critique of the program, that the idea is sound, but success depends greatly on the money available, and on teachers acceptance." [p. 483]

Clearly, the schools must do a better job of providing students with mathematical competence. It is all the better if it can be done in a manner that is pleasant and interesting to students and a positive experience. The curriculum revisions of the 1960's appear to have been quite successful in providing the schools with updated relevant mathematics. What seems to be needed at present are classroom management techniques and methodologies that will allow each child the maximum opportunity to learn as much of this mathematics as his abilities and

interests permit. However, any scheme to change the status-quo of the average public school classroom is, in reality, subject to some difficult barriers. Among these are the initial and ongoing costs of the proposed change, which may include not only new equipment, learning materials, and supplies, but, considerable teacher retraining. The difficulty of the implementation and management processes is also a crucial factor and in particular, as regards the attitude and cooperation of both school personnel and the community.

The Problem

It was the writer's desire to investigate two supplementary programs of instruction, one based on within class tutoring and the other based on a low cost, commercially prepared, skills development kit. Both programs provide clear alternatives to most present classroom practices and neither founders a-priori, on the rocks of high cost, teacher retraining, or management and scheduling difficulties.

Student tutoring has a long, but sporadic, history of use in the public schools. Many recent investigations, mostly unrelated to mathematics education and utilizing older students to tutor younger students, have shown generally positive results. This study sought, in part, to determine the overall effectiveness of a same-age, in-class tutor-tutee program.

The skills development kit used in this study appears to have wide public school use, but little research information concerning its effectiveness is available. The results that have been reported are mixed. It was felt that the skills kit program would provide a sufficient control program for the tutor-tutee situation and it was also of interest

to assess the effectiveness of the skills kit. This plan had the additional benefit of helping to control for the Hawthorne Effect. Students in the skills kit group who were comparable to the tutors were assigned supplementary work related to the regular program of instruction. This procedure provided for the collection of data to assess whether or not the time spent by tutors in helping others could be justified on the basis of the tutors' mathematics achievement.

The preparation of the two supplementary programs was guided by adhering to the following general objective:

General Objective:

To construct, within the context of a normal public school classroom environment, classroom learning task management procedures that are negligible in cost, easily implemented, require minimum teacher time and expertise, and that will accomplish the following:

1. Identify, prescribe treatment for, and alleviate individual student computational deficiencies;
2. Provide for normally expected achievement in the regular course work;
3. Meet with positive affective response from both students and teachers.

The students were separated into three computational achievement levels and then randomly assigned to classes so that each class would reflect these three achievement levels. Each treatment group and its subgroups will be identified as follows:

T treatment using tutoring and group work,

S treatment using skills kit, and supplementary work,

TH high achieving students who served as tutors of low achieving students

TM middle achieving students who worked in groups, helping each other,

TL low achieving students who were tutored by high achieving students,

SH high achieving students who did teacher assigned supplementary work,

SM middle achieving students who did work in the skills kit until they finished it and then did supplementary work,

SL low achieving students who did work in the skills kit.

Each class was taught from the same textbook and the teachers attempted to standardize methodology, tests, and homework. The T group utilized 30 minute tutoring sessions, 2 to 5 times per week for a total of 40 sessions. The S group used a computational skills kit for exactly the same time and number of sessions.

An attempt was made to compare the effectiveness of the two procedures both between treatment groups and between ability levels in the treatment groups. The general criterion variables were: concept achievement, computation achievement, application achievement and attitude toward mathematics. Subtests of the concept and computation tests were examined in an attempt to find any specific achievement differences that might result from the experiment. In addition, a subjective evaluation of the treatments was made by students and teachers. The answers to six questions were sought: The questions were:

1. How does the mathematics achievement of students in a tutor-tutee-group work program (T) compare with that of students in a supplementary work-skills kit program (S)?

2. How does the mathematics achievement of students who tutored (TH) compare with that of students who did supplementary work (SH)?

3. How does the mathematics achievement of students who worked in groups (TM) compare with that of students who worked basically in a skills kit (SM)?

4. How does the mathematics achievement of students who were tutored (TL) compare with that of students who worked in a skills kit (SL)?

5. How do the treatments affect the attitudes of both treatment groups and their respective subgroups?

6. How do the teachers view the usefulness and success of the two treatments?

CHAPTER II

REVIEW OF THE LITERATURE

The literature related to the study is reviewed in this chapter. Included are sections on student tutoring in the public schools and use of the Science Research Associates, Skills Kit.

The supplementary programs under investigation attempt to provide for individual differences, hence the assumption is made that provision for such differences is a valid educational goal. The literature on individual differences is extensive and has been frequently and thoroughly reported elsewhere, so will not be reviewed here. The majority of the studies and articles on tutoring have not involved mathematics education and many of them have primarily studied the social consequences that might be inherent in the tutoring process. These topics are tangential to the present study and are rather fully reported by Gartner, Kohler, and Riessman [1971] in their book Children Teach Children and will not be summarized here.

Student Tutoring

Bender [1967] writing about tutoring and individualized instruction states:

> One way in which increased individualization might better be implemented to help both the bright and the less bright student is to employ the tutorial system that was basic in the one room school--only in place of having the older child help the younger, the bright student is used to help the less bright; in the process both students are helped. . . [p. 156].

Glasser [1969] advocated working together and tutoring:

> We must get more students involved with each other in an educational system that seems important enough to them so that they will work to learn to think, to solve problems and to become socially responsible. . . [p. 76].
>
> . . . the faster learners can be used to help the slower, a procedure highly beneficial to both. [p. 90].
>
> Those who do badly are tutored by the better students as a class project, receive help from upper classes as a school project, and are encouraged to attend short remedial sessions after school led by volunteer teachers on school time. [p. 93].
>
> In addition, when a student attempts an S, (S means a superior ranking) he agrees to devote some time each week to help those students who are not doing well. [p. 102].

In Children Teach Children, Tyler writing in support of tutoring states:

> Children and youth learn far more when performing the teaching role than when acting as students in the classroom. This principle has been known for centuries, but the development of practices that embody it within the structure of the school systems of today is a very recent achievement. [p. ix].

The tutoring programs that have been reported in the literature are quite varied. The following types have been reported: older students tutoring younger students, brighter students tutoring slower students, and students working in group situations, tutoring each other. Very few programs below the college level have involved tutors and tutees of the same age or in the same regular classes. The programs have ranged from regular school programs to programs sponsored by governmental agencies--and have been conducted during regular school hours, before and after school, and during the summer.

Thelen [1969] reports that proponents of student tutoring feel that it helps meet individual needs, combats prejudice and discrimination, promotes cooperation rather than competition and of: s a focal point

for institutional change. The support for these claims, however, is largely subjective and is more concerned with affective measures rather than cognitive ones.

There is little experimental research of the effects of student tutoring and mathematics learning at any level of the public school. That mathematics education, thus far, has been little concerned about student tutoring is substantiated by the fact that a review of the following books and periodicals does not show a single listing involving student tutoring: The Mathematics Teacher and The Arithmetic Teacher from 1963 to 1971;

Mathematics Education, the 1970 yearbook of the National Society for the study of Education;

A History of Mathematics Education, the thirty second [1970] yearbook of the National Council of Teachers of Mathematics;

Secondary School Mathematics, the Library of Education [1965];

Elementary School Mathematics, the Library of Education [1964].

Mathematics Education [1970] contains only one brief mention of student tutoring. Willoughby writing about the ethical status of teachers tutoring their students without charge before or after school states: "If such informal tutoring is not sufficient, it might be desirable for the school system to set up a tutoring bureau in which older students are asked to tutor for small sums of money in order to avoid involving teachers in a potentially unethical situations." [p. 45]

Burrow [1970] writing about a lack of research on tutoring states:

> There is a paucity of research and experimentation involving junior high and elementary students tutoring elementary students. The majority of research has been reported for the high school and college level tutors rather than for junior high and elementary tutors. [p. 17]

The literature involving tutoring that will be reviewed is divided into three sections: first, position papers and non-mathematics reports; second, descriptive reports on tutoring and mathematics; and third, experimental studies on tutoring and mathematics.

Position Papers and Non-Mathematics Reports

The idea of students tutoring other students is certainly not of recent origin. Wright [1960] states,

> As early as the 1st century, the great Roman teacher, Quintillian, pointed out in his Institutio Oratoria how much the younger children can learn from the older children in the same class. In Hindu schools the use of mutual instruction dates back to ancient times. [p. 353]

Gartner [1971] reports in Didactica Magna, probably completed in 1632 but published first in 1849, the Moravian teacher, John Comenius wrote:

> The saying, "He who teaches others, teaches himself," is very true, not only because constant repetition impresses a fact indelibly on the mind, but because the process of teaching in itself gives a deeper insight into the subject taught. . . The gifted Joachim Fortius used to say that. . . if a student wished to make progress, he should arrange to give lessons daily in the subjects which he was studying, even if he had to hire his pupils. [p. 14-15].

The earliest reported program involving student tutoring in American public schools appears to have been conducted at West High School, Akron, Ohio, in 1924. Horst [1924] reported that some of the better academic students volunteered to serve as advisors and tutors of weaker students. As many as 70 students were tutored in one semester. Records were kept on the academic progress of the tutees, but it was felt that the number of cases was too few to make any definite evaluation of the program.

Horst [1933, 1940] also reported briefly on other high school tutoring programs that were carried out during the 1930's.

In 1933, National Honor Society members served as tutors at the John Adams High School of Cleveland, Ohio. The tutoring was conducted as a regular part of the school program. In all, 145 slower pupils were tutored by 125 National Honor Society members. At Topeka High School, Topeka, Kansas, 94 tutors helped 117 pupils in 1935. It was reported that 82 per cent of the tutees passed their work. High achieving ninth grade pupils at Garfield High School, Akron, Ohio, tutored slower ninth grade pupils. Tutors and tutees were enrolled in the same class and time period. This arrangement was thought important since it enabled tutors to follow the teachers' assignments and methods and helped make the teachers readily available to assist the tutors.

David [1937] reported on a tutoring program at Collinwood High School, Cleveland, Ohio. Senior high school students tutored junior high school students. A study of report card grades indicated that the number of failures in all subject areas declined after the start of the project.

C. C. Harvey [1937] of the Department of Secondary School Principals of the N.E.A. states that student tutoring

> . . . has developed as the best solution to the problem found in many schools of providing more assistance for failing and weak students. . . It promises to become even more important in the future because students needing help often profit more from the assistance of other students than they would even from their teachers. [p. 307]

The majority of tutoring projects of more recent origin have been concerned with reading and/or social studies. Even those projects that have been multi-disciplinary have tended to concentrate on language arts components. Among these were studies or articles by Hawkins [1959],

Delaney [1963], Kuppel [1964], Baum [1965], McCrachen, Leaf and Johnson [1965], Lippitt and Lippitt [1965], Lippitt and Lohman [1965], Weitzman [1965], Luke [1966], Avila [1966], Edler [1966], Wright [1966], Block and Liberman [1967], Stauffer and Groff [1967], Cloward [1967], Davis [1967], Greene [1967], Harris [1967], Schoeller [1968], Rime and Ham [1968], LeBoeuf [1968], Little and Walker [1968], Klosterman [1968], Nichols [1968], Boyd [1969], Hassinger and Via [1969], Ellson, Harris, and Barber [1969], Taylor [1969], Rogers [1969], Noce [1969], Fox, Lippitt, and Lohman [1969], Lippitt, Eiseman, and Lippitt [1969], Fleming [1969], and Frager [1970].

Some larger scale tutoring programs that have been reported in the literature are: the Homework Helper Program reported by Gartner [1971] which began under the direction of the Mobilization for Youth Program in 1963 and since 1969 has operated under the auspices of the New York City Board of Education; the Youth Tutoring Youth Program [1968] of the National Commission on Resources for Youth which started in 1967 and by 1970 had programs operating in more than 200 schools; the Pocoima Elementary School Project reported by Newmark [1969] which began in 1968; and the Student Assistant Program reported by Fleming [1969] which began in 1956 at Woodrow Wilson High School, Portland, Oregon, and by 1969 had spread nearly system wide.

Descriptive Reports on Tutoring and Mathematics

Horst [1929] reporting on the tutoring program at West High School, Akron, Ohio, listed the following quotations from mathematics teachers of tutored students:

> During the fifth week a girl entered my IXA Algebra class with no work beyond IXB. A senior tutored her three times a week for

> more than a month, and at the end of that time she passed an examination with a grade of B, at the same time keeping up with her regular classwork, always with outside help. [p. 347]
>
> In IXB algebra, one boy who did failing work during the first and second weeks had enough help from a student tutor to pass his final examination with a mark of 100. [p. 347]

It was reported that tutors generally agreed that tutoring helped them in their own study of the subject and teachers felt that of 32 tutors, 8 were helped, 2 hindered, and 22 experienced no noticeable effect.

In a follow up report, Horst [1933] reported on a more careful study of the West High School tutoring program. He writes,

> . . . we have the records of 117 students who received help in mathematics in the first seven semesters of organized student help. . . we arbitrarily eliminated students who have fewer than 10 lessons of help, as well as those whose failure to make progress was due to their own lack of effort or cooperation.
>
> The students showed a 9.6 per cent average grade increase and were able to continue successfully without further help. In response to a questionnaire, all but one student tutor said that helping others aided them in preparation of their own lessons. [p. 206]

In another report, Horst [1940] wrote of a program at Garfield High School, Akron, Ohio, and gave a summary of data he had gathered concerning tutoring programs.

> Mr. A. D. Ladd, principal of the Garfield High School at Akron, Ohio, finds that in mathematics and foreign languages, ninth year pupils who did "outstanding work" became the best tutors of other ninth-year pupils when both tutor and tutee had the same teacher and at the same period. [p. 51]

Horst gathered data on 4,000 tutees from various schools and reported that about 60 per cent or approximately 2,400 received benefit from the tutors help. The records of progress given below represents

the work of tutees in mathematics and foreign language, mostly during the years following the beginning of student tutoring in 1923 up to the 1939-1940 school year.

Number of Students	Per Cent of Increase
86	1 to 5
74	6 to 10
50	11 to 15
20	16 to 20
7	21 to 25
6	26 to 30
2	31 to 35 [p. 52]

Horst found that students had an average initial mark of 69.1 per cent and this was raised through tutoring to an average mark of 76.81 per cent. To find how marks were affected after withdrawing tutoring help, after a full semester of tutoring, Horst compared end of semester grades. He found that mathematics averages went from 79.8 per cent to 81.0 per cent and concluded that after one semester of tutoring, most tutees had reached their maximum grade average.

Lansdown [1952] reported on a program which sent college students, enrolled in a course titled "Methods of Teaching Reading and Arithmetic," to elementary schools to tutor selected students. The college students tutored twice a week for a semester. The tutees were selected by their teachers as needing help in mathematics. The writer states, "What the students did for the pupils was (1) to establish an atmosphere in which the pupil wanted to learn and (2) to give them some conceptual understanding of the decimal system." [p. 273] No statistical measures were kept; however, the college instructors found that the methods course students who tutored made better course examination scores and that they unanimously felt the activity to be valuable.

Durell [1965] reported on a project carried out in Dedham, Massachusetts during the 1958-1959 school year. Forty seven self-contained

intermediate grade classrooms in eight elementary schools participated. Research fellows conducted workshops in the fall and were present in the classrooms every day during the school year assisting the teachers. The project was mainly concerned with spelling and arithmetic.

Durell felt that the teacher was the key figure in successful team learning situations since she set the tasks, planned the balance between whole class and team learning activities, analyzes and evaluates individual achievement, and disciplines. He describes the project as follows:

> During learning practice, pupils may compare and correct answers, exchange ideas and evaluate approaches to problems, work together on plans or projects, and assist each other at points of difficulty. Sometimes they may present a team product rather than a collection of individual practice papers. Evaluation and analysis of the results of learning are of course, based upon individual work. [p. 237]

The Metropolitan Achievement Tests were used to make general achievement comparisons. The average achievement gain for the team learning group improved 6 months over the control group for the sixth grade year. Teachers reportedly were pleased with the program and 95% of the parents responding to an anonymous questionnaire were "very pleased" or "satisfied."

Stainback [1971] reviewed a report by Caditz in 1962 regarding a high school tutorial program that was started in the hope of reducing the number of failures in ninth-grade algebra. The number of failures was reduced by the tutorial program.

Kuppel [1964] reported on a student tutoring program inaugurated by the Key Club of Belleville High School, Belleville, New Jersey. Most of the tutoring was done in mathematics with English running a close second. Sophomores, Juniors, and Seniors belonging to the Key Club did the tutoring while the tutees were students who make application

to the Key Club for tutoring help. The program was thought to be a success but no data were reported.

Gross [1968] reported on a tutoring program that involved 50 high school students who were members of the Future Teachers of America Club. The students reported to one of seven selected elementary schools twice a week and tutored after the regular school day. Arithmetic was one of the subjects taught. No statistical data were reported, but the program was deemed a success.

Bell, Garlock, and Colella [1969] reported on a program that involved 38 volunteer high school students tutoring 34 elementary children who were referred for help by their teachers. The writers stated,

> The changes in the elementary pupils themselves were two fold: First of all, the classroom teachers stated that the pupils being tutored showed considerable improvement in their academic performance, particularly in rote-type operations, e.g. multiplication, division. Secondly, the pupils involved had more positive attitudes toward school and their studies. [p. 243]

Experimental Studies on Tutoring and Mathematics

Glatter [1967] investigated the effects of having University education majors in their junior or senior year tutor forty inner-city fifth and sixth graders. The sessions were held on Saturday mornings with one and one-half hours of work on arithmetic and language, followed by one and one-half hours of art work or play. Twenty one elementary students from the same school were used as controls.

Pretest and post-test results in arithmetic and word knowledge were compared and showed pupils in the experimental group with statistically significant achievement increments. Results in relation to changes of

self concept or attitude toward school were indecisive.

Harrison [1968] investigated the effects of having high school students with a record of proficiency in mathematics tutor students selected from a course titled Related Math I. A total of 66 Related Math I students volunteered for the project and an experimental and control group were formed from this group. The experimental group was then subdivided into 5 groups of varying sizes and 1 high school tutor was assigned to each group. The five tutors were selected from 28 applicants. Three boys, and two girls were chosen with all but one junior girl being a senior.

The students were tutored one hour each school day, on school time, in addition to their regularly scheduled Related Math I class. The control group received no help. Three achievement intervals were selected; one after ten hours, the second after twenty five hours, and the last after fifty hours. It was found that the tutored group's gain over the controls was statistically significant at the .05 level after ten hours of instruction. The control groups were found to have a slightly larger gain over the entire experiment period.

Olsen [1969] investigated the effects of enrichment tutoring on (1) self concept, (2) educational achievement, and (3) measured intelligence of male underachievers in an inner city elementary school. Sixty five, second, third, and fourth grade students who were identified by their teachers as underachievers were selected for the study. Volunteer enrichment tutors were assigned to work with the underachieving pupils in areas of academic and enrichment needs. The pupils were stratified by grade level and randomly assigned on a proportional basis by grade level to experimental and control groups. Analysis of covariance was

used with significance set at the .05 level. No differences were found between the tutored and non-tutored groups at the second and fourth grade levels in arithmetic achievement. The tutored group at the third grade level significantly exceeded the control group in arithmetic achievement.

Coker [1969] investigated tutoring with a group of 284 pupils. He employed a factorial design, with sex and mode of treatment being the two factors, and change in achievement and attitude being the composite dependent variable. He found a significant difference between the sexes, with females showing more improvement on science, social studies, and reading vocabulary while males improved more on mathematics and reading comprehension.

Akerman [1970] investigated the effects of both high and low achieving sixth grade students acting as tutors of low achieving third grade students. An arithmetic computation test was given to both the third and sixth graders and twenty four third graders were selected from those scoring in the lower 40 per cent. Six tutors were selected from the upper 40 per cent, six student tutors were selected from the lower 40 per cent, six students who acted as friends of the third graders, and six, sixth graders who remained in their rooms were selected as controls. The tutoring sessions took place in the hallway during the regular third grade arithmetic period throughout the six weeks that the study was conducted. These students received no help from their regular teachers. Analysis of covariance was employed with significance set at the .05 level. It was found that the treatment groups achieved significantl, over the controls. Akerman felt that even though the study was limited it indicated that tutoring helped regardless of the tutors' achievement background.

Rust [1970] investigated the effects of tutoring on the tutors' academic achievement, social status in the class, and overt behavior. He theorized that the use of children, as tutors who had learning, behavior, and social problems, would result in the improvement of their problems. Thirty six, sixth grade students were picked randomly from the lowest 40 per cent of scores on an arithmetic computation test. Three groups were formed; (1) low tutor, (2) friends group, and (3) control group. Third grade tutees were selected and grouped in the same manner. Each low tutor taught arithmetic to a third grade student, the friends group acted as buddies but gave no help in arithmetic, and the controls remained in the classroom.

Rust used the analysis of covariance with pretest arithmetic scores as the covariate. He found a statistically significant difference at the .01 level in favor of the low tutor group compared to the control group. The difference between the low tutor group compared to the friends group approached but did not reach significance in favor of the low tutors.

Stainback [1971] investigated the effects of pupil to pupil tutoring on arithmetic achievement and personal and social adjustment of both tutors and tutees in grades five through seven. His review of the literature on pupil to pupil tutoring concluded that although many educators were advocating tutoring to help individualize instruction, the research on pupil to pupil tutoring was inconclusive.

The study utilized two fifth grade classes, two sixth grade classes, and two seventh grade classes with each class containing approximately thirty students. Thirty tutors and thirty non-tutors were selected from the six classes on the basis of scoring in the top one third of their respective classes on the California Arithmetic Test. Thirty

tutees, and thirty non-tutees were selected by scoring in the bottom one third on the CAT.

One teacher, who volunteered for the task, taught the six classes in arithmetic. The study was conducted for 57 days and the teacher conducted the classes according to normal routine except that each class was assigned a twenty minute arithmetic study lesson each day. It was during this twenty minute period that the experiment was carried out. The teacher was instructed not to give assistance to the students working in the tutoring relationship but could assist the middle group and the control group, in which students were working independently of each other.

A one way analysis of variance statistical technique was used with significance set at the .05 level. Stainback found no significant difference between tutors and non-tutors on arithmetic achievement gain, personal adjustment gain, or social adjustment gain. The same held true for tutees and non-tutees. He felt one plausible explanation of the results was that the tutoring program was just as effective as having one teacher provide assistance for twenty students since the only trends were in the direction of the experimental tutors, and the teacher felt the tutoring program provided more assistance than would have been obtained otherwise.

After completion of the study students were given the option of studying in a one-to-one tutoring relationship or independently. The majority chose the tutoring relationship.

Burrow [1970] investigated the effects of older volunteer students tutoring younger students in arithmetic computation. He felt that there might be a waste of ability, skills, and information by not organizing

the classroom instructional program to utilize older students as tutors of the younger students. The study was conducted during the summer so that the tutoring would not interfere with or be contaminated by the regular classroom work and more time would be available for an organized program of tutoring. It was hypothesized that, (1) tutored pupils would achieve higher gain scores on computational skills than non-tutored pupils; (2) tutors would achieve higher gain scores on computational skills than non-tutors; (3) female tutors would achieve better results than male tutors; (4) tutors who were above the median on the pretest would achieve better results than tutors who scored below the median.

Students in grades three through eight were given the whole number computation subtests of the Stanford Diagnostic Arithmetic Tests. A subgroup of the third, fourth, and fifth graders who scored at or below the fifth stanine comprised the tutees group. A subgroup of the sixth, seventh, and eighth graders who scored at or above the third stanine comprised the tutors group. Control group tutors and tutees were similarly chosen.

The experimental treatment consisted of one-to-one tutoring in whole number computational skills. Eighteen tutoring sessions were followed by a free play period. The diagnostic test results were used to prepare materials for the tutoring act. These results were keyed to the California Self-Helps in Arithmetic for each tutee. Tutors were given directions for performing the tutoring act and a set of thirteen specific directions relating to the tutoring procedure were written out and given to each tutor.

Analysis of variance was used to test significance on the pre- and post-test gain sc[illegible] with significance set at the .05 level. Results

showed (1) tutored pupils scored significantly higher than non-tutored pupils, (2) tutors showed no significant gain over the control non-tutors, (3) tutees tutored by girls had significantly higher gain scores, and (4) there was no significant difference between gains of pupils taught by more-able or less-able tutors.

Ellis [1971] investigated the effects of high achieving high school students tutoring low achieving high school students. Using the median from averaged factors of grade point, mathematics grade point, and grade from most recent mathematics class, tutors were selected from the group above the median, while tutees selected from those below the median. The Cooperative Mathematics Tests were used as the evaluative instrument. It was found that the tutees showed greater gains than the tutors and results from a questionnaire indicated little difference between experimental and control classes in terms of attitudes toward mathematics. Correlation comparisons showed tutoring was the most important variable in contributing to student gains.

The Skills Kit

The skills kit used in this study is the commercial version of materials developed by Charles M. Proctor and Patricia Johnson in 1962. In a letter dated November 1, 1971 Mr. Proctor states:

> The Computational Skills Development Kit was initially developed for Montgomery County Public Schools by Mrs. Johnson and me beginning in the fall of 1962. It was used in the initial unpublished form for two years (it took us about a year to complete it, get it duplicated, distributed, and train the teachers in making use of it). During the two years in which it was used in the preliminary form we kept a record of the achievements of our seventh grade mathematics students in Montgomery County Public Schools. The test we used was part of the old California Battery. The result was a very significant improvement in test scores for a very large group of students (approximately 7,000).

The Computational Skills Development Kit has been commercially available from Science Research Associates since 1965. Even though the Kit has probably had wide use, since it is still available and advertised, the published research on its effectiveness is meager.

Collins [1971] reported that he used the SRA Computational Skills Kit as a part of a group of alternate resource materials. He found, "The use of alternate resources did not appreciably increase student achievement, indicating that the prescriptions based on the text and classwork were adequate." Collins did his study with four seventh grade classes and four eighth grade classes.

Mastbaum [1969] in a well documented statistical study compared the achievement of both seventh and eighth graders who were grouped as follows: calculator group, skills kit group, calculator and skills kit group, and no calculator or skills kit group. Among the conclusions he reached were the following:

> 5. The classes which used the skills kits achieved as well as the no skills kit classes with respect to attitude, mathematical achievement, mastery of mathematical concepts and ability to solve problems.
>
> 6. The skills kit, when used as it was used in this study, was not effective in increasing the computational skill of the classes using it when compared with the classes not using it. [p. 1972]

Summary

The results of experimental research on tutoring and mathematics is quite limited and not in agreement. This is probably due to both the small number of studies and the fact that they are often not comparable. Glatter [1967] found that tutored students achieved significantly when tutored by college students. Harrison [1968] found that high school students tutored by high school students made significant gains after

ten hours of instruction, but not after twenty five hours or fifty hours. Olsen [1969] found no significant difference for tutored second or fourth grade students, but found tutored third graders scoring significantly higher than controls. Akerman [1970] found third graders tutored by sixth graders achieving significantly over the controls. Rust [1970] found low achieving sixth graders acting as tutors achieved significantly better than low achieving sixth graders who did not tutor. Stainback [1970], in the only mathematics tutoring study reviewed which used tutors and tutees of the same age and in the same classroom, found no significant differences between tutors and non-tutors or between tutees and non-tutees. Burrow [1970] found tutees scoring significantly higher than non-tutees, but no significant differences between tutors and non-tutors.

Experimental studies of tutoring that did not involve mathematics are not in agreement. Weitzman [1965] found tutored students showing no significant gain over non-tutored students on classroom examinations. Cloward [1967] found tutoring of significant benefit to both tutor and tutee. Davis [1967] found significant gain for the tutors over their control group, but not for the tutees. Hassinger and Via [1969] found high school tutors making significant gains when compared to their fourth, fifth, and sixth grade tutees. Rogers [1969] found third grade under-achievers when tutored by sixth graders scoring significantly better than the controls, but the gains for tutors were not significant. Boyd [1969] in a replication of Rogers' study had identical findings.

The literature on student tutoring consists mostly of position papers and non-experimental reports. These papers and reports all tend to present positive results, opinions, and/or feelings. As has been shown, the

experimental reports are not in agreement as to the benefit of student tutoring in relation to the tutors or the tutees. It should be noted, however, that no report or study reviewed showed tutoring to be a detrimental classroom practice.

CHAPTER III

DESIGN OF THE STUDY

The purpose of this study was to examine the effects of two supplementary programs of instruction on the mathematics achievement and attitude of seventh graders. One program was based on student tutoring, while the other was based on the use of a computational skills kit. Details of the programs and of the design of the study are included in this chapter, using the following organization:

1. The Null Hypotheses
2. Instruments Used
3. Selection of Treatment Groups
4. The Setting for the Study
5. The Treatments
6. Statistical Analyses Used

The Null Hypotheses

There were four major criterion variables, computational achievement, concept achievement, application achievement, and attitude towards mathematics. The following four null hypotheses were applied to each variable.

H_1: There are no significant differences in the mean test scores of the T and S groups.

H_2: There are no significant differences in the mean test scores of the TH and the SH groups.

H_3: There are no significant differences in the mean test scores of the TM and SM groups.

H_4: There are no significant differences in the mean test scores of the TL and SL groups.

Computation, concepts, and applications achievement were tested by Test 1, Test 2, and Test 3, respectively of the Stanford Arithmetic Tests, Advanced Level, Forms W and X. Attitude towards mathematics was tested by the Aiken-Dreger mathematics attitude opinionnaire.

The major criterion variables of computation and concepts achievement were subdivided into the following classifications:

Computation Achievement; (1) addition and subtraction of whole numbers, (2) multiplication of whole numbers, (3) division of whole numbers, (4) computation with common fractions, and (5) computation with decimal fractions and per cent.

Concepts Achievement; (1) number systems and operations, (2) decimal place value, and (3) understanding of common fractions.

Each of these eight sub-variables generated a set of four null hypotheses identical to H_1, H_2, H_3, and H_4. These hypotheses were tested using the data from the appropriate subtests of the Stanford Diagnostic Arithmetic Tests, Level II, Forms W and X.

Instruments Used

The following instruments were used in this study:

1. Stanford Arithmetic Tests, (SAT 2), Intermediate II Level, Form W, 1964
2. Stanford Arithmetic Tests, (SAT), Advanced Level, Forms Wand X, 1964
3. Stanford Diagnostic Arithmetic Test, (SDAT), Level II, Forms X and W, 1966
4. Lorge-Thorndike Intelligence Tests, (IQ), Verbal Battery, Form 2, Level D, 1964
5. Aiken-Dreger Mathematics Attitude Scale (ADMA).

The SAT and SDAT were chosen because: (1) they met the needs of the study for achievement and diagnostic instruments, (2) they cover all the mathematics skills that the study sought to affect and assess, (3) both have national norms and are correlated to each other, (4) SAT had been used during the past four years to measure mathematics achievement in the Cobre School System, (5) both tests are widely used and are available to most schools, and (6) both have been used in studies relative to mathematics achievement and have been accepted by many researchers as valid and reliable instruments. The SAT 2 was chosen because student scores were available in the student folders. The test was administered in April, 1971 and the computation scores were used to group the students initially.

The Lorge-Thorndike Test was chosen because it is the I.Q. Test available in the Cobre Consolidated Schools' pupil records. The test is widely used and considered to have high validity and reliability. The test was administered to all but 16 of the students who participated in the study in February, 1971, when they were sixth graders. The test was administered in separate classrooms by the systems' director of guidance services. The other 16 students were given the test between September 15, 1971, and November 1, 1971.

The Aiken-Dreger Attitude Scale was chosen as a suitable instrument to measure attitude toward mathematics and any subsequent changes in attitude. The ADMA has been used in several doctoral studies and it appears to be an appropriate instrument to measure change of attitude through comparison of pre and post-test results.

The SAT was administered as a pretest, post-test, and retention test by the teachers and the writer. The tests were machine scored. The SDAT

was administered as a pretest and post-test by the teachers and the writer. The tests were scored first by the teachers and then by the writer. This served to help minimize checking errors and also gave teachers and the writer greater insight into the students' difficulties. The Aiken-Dreger Attitude Scale was administered by the writer as a pre-test and a post-test.

All tests were administered in the same order and at approximately the same time in both T and S classes. The necessary make-up tests were given under conditions as near to the original as possible. All tests were administered exactly according to the directions given in the test manuals.

Stanford Arithmetic Tests

Form W of the Stanford Arithmetic Tests, Intermediate II Level, was used to determine the initial selection of students to specific classes and treatment groups. Only the scores obtained on the Arithmetic Computation subtest were used. The Computation subtest contains 39 items and allows 35 minutes for completion. The Computation subtest has odd-even split half reliability coefficients correctial by Spearman-Brown Prophecy Formula, and Kuder Richardson reliability coefficients for grade 6 of $r_{II} = .89$ and $r_{KR20} = .87$, respectively.

Form X of the Stanford Arithmetic Tests, Advanced Level, was used as a pretest to determine if any pre-experiment differences existed in the areas of computation skill, concept mastery, and application of mathematics. Form W of the same tests was used as a post-test to determine if any post-experiment differences existed in the same three areas. Form X was used for retention.

The Stanford Arithmetic Tests, Advanced Level, are divided into three subtests. Test 1, Arithmetic Computation, contains 41 items and allows 32 minutes for completion. Test 2, Arithmetic Concepts contains 40 items and allows 25 minutes for completion. Test 3, Arithmetic Applications contains 36 items and allows 30 minutes for completion. All of the tests are multiple choice, and were used with a MRC answer sheet supplied by Harcourt, Brace, and World Test Scoring Service which machine scored the tests. The statistical analyses of this study were made using the raw scores of the subtests. Forms W and X used in this study are from the 1964 revision of the Stanford Achievement Test Battery.

The Stanford Diagnostic Arithmetic Tests

The SDAT, Level II, is a series of measures designed to identify needed areas of instruction in fundamental arithmetic skills. It may be used for the joint purpose of diagnosis and measurement and was so used in this study. The SDAT, Level II, consists of the following subdivisions:

(1) Concepts of Numbers and Numerals,
Part A. Number System and Operations
(Time: 20 minutes, 20 questions)
Part B. Decimal Place Value,
(Time. 20 minutes, 26 questions)

(2) Computation with Whole Numbers
Part A. Addition and Subtraction,
(Time: 12 minutes, 26 questions)
Part B. Multiplication,
(Time: 20 minutes, 18 questions)
Part C. Division,
(Time: 30 minutes, 18 questions)

(3) Common Fractions,
Part A. Understanding,
(Time: 20 minutes, 22 questions)

Part B. Computation,
(Time: 28 minutes, 28 questions)

(4) Decimal Fractions and Per Cent
(Time: 35 minutes, 48 questions)

(5) Number Facts,
(This is a set of orally given subtests that were not used in this study.)

This study used the suggested time limits and they were found to be generous for each class.

Form W of the SDAT, Level II, was used as a pretest to determine if any pre-experiment differences existed in the areas tested by tests 1-4. The pretest was also used by the teachers as one criteria for selection of tutors in T Groups and was used by all T group students during tutoring treatment sessions. These uses are detailed later on in this chapter. Form X of the SDAT, Level II was used as a post-test to determine if any post-experiment differences existed in the areas tested.

The directions contained in the Manual for Administering and Interpreting SDAT, Level II, were followed as closely as possible. The manual contains general guidelines for interpreting test results and analyzing student responses to the test questions. This section of the manual was studied by the teachers and discussed in two teacher meetings conducted by the writer. The material on the analysis of student responses was also used as a part of the background given to the tutors to help prepare them for their role.

The 1966 edition of the SDAT has the following characteristics: (1) approximately 15,000 second through eighth grade students from 7 school systems in 5 states participated in the item analysis program, (2) 8,000 cases from 4 school systems were used in the standardization

program, (3) the SAT was administered two weeks prior to the SDAT to provide comparative norms and correlations, and (4) reliability coefficients, national norms, correlations between SDAT and SAT subtests, SDAT subtest intercorrelations, and percentile ranks are provided.

Lorge-Thorndike Intelligence Tests

Form 2, Level D of the 1964 Lorge-Thorndike Intelligence Tests was administered to all sixth grade students in February, 1971. MRC answer sheets were used and the tests were scored by a commercial test scoring service. Sixteen students who did not take the test during February, 1971, took the test between September 15, 1971, and November 1, 1971. Their tests were hand scored. The I.Q. scores were obtained from the personnel records of the school.

The 1964 edition of the test has the following characteristics: (1) a stratified sampling procedure using population and two socio-economic indices to form classes from which one community per class was randomly chosen, (2) norms based on 72 sampling units with approximately 19,000 students per grade level for grades 3 through 12, (3) an alternate form reliability coefficient based on forms 1 and 2 of greater than .85 for all levels of the test, and (4) a good validity in terms of correlations with three other widely used intelligence tests of .77, .79, and .84.

Selection of Treatment Groups

A sixth grade population of 204 students who had completed the Stanford Achievement Tests, Intermediate II, Level 1, in the Spring of 1971 was available as a sample population. A three level stratification based on the computation subtest scores was made so that approximately

equal numbers of students would be contained in each level. Level 1 represents the upper third, Level 2 the middle third, and Level 3 the lower third in computation achievement. This resulted in 65 students being placed in each of levels 1 and 2 with 74 students being placed in level 3.

It was desired to have each treatment class consist of 9 students from each achievement level for a total of 27 students per class. To this end students in each of the three stratifications were assigned numbers beginning with 01. The six classes to be used in the experiment were labeled 1 through 6. A table of random numbers was entered and the numbers were read two digits at a time in order left to right. Students were selected from stratification level 1 as their numbers occurred for classes 1 through 6 in a revolving manner, i.e., one student for class 1, then one student for class 2, and so on until 9 level 1 students were in each class. The same procedure was used to select students from level 2 and level 3. The students not selected by this process were then placed in the two classes not being used in the experiment.

The six classes selected were split into 3 tutor group (T) classes and 3 skills kit (S) classes by drawing numbers out of a box without replacement. The 3 teachers, who volunteered to teach the classes, were matched to classes by drawing numbers out of a box. Each teacher taught one T class and one S class.

As often happens in the public schools, by the time the 1971-1972 school year began it was necessary to switch some students due to scheduling difficulties. 8 T students and 7 S students were affected. In the T group there were 2 level 1, 3 level 2, and 3 level 3 students affected while in the S group there were 3 level 1, 1 level 2, and 3

level 3 students affected. Students from the two classes not selected for the experiment, whose schedules could be changed, were selected at random to fill the vacancies in each respective achievement level.

The teachers of T classes selected the nine student tutors for each class from the top 14 scores on the pre-achievement test. By the time this selection was made the teachers had known the students for 15 weeks and it was hoped they could select the students who would do the best job of tutoring. This selection resulted in only 5 students chosen who were not in the top nine in each class. Two in two classes and one in another class.

The Setting for the Study

The school system in which the study was conducted serves a total grade one through grade twelve student population of 3,000. The system is comprised of five elementary schools, one junior high school, and one senior high school. The school system is located in an area where the economy is based primarily on the mining and processing of copper and related metals with cattle ranching and general agriculture being other economic contributors. Approximately twenty per cent of the schools' students qualify for aid under the Elementary and Secondary Education Act which is based on a family income of $2,500 or less. English is a second language for approximately twenty per cent of the students and over fifty per cent are bilingual speaking both English and Spanish. The school wide I.Q. level as measured by the Lorge-Thorndike verbal batteries is approximately 94 to 95.

The 1972 seventh grade class which comprises the population for the proposed study has an average I.Q. of 93 according to tests administered in February 1971.

The Curriculum

The student population in grades three through six is grouped for instruction on the basis of reading test scores and teacher recommendations. The organization used is the contained classroom. The Addison Wesley Elementary School Mathematics Series has been the basal textbook series for grades one through six since 1965. A survey of the computational material contained in the ESM series indicates that the computational skills tested by the Stanford Achievement Tests are developed in the ESM series. A survey of elementary teachers indicates that they feel they have taught the computational skills developed in the ESM program.

The student population in grades seven through twelve is grouped for instruction on the basis of mathematics achievement test scores and teacher recommendations. Mathematics is an elective subject in grades eleven and twelve. Seventh grade classes have used Scott-Foresman's Seeing Through Mathematics, Book I since 1964. Eighth grade students are grouped into three tracks and ninth graders are grouped into four tracks. The high school program offers courses ranging from business and vocational mathematics to a two semester calculus course.

Special E.S.E.A. Title I funded programs have been conducted since 1966 for the lowest twenty per cent of the students in mathematics achievement at the ninth and tenth grades. The emphasis of these special programs has been on the improvement of computational skills, practical consumer and job-oriented problem solving experiences, and effecting appreciation for the usefulness of mathematics. A wide range of learning aids and materials have been used including the use of desk top calculators. Test results for these special programs have been very disappointing. Subjective evaluation concerning attitude has tended to be positive.

The mathematics coordinator and the elementary and secondary mathematics teachers have been aware of the computational deficiency of the student population for several years. The coordinator has conducted numerous individual and group meetings with teachers concerning this problem. Numerous short term workshops have been conducted in each school dealing with the teaching of computational skills in a meaningful manner. It is the opinion of the coordinator that teachers have tried to remedy the problem without giving it undue emphasis in regard to the total mathematics curriculum. As the test results indicate, these efforts have not been successful in a measurable sense.

The Teachers

As part of a 1969-70 school wide evaluation made for the New Mexico State Department of Education, the following statistics on the mathematical training of the instructional staff were compiled:

Secondary (7-12)	Semester Hours
Average number of mathematics hours	36.9
Average number of undergraduate mathematics hours	24.9
Average number of graduate mathematics hours	12.0
Elementary (1-6)	
Average number of mathematics hours	8.05
Average number of undergraduate mathematics hours	3.76
Average number of graduate mathematics hours	4.30
Average number of mathematics education graduate hours	1.95

The average number of graduate hours for elementary teachers in mathematics and mathematics education, which totals 6.25 semester hours, were compiled during the past seven years through special modern mathematics courses for inservice elementary teachers. (These courses were offered at a local university.) The majority of the 12 graduate mathematics hours compiled by secondary teachers were gained through a similar program, at the university, designed for secondary teachers. The courses offered, at both levels, represented the University's implementation of the CUPM recommendations for the training of teachers of mathematics.

The Junior High School Mathematics Staff consists of six teachers. Four of these teachers have undergraduate majors in mathematics and all are working on Masters Degrees in Education. The other two teachers have undergraduate minors in mathematics and hold Masters Degrees in Education. The experience factor ranges from four to fourteen years of teaching experience and averages 7.6 years. Most of these years of teaching experience have been compiled in the local Junior High School.

The three teachers, one male and two female, who participated in this study had the following characteristics: one had over ten years of teaching experience, an undergraduate science major and a mathematics minor, and fifteen semester hours of modern mathematics courses for secondary teachers; another had six years of teaching experience, an undergraduate major in elementary education and a mathematics minor, eighteen semester hours of modern mathematics courses for secondary teachers, and a master's degree in education; the third had three years of teaching experience, an undergraduate mathematics major, twelve semester hours of graduate mathematics, and three semester hours of modern mathematics courses for secondary teachers.

The purpose of this record of staff training is to document that, at least on the basis of paper qualifications, the elementary and Junior High instructional staff is well qualified as regards their mathematical training. The degree to which this level of training has contributed to the success of the instructional program, as regards student achievement, is purely speculative. One might guess, from a study of the statistical results listed in the next section, that this training has contributed positively to the students' achievement of concepts while having no positive effect on computational achievement.

Test Data 1968-1971

The achievement data for Cobre Schools covering the years 1968-1971 are shown in Tables 1, 2, 3, and 4. The scores portray a consistent pattern of lack of desired achievement in computational skills.

The test results show that between the end of the fourth grade and the end of the seventh grade computational achievement has not kept pace with either concept or application achievement as measured by the Stanford Achievement Tests. The 1968 fourth grade and the 1971 seventh grade are basically the same group of students. This class shows a 1.4 grade level gain in computation compared to a 2.7 gain in concepts and a 2.5 gain in applications over the three year period. The 1969 fourth grade and the 1971 sixth grade are basically the same group of students. This class shows a 1.0 grade level gain in computation compared to a 1.6 gain in concepts and a 1.6 gain in applications. The 1968 seventh grade and the 1971 tenth grade are basically the same group of students. It is difficult to make a comparison here due to the different nature of the Stanford Test instruments used at these two grade levels. The

TABLE I

MEAN GRADE OF PERCENTILE SCORES - STANFORD
ACHIEVEMENT TEST - COBRE SCHOOLS
BAYARD, NEW MEXICO

	4th 1968	4th 1969	4th 1970	6th 1971	7th 1968	7th 1969	7th 1970	7th 1971	10th 1968	10th 1969	10th 1970	10th 1971
Computation	4.2	4.4	4.4	5.4 18%	6.7 38%	6.7 38%	5.8 18%	5.6 14%	RS 21 26%	RS 21 26%	RS 21 26%	RS 22 30%
Concepts	4.0	4.3	4.1	5.9 30%	5.7 48%	7.7 54%	7.0 40%	6.7 34%	RS 18 44%	RS 20 48%	RS 17 38%	RS 19 50%
Applications	4.0	4.1	4.0	5.7 30%	6.8 34%	7.2 38%	6.7 32%	6.5 28%				
Average I.Q.	90	92	90	93	94	97	94	92.5	93	93	91	93
Number Tested	227	230	234	194	231	222	243	231	220	199	255	210

4th, 6th and 10th scores at end of 7th month.

7th scores at end of 6th month.

Expected deviations from grade scores for low average I.Q. at 7th grade.

Computation	-0.4
Concepts	-0.7
Applications	-0.9

TABLE 2

MEAN GRADE LEVEL ON STANFORD ACHIEVEMENT TEST - 4TH GRADE - COBRE ELEMENTARY SCHOOLS (BAYARD, HURLEY, CENTRAL, SANTA RITA, SAN LORENZO, N.M.)

MARCH TESTINGS

Name of Test	National Norm Based Grade Level of 4.7		
	1968	1969	1970
Word Meaning	4.0	4.3	4.1
Paragraph Meaning	4.0	4.3	4.2
Spelling	4.3	4.3	4.3
Work Study	3.9	4.0	4.2
Total Language	3.8	3.8	4.0
Arithmetic Computation	4.2	4.4	4.4
Arithmetic Concepts	4.0	4.3	4.1
Arithmetic Applications	4.0	4.1	4.0
Total Social Studies	4.4	4.6	4.4
Science	4.1	4.5	4.3
Number Tested	227	230	234
Average I.Q.	90	92	90

TABLE 3

MEAN GRADE LEVEL ON STANFORD ACHIEVEMENT TEST
7TH GRADE - SNELL JUNIOR HIGH SCHOOL
BAYARD, NEW MEXICO

FEBRUARY TESTINGS

Name of Test	National Norm Based Grade Level of 7.6			
	1968	1969	1970	1971
Paragraph Meaning	6.9	6.9	6.4	6.3
Spelling	7.0	7.3	7.0	6.7
Total Language	6.7	6.7	6.2	5.9
Arithmetic Computation	6.7	6.7	5.8	5.6
Arithmetic Concepts	7.5	7.7	7.0	6.7
Arithmetic Applications	6.8	7.2	6.7	6.5
Total Social Studies	6.7	7.1	6.8	6.5
Science	7.1	7.3	6.8	6.5
Number Tested	231	222	243	231
Average I.Q.	94	97	94	92.5

TABLE 4

PERCENTILE RANK ON STANFORD ACHIEVEMENT TEST
10TH GRADE - COBRE HIGH SCHOOL
BAYARD, NEW MEXICO

Name of Test	National Percentile Rank of Class Average Score			
	1967-68	1968-69	1969-70	1970-71
English	36	36	28	28
Numerical Computation	35	37	32	40
Mathematics	44	49	38	50
Reading	32	32	28	32
Science	46	46	32	35
Social Studies	36	34	34	37
Spelling	42	42	30	36
Number Tested	220	199	255	210
Average I.Q.	93	93	91	93

numerical competence test of the high school battery appears to be testing the same area of achievement as the computational test of the junior high school battery. If this observation is valid, a comparison shows an 11 point drop in percentile scores in computational achievement over the three year period. The mathematics part A test of the high school battery measures specifically the content of the usual high school courses and emphasizes elementary algebra and geometry. If a comparison here has any validity in relation to either concepts or applications measured in the seventh grade it indicates a normally expected gain over the three year period.

The foregoing analysis of achievement test scores when viewed in relation to the overall mathematics curriculum and student population characteristics indicates that the achievement of mathematical concepts and applications has been satisfactory. This is further supported by the fact that the expected deviation from grade norms for a low I.Q. group on the Stanford Test at the seventh grade level is as follows: -0.4 computation, -0.7 concepts, and -0.9 applications. The achievement of computational skills is clearly not reaching the desired or normally expected level.

The Lorge-Thorndike Intelligence Test was administered to members of both treatment groups in February, 1971. The test scores were analyzed to test for any pre-existing differences in I.Q. among the main treatment groups and each of the subgroups. The I.Q. test was used as a covariate in the ANCOVA test on post and retention tests.

Table 5 shows the means for the full groups and each subgroup. According to the manual accompanying the Lorge-Thorndike test the TH-SH group belongs to a normal average I.Q. grouping, the TM-SM group

TABLE 5

LORGE-THORNDIKE INTELLIGENCE TEST SCORES

	Treatment			
	T	S	TH	SH
Mean	93.64	93.83	103.11	101.89
S.D.	12.37	14.52	11.13	12.17
	TM	SM	TL	SL
Mean	91.85	92.85	85.96	86.16
S.D.	11.65	16.98	7.31	8.93

Analysis of Variance Results

	T vs. S		TH vs. SH	
	F	P	F	P
Equality of Means (one-way ANOVA)	0.01	p > .25	0.15	p > .25
	TM vs. SM		TL vs. SL	
	F	P	F	P
Equality of Means (one-way ANOVA)	0.06	p > .25	0.01	p > .25

belongs to a weak average, while the TL-SL group is below average.

The results of the ANOVA test performed on the scores for each group showed no significant differences. The groups are reasonably well defined on the I.Q. variable and are extremely well matched within each grouping.

The Treatments

The Regular Program

The regular instructional program was based on the material contained in Scott-Foresman's Seeing Through Mathematics, Book I, copyright 1962. The text is decidedly modern and is highly concept oriented. It is written with a question-answer format that contributes greatly to a guided discovery teaching approach. The chapter titles are as follows:

SEEING THROUGH MATHEMATICS, BOOK I

Chapter 1. Sets, Conditions, and Variables
2. Intersection and Union of Sets
3. Conditions in Two Variables
4. Conditions Involving Rate Pairs
5. Numeration Systems
6. The Natural Number System
7. The Rational Numbers of Arithmetic
8. Geometry and Measurement

The first basic computation work appears in Chapter 1, pages 50-60. Teachers were asked to skip this material until the experiment was in progress. Chapter 2 contains no basic computation work. Teachers were asked to skip Chapter 3 until the experiment was in progress and to go to Chapter 8 and work primarily on geometry that involved little computation. Each of these chapters contains exercise sets called "Keeping Skillful" which are basically computation exercises. The teachers were instructed to skip these until the experiment was in progress. During the experiment period the classes covered most parts of Chapters 3, 4, and 5. After the experiment period the classes covered parts of Chapters 6 and 7. Approximately five sixths of the available classroom time for the school year was spent on the regular instructional program. The following approximates the time allotment schedule for the classes during the study:

80 minutes per week--Whole class guided discovery instruction based on the textbook.

40 minutes per week--In class directed study of material in the textbook.

90 minutes per week for 13 weeks--Time spent on supplementary programs; Treatments T and S.

30 minutes per week--Tests.

45 minutes per week--Classroom management activities.

An attempt was made to provide some standardization of the following:

1. Type and amount of homework;
2. Rate of coverage of material in the regular program;
3. Evaluation of students' progress.

The foregoing schedule and suggested standardization was meant to serve as a guide for teachers in organizing the regular instructional program. It was not rigidly followed, particularly whenever the teacher felt that it compromised his ability to make full use of his teaching skills. The time periods used for Treatments T and S were the same. The time the classes met were as follows:

T classes met at 8:30-9:30, 8:30-9:30, and 12:20-1:20;
S classes met at 9:35-10:35, 1:20-2:20, and 2:25-3:25.

Treatment T

The Teachers' Role

The teachers of Treatment T classes were supplied with pre-achievement test results including an item analysis and class profile chart. They also received copies of their students' scored diagnostic tests with written interpretations for items missed and suggestions for remediation and reinforcement work. The teachers used this information

to form the student tutoring groups. It was hoped that they would also use it in relation to their teaching of the regular program; for instance, as a basis for differentiating assignments.

The teachers were asked to act in the role of facilitators in relation to the tutor group process. This meant specifically, that they would try to keep each group actively in pursuit of its specific goal by supplying encouragement and instructional help only to the minimal degree necessary to keep the group process functioning. The objective was to provide the group members with maximum independence in working toward the specific goal they had been assigned.

At the end of each group session the students filled out a prepared "Record of the Group Session" report. The report's purpose was to provide a record of group membership, topics studied, and student comments concerning the success of the session. The teachers collected, initialed, and filed these reports which, in addition to their record keeping function, provided some immediate feedback that was useful in the forming of groups and in facilitating their functions.

The students also completed an anonymous opinionnaire given twice during the treatment period. The purpose of the opinionnaire was to attempt to assess each student's feelings as regarded some rather specific cognitive and affective areas of student response to participation in Treatment T. The opinionnaire was designed to provide data that might be useful in attempting to answer some of the questions posed for the study. The opinionnaires were turned in directly to the writer and the resulting information was not made available to the teachers until the end of the treatment period. It was felt that this practice might serve to enhance the integrity of the student responses. Teachers also

responded to a questionnaire. The teachers questionnaire attempted to assess the teacher's feeling about the usefulness of specific parts of the treatments and about specific areas of student behavior. The student opinionnaires (and both student and teacher written comments) appear in Appendix B. The teacher questionnaire appears in Chapter 4.

The Students' Role

The student tutoring group concept is based on the belief that seventh grade students who are proficient at both concept and skill levels in relation to specific computational tasks have the potential to assist fellow students in their efforts to understand and perform such computational tasks. Two and one half class periods were used to orient all students to the student helper group process, its purpose and its goals.

It was felt that the student tutors would need some initial direction in how to perform the role they had been given. To this end the writer met with the tutors, one class at a time, and discussed their responsibilities and procedures that might be helpful to them. Suggestions given the tutors included the following:

(1) Try to make the student you are helping feel that you really want to help him,

(2) Give him general encouragement and praise him when he is successful,

(3) Do not emphasize his failures or lack of understanding,

(4) Always try to review briefly what the student did during the last helping session,

(5) Never do problems for him, rather do problems <u>with</u> him,

(6) Do not be hesitant to admit that you do not know how to do some particular problem, if you need help be sure to ask the teacher for assistance, and

(7) Between tutoring sessions try to spend some time thinking of ways you might be more effective in your helping role.

Three meetings were held with the tutors with each lasting approximately 50 minutes. The writer attempted to answer the tutors' questions. Two meetings occurred after the tutors had experienced five helping sessions. Their questions were primarily concerned with how to actually perform the tutoring act and what to do when the person they were helping still didn't understand, after their first or second try at helping him. The writer felt that by the end of the third meeting the tutors were self confident enough to rely on their teachers for any further assistance.

The Student Record Booklet

Each student received a student record of progress booklet containing a copy of his scored diagnostic test, an item content outline cross referenced with both fifth and sixth grade elementary mathematics texts that were available for reference, and a set of directions detailing how to interpret and use the provided materials. The student's work relating to items on the diagnostic test were kept in the record book. Each student was asked on two occasions to answer a prepared questionnaire concerning how he viewed his progress, his attitude toward the helper group process, the usefulness of the provided materials, and his attitude toward the regular class work.

Operational Examples

To supply background for the example to be given it was expected that the following would have been accomplished:

1. The teachers have received and familiarized themselves with the achievement test results, item analysis, class profile chart, and scored copy of each students diagnostic test;

2. The students have received and familiarized themselves with their scored diagnostic tests and cross referenced item content outlines;

3. The teachers and students have been thoroughly oriented in the use of the materials, procedures, and general objectives of the treatment.

Example I

In studying the diagnostic profiles, the teacher finds that John scored at stanine two on the Decimal Place Value Subtest and at stanine three on the Addition and Subtraction Subtest. An examination of the problems missed indicates that John's main problem with both addition and subtraction hinges on his inability to properly rename (regrouping, carrying and borrowing). It then seems likely that when he becomes more proficient with place value concepts his addition and subtraction problems can be alleviated.

The teacher then selects Rene to help John, due to the fact that Rene scored at stanine nine on the Decimal Place Value Subtest and stanine eight on the Addition and Subtraction Subtest. Before they begin the group session each fills out the first part of their Record of Group Session reports.

In helping John, Rene has the following two options; she can use the cross referenced item content outline to select sections in the provided textbooks that will serve as a basis for her help or she may feel her own understanding is strong enough that she can provide the concepts, examples, and exercises without consulting the textbooks. If she chooses to use the textbooks, the problems John missed would indicate from the content outline that she should select pages 1-6 in Book 5 or 1-4 in Book 6 as a starting point. She would then help John in working through these pages. When Rene and John feel he understands the material,

she will administer and score a short oral or written test over the material. Rene and John will then consult with the teacher concerning John's progress. At the end of each 30 minute session Rene and John will fill out the last part of their respective Records of the Session and give them to the teacher.

When John appears to be ready for a new set of work, in this case addition and subtraction remediation, the teacher will repeat the process of assigning a student to help him. The teacher may choose Rene again due to her rapport with John or may choose another student from the tutor group.

Example II

In studying the diagnostic profiles, the teacher finds that Bill, Susy, and Enrique have all scored in the four to six stanine level on the Decimal Place Value Subtest. A study of the problems they missed shows their performance to be spotty rather than consisting of the same type of mistakes. The teacher may handle this situation in either of the following two ways; he may decide these students are capable of proceeding without a specified tutor or he may assign a student tutor to the group. In the first case, the students would form a group and using the item content outline as a guide would select pages 1-6 in Book 5 or pages 1-4 in Book 6 as a starting point. They would work through this material as a group, discussing it and giving mutual help. When they feel they have remedied their problems they will ask the teacher to test them. The teacher may give them a short oral test, a written test (that they will score themselves), or may ask each one to prepare and score a test for another group member. If the teacher decides to assign a student tutor to this group, he will, in addition to helping

the group with their problems, help with their evaluation as the teacher would have done. When the group feels ready, they will consult with the teacher about the groups' progress.

This type of group also filled out the first part of a Record of the Group Session report at the beginning of the group session, completed the report at the end of the session and then gave it to the teacher. Except for individual comments, it was a single group report rather than three or four individual reports. As it turned out, the situation of assigning a tutor in a middle group occurred less than five times in each class.

Treatment S

The Teachers' Role

The teachers of Treatment S classes were supplied with pre-achievement test results including an item analysis and class profile chart. They used this information, in conjunction with the year end sixth grade achievement test results, to form two groups; a high achieving group that began supplementary work at the start of the treatment period, and a group of average and low achieving students who began skill kit work at the start of the treatment period. It was hoped that the teachers would use these test results to assist them in assigning supplementary work and in planning the work of the regular program, for instance, in providing differentiated assignments.

The teachers did not encourage or discourage students working together or asking classmates for help during the Treatment S class sessions. Their teachers did encourage students to ask them for help, whenever the students felt they had to in order to be able to continue their work.

Due to the nature of both the supplementary work and the skill kit programs, no Record of the Session reports similar to those used in Treatment T were planned. It was felt that the work of both programs was clearly enough defined, so that the student record book, accompanying the skill kit program, and the turned in assignments of the supplementary program, would provide the teacher with whatever feedback was necessary to keep these programs functioning as planned. This proved to be a correct decision.

The students completed an anonymous opinionnaire that was given twice during the treatment period. It was similar to, and had the same purpose as, the anonymous opinionnaire used in Treatment T. It was turned in directly to the writer and the resulting information was not made available to the teachers until the end of the treatment period.

The teachers' questionnaire which was discussed in the Description of Treatment T, contained questions about student behavior and the usefulness of specific parts of Treatment S. These questions have the same purpose in regard to Treatment S as those for Treatment T.

The Skill Kit

The commercially prepared kit that was used is, The Computational Skills Development Kit, marketed by Science Research Associates, Incorporated. The skills kit covers the same computational areas as those tested by the Level II Stanford Diagnostic Test. The kit contains one survey test, 16 specific diagnostic tests, 16 progress tests, and a student record book. Problems on the diagnostic tests are keyed to exercise cards contained in the kit. Problems are worked on the reverse side of each exercise card so that the student can check his own work and receive quick feedback to his responses. The student records all of

his test scores and a record of each exercise set he completes in the student record book. The kit requires little, if any, teacher time once the students are familiar with its use.

The Supplementary Work

The supplementary work, which was directly related to the regular program of instruction, consisted of assignments of the following type:

1. To work the more difficult exercises contained in the text;
2. To work on enrichment topics that are contained in the text or teachers manual;
3. To work on teacher prepared exercise sets that add depth to, or extend, the concepts, skills, or applications that are covered in the regular program.

Operational Procedure

To supply background for the description of procedures to be given it was expected that the following would have been accomplished:

1. The teachers have received and familiarized themselves with the achievement test results, item analysis, class profile chart, and instructions contained in the skill kit's Teacher's Guide.
2. The students are thoroughly familiar with how they are to use the skill kit.
3. The teachers and students have been thoroughly oriented in the procedures and objectives of the treatment.

The teachers prepared initial assignments for the selected supplementary work group prior to the first session of Treatment S. The students were given their assignments, which differed for particular students, and were given deadlines for the completion of the assignments. The students were requested to write the assignment and the deadline date on a paper to be handed in with the completed assignment. These assignments were usually for the normal 30 minute treatment session, but occasionally covered several sessions. In general, the teachers

were encouraged to give assignments that could be completed in three or fewer sessions.

All other students completed the Survey Test of the Skill Kit during the first treatment session. They then completed the first specific diagnostic test indicated for them by the Survey Tests' results. This test indicated which exercise cards should be completed. The students then began this work and thereafter proceeded as per the directions for use of the kit.

To minimize the probable event of two or more students needing a specific exercise card at the same time, three kits were available for student use. It is not usual that three kits would be necessary in a normal situation, but for purposes of comparison integrity in regard to the proposed study, their use was felt to be sufficient, if not necessary. It also happens that in the above situation the students usually need to complete more than one exercise card related to a specific diagnostic test and that the cards, quite often, need not be completed in a particular order. This, of course, tends to maximize the options available to students using the kit.

As soon as a student finished all of the skill kit work indicated by his particular test results, he began doing supplementary work during the treatment sessions. The teachers were requested to give these students supplementary work, that while being of the type previously described, was clearly commensurate with their abilities.

Time Schedule

1971

October 7, 8	Explained to classes why they were going to take achievement tests and diagnostic tests. Students were not

	told the treatment group in which they would participate.
October 13, 14, 15	Administered Stanford Achievement Tests, Form X.
November 3, 4, 5, 8, 9, 10	Administered Stanford Diagnostic Arithmetic Tests, Form W.
December 6	Gave instructors copies of their T students' scored diagnostic tests, an item analysis for each T class, and a class record and class analysis chart.
December 15, 16	Students were informed as to the treatment in which they would participate. The procedures for their respective group were discussed and they were informed in general terms why the school was conducting the experiment. Students were given an opportunity to ask questions concerning the experiment.
January 3	Gave instructors the achievement test results for both T and S classes. This included an item analysis, Class analysis chart, and individual student roster. T and S groups were given detailed oral explanation of the procedures they were to follow. A separate meeting was conducted with the tutors; their role was discussed and their questions answered.
January 4	Administered attitude opinionnaire. Practiced forming into groups in T classes and working with skills kit in S classes.
January 5	Practiced procedures in both groups and gave the survey test in S classes, then both groups had their first treatment sessions.
January 18, 19	Had 'trouble shooting' meeting with tutors.
January 5-31	13, 30 minute treatment sessions.
February 1	Meeting with instructors to discuss program.

February 8	Meeting with instructors to discuss program.
February 18	Meeting with instructors to discuss program. Instructors filled out first written reports. Students completed questionnaire about the program.
February 22	Meeting with instructors to discuss program.
February 1-29	15, 30 minute treatment sessions.
March 7, 14, 21, 28	Meeting with instructors to discuss program.
March 1-31	12, 30 minute treatment sessions. Treatment sessions are finished.
April 5, 6, 7	Administered Stanford Achievement Tests, Form W and attitude opinionnaire.
April 10	Students completed questionnaire about the program.
April 11, 12, 13, 14, 17	Administered Stanford Diagnostic Arithmetic test, Form X.
April 18	Instructors turned in final written reports.
May 15, 16, 17	Administered Stanford Achievement Tests, Form X.
May 18	Students wrote brief essay about their reactions to the program.

Statistical Analyses Used

The statistical techniques used in this study were the analysis of variance and the analysis of covariance. Pretest, post-test, and retention test data were analyzed for significant differences by a one way analysis of variance. Post-test and Retention test data were analyzed for significant differences by the analysis of covariance, using pretest scores as the covariate, and I.Q. as a covariate.

The statistical analyses were performed at the New Mexico State University Computing Center. The computer programs used were as follows:

(1) BMDOIV - Analysis of Variance For One-Way Design-Revised June 24, 1969.

(2) BMDX82 - Analysis of Covariance-Revised May 10, 1968.

Both programs were written for the Health Sciences Computing Facility, UCLA.

CHAPTER IV

ANALYSIS OF DATA

This chapter contains the analysis of the data collected from pupils on achievement and attitude and from teachers on their views of the treatment. The first section restates the abbreviations used and describes the way the data are reported in the chapter. Next the achievement data on computation, concepts, and applications are reported and analyzed. The affective data on pupil attitudes and their reactions to the treatment are presented next and the chapter is concluded with a report of teacher reactions.

Abbreviations and Reporting Procedure

The abbreviations for the treatment groups are as follows:

T	(n = 81)	-	treatment using tutoring and group work
TH	(n = 27)	-	high achieving students who served as tutors of low achieving students
TM	(n = 27)	-	middle achieving students who worked in groups, helping each other
TL	(n = 27)	-	low achieving students who were tutored by high achieving students
S	(n = 78)	-	treatment using skills kit and supplementary work
SH	(n = 27)	-	high achieving students who did teacher-assigned supplementary work
SM	(n = 26)	-	middle achieving students who did work in the skills kit until they finished it and then did supplementary work

SL (n = 25) - low achieving students who did work in the skills kit

The statistical procedures and tests used are designated as follows:

ANOVA - One-way analysis of variance

ANCOVA - One-way analysis of covariance

SAT - Stanford Achievement Tests

SDAT - Stanford Diagnostic Arithmetic Test

ADMA - Aiken-Dreger Mathematics Attitude Opinionnaire

The SAT mathematics battery was administered as pre-, post-, and retention tests. The SDAT and ADMA were administered as pre- and post-tests. The results of each test are summarized in tables for the full treatment groups and for each of the subgroups. The test means, mean gain scores, adjusted group means, and standard deviations are reported in each table. All adjusted group means, except two, were done using the corresponding pre-SAT or pre-SDAT scores. The exceptions are noted in the tables in which they occur when I.Q. was used as a covariate. Only significant F ratios and the corresponding probabilities are reported in the tables. On occasion it was found useful to convert raw gain scores into grade level or schoolmonths scores when analyzing the SAT data. The table for this conversion is given in Appendix C.

The degrees of freedom for the statistical analysis were as follows:

T vs S	-	ANOVA	-	1,157
		ANCOVA	-	1,156
TH vs SH	-	ANOVA	-	1,52
		ANCOVA	-	1,51
TM vs SM	-	ANOVA	-	1,51
		ANCOVA	-	1,50
TL vs SL	-	ANOVA	-	1,50
		ANCOVA	-	1,49

Achievement Data

The achievement data are reported in the following order: computation, concepts, common fractions, and applications. For computation and concepts, the SAT is reported first, followed by the SDAT and its appropriate subtests. The SDAT common fractions test has both computation and concepts subtests which are reported under the appropriate headings with the complete test being reported separately.

Computation

The test results for computation as measured by the SAT, Test 1 are summarized in Table 6. The T-S comparison shows no significant differences on any of the analyses. It is interesting to note that both groups made larger gains during the post-retention period than during the treatment period. This is difficult to account for, since both groups worked in the regular text during this period. The content of Chapter 6, which deals with the natural number system and is highly concept-oriented, was covered during this post-retention period, as was a part of Chapter 7, which deals with the rational numbers of arithmetic.

TABLE 6

SAT PRE, POST, AND RETENTION TEST SCORES, TEST 1 - COMPUTATION (POSSIBLE SCORE = 41)

	T		S		TH		SH	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	10.8		10.4		14.8		15.1	
Post	12.3	12.1	12.0	12.1	16.3	16.4	14.4	14.3
Ret	14.1	13.9	14.7	14.9	20.6	20.8	20.1	20.0
Post Gain	1.5		1.6		1.5		-0.7	
Ret Gain	3.3		4.3		5.8		5.0	
Pre SD	4.05		4.78		2.95		3.94	
Post SD	4.80		5.17		3.97		6.24	
Ret SD	6.71		6.81		5.98		6.56	

	TM		SM		TL		SL	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	10.5		10.0		7.1*		5.6	
Post	10.7	10.7	12.2	12.2	9.8	9.5	9.0	9.3
Ret	12.7	12.8	13.1	13.1	9.0	8.8	10.4	10.7*
Post Gain	0.2		2.2		2.7		3.4	
Ret Gain	2.2		3.1		1.9		4.3	
Pre SD	2.52		1.71		2.13		2.20	
Post SD	4.13		4.04		3.58		3.20	
Ret SD	4.74		5.65		2.85		3.72	

*Pre, TL vs SL, ANOVA, $F = 6.03$, $.01 < p < .025$

*Ret, TL vs SL, ANCOVA, $F = 4.48$, $.025 < p < .05$

The high and middle groups account for most of the post-retention gain and particularly the high group. TH gained 4.3 items or 14 school months and SH gained 5.7 items or 16 school months during this period. This compares to post-retention gains of four months for T and six months for S. These gains for the complete groups are clearly disappointing, since both treatments were attempting to increase computational achievement more than would normally be expected.

The TH-SH comparison shows no significant difference on any of the analyses; however, the pre-post ANCOVA indicated a trend favoring TH ($F=3.09, .05 < p < .10$). A weaker trend occurred on the I.Q.-post ANCOVA. TH gained two months during the pre-post period, while SH lost two months.

The TM-SM comparison shows no significant differences on any of the analyses; however, both the pre-post and I.Q.-post ANCOVA indicate a weak trend in favor of SM ($F=1.69, .10 < p. < 25$).

The TL-SL comparison shows a significant difference in pretest means ($F=6.03, .01 < p < .025$) in favor of TL. When post-test scores were adjusted using the pretest as a covariate, there was no significant difference. The pre-retention ANCOVA shows a significant difference in favor of SL ($F=4.48, .025 < p < .05$) and the I.Q.-retention ANCOVA indicates a trend ($F=2.30, .10 < p < .25$) favoring SL.

The TL and SL groups both made approximately nine school months' gain during the pre-post period. It is interesting to note that this is opposite to the results for the high and middle groups. This gain is a substantial one and clearly indicates that both the tutees and low skill kid students profited from their respective programs. TL lost three months, while SL was gaining four months during the post-

retention period. This post-retention period accounts for the previously cited significant differences in favor of SL. It is also interesting that TL is the only group whose computation declined during the post-retention period.

If the significant difference in favor of SL can be attributed to treatment effects, it would clearly indicate that the independent, repetitive, and highly organized work of the computational skills kit results in superior retention of computational facts for students of low ability than does tutoring. It may also be the case that the tutees are showing evidence of having built up a dependence on the tutors and have suffered during the post-retention period when tutoring was withheld from them. In any case, some treatment effects in favor of SL were evidenced.

The lack of significant differences in relation to the high and middle groups on all of the tests suggests that the treatments differed very little. The computational achievement gains for the high and middle groups, as measured by the SAT, Test 1, are quite disappointing.

Table 7 summarizes the test results for arithmetic computation as measured by the SDAT, Test 2. None of the F ratios for any of the comparisons were significant. A weak trend appeared in favor of SM on the pre-post ANCOVA ($.10 < p < .25$). A similar trend appeared in favor of TL on the pre-post and I.Q.-post ANCOVA.

The SDAT, Test 2 is composed of three subtests, each of which will be separately analyzed.

TABLE 7

SDAT PRE AND POST-TEST SCORES, TEST 2, ARITHMETIC COMPUTATION (POSSIBLE SCORE = 56)

	T		S		TH		SH	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	37.7		36.7		47.7		47.3	
Post	41.6	41.2	40.5	40.9	50.1	50.0	48.9	49.0
Gain	3.9		3.8		2.4		1.6	
Pre SD	13.6		13.8		6.12		6.46	
Post SD	11.4		12.4		4.34		5.60	

	TM		SM		TL		SL	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	37.9		36.3		27.4		25.5	
Post	39.9	39.3	41.0	41.6	34.8	34.1	30.8	31.6
Gain	2.0		4.7		7.4		5.3	
Pre SD	11.0		11.5		13.9		13.1	
Post SD	10.8		9.8		11.8		13.6	

The test results for addition and subtraction of whole numbers are summarized in Table 8. The only significant differences occurred in the TH-SH comparison in favor of TH. Both the post ANOVA and the post-test with I.Q. as a covariate showed a significant difference at the .05 level, while the pre-post ANCOVA showed a strong trend favoring TH ($F=3.83$, $.05 < p < .10$). This test contains 20 items of which TH

answered 19.5 correctly, while SH answered 18.7 correctly. The pre-post item gain favoring TH is only 0.4 items. In view of this, the difference between the groups, although significant, is probably of little practical importance. While none of the groups made large gains, the high and middle groups correctly answered at least 88 per cent of the items and the low groups correctly answered at least 73 per cent of the items.

TABLE 8

SDAT PRE AND POST-TEST SCORES, TEST 2A,
ADDITION AND SUBTRACTION COMPUTATION
(POSSIBLE SCORE = 20)

	T		S		TH		SH	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	16.0		15.8		18.6		18.2	
Post	17.7	17.6	17.2	17.3	19.5*	19.5*[a]	18.7	18.7[a]
Gain	1.7		1.4		0.9		0.5	
Pre SD	4.30		4.58		1.86		1.49	
Post SD	3.85		3.85		1.01		1.66	

	TM		SM		TL		SL	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	16.1		16.1		13.2		12.8	
Post	17.6	17.6	18.1	18.1	15.9	15.7	14.6	14.7
Gain	1.5		2.0		2.7		1.8	
Pre SD	3.87		4.01		4.82		5.64	
Post SD	4.04		2.39		4.64		5.29	

*Post, TH vs SH, ANOVA, $F=4.74$, $.025 < p < .05$

*I.Q.-Post, TH vs SH, ANCOVA, $F=4.52$, $.025 < p < .05$

[a]Adjusted by I.Q.

Table 9 summarizes the test results for whole number multiplication. The only significant differences occur in the TL-SL comparison in favor of TL. The pre-post ANCOVA shows a significant difference at the .05 level and both the post ANOVA and I.Q.-post ANCOVA show weak trends in favor of TL. The 3.5 item gain by TL which is the largest for any of the groups lends support to the contention that some treatment effects were evidenced.

TABLE 9

SDAT PRE AND POST-TEST SCORES, TEST 2B,
MULTIPLICATION COMPUTATION
(POSSIBLE SCORE = 18)

	T		S		TH		SH	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	12.1		12.0		15.1		15.0	
Post	13.8	13.8	13.3	13.3	15.8	15.8	15.4	15.4
Gain	1.7		1.3		0.7		0.4	
Pre SD	4.71		4.54		2.40		2.20	
Post SD	3.91		4.40		1.87		2.56	

	TM		SM		TL		SL	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	12.6		12.2		8.5		8.5	
Post	13.7	13.5	14.0	14.1	12.0	12.0*	10.2	10.2
Gain	1.1		1.8		3.5		1.7	
Pre SD	4.02		3.57		4.86		4.97	
Post SD	3.92		3.21		4.56		5.38	

*Post, TL vs SL, ANCOVA, $F=4.29$, $.025 < p < .05$

Groups TL and SL showed the greatest differences favoring TL on the following five items: 1 on an easy facts one digit multiplier problem, 1 on zero as a factor, with carrying, 2 with zero on the ones position of the multiplier, and 1 two by four digit problem.

Table 10 summarizes the test results relative to division computation with whole numbers. None of the comparisons show significant differences on any of the analysis. Even though the middle and low groups were very weak in division achievement, neither treatment effected an appreciable gain. It may be that even though the tutors could do division problems rather well, they did not really understand the algorithmic processes involved and could not relate to the tutees on the topic. In any event, the results would support the common notion that division is a difficult topic at best.

TABLE 10

SDAT PRE AND POST-TEST SCORES, TEST 2C, DIVISION COMPUTATION (POSSIBLE SCORE = 18)

	T		S		TH		SH	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	9.7		9.1		14.0		14.1	
Post	10.1	9.9	10.0	10.3	14.9	14.9	14.9	14.8
Gain	0.4		0.9		0.9		0.8	
Pre SD	5.76		6.16		3.78		3.86	
Post SD	5.60		5.99		2.89		2.74	

Table 10--Continued

	TM		SM		TL		SL	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	9.3		8.5		5.9		4.2	
Post	8.6	8.3	8.8	9.2	6.9	6.2	6.0	6.7
Gain	-0.7		-0.3		1.0		1.8	
Pre SD	4.88		5.80		5.45		4.13	
Post SD	5.00		6.07		5.15		4.89	

An examination of the SDAT, Test 2 and its three subtests fails to support a contention favoring either treatment. The significant differences that did occur favored the tutoring group on addition and subtraction and the tutees on multiplication.

The test results for fraction computation are summarized in Table 11. None of the comparisons show any significant differences. The high and middle groups made item gains ranging from 3.4 to 5.3, which are not unusual given the nature of this particular test. Very few of the more difficult addition and subtraction items were answered correctly and few of the multiplication and division items were answered at all. Neither of the treatments appear to affect student achievement in relation to fraction computation.

Table 12 summarizes the test results for decimal fraction and per cent computation. Significant differences exist in favor of T and TH, while a strong trend exists favoring TL.

TABLE 11

SDAT PRE AND POST-TEST SCORES, TEST 3B, FRACTION COMPUTATION (POSSIBLE SCORE = 28)

	T		S		TH		SH	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	5.5		4.7		10.4		8.1	
Post	8.9	8.5	8.5	8.9	15.7	14.7	12.7	13.6
Gain	3.4		3.8		5.3		4.6	
Pre SD	6.73		5.28		7.88		6.21	
Post SD	7.87		8.23		7.99		8.59	

	TM		SM		TL		SL	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	4.3		4.2		1.7		1.6	
Post	7.7	7.7	8.7	8.8	3.3	3.3	3.9	3.9
Gain	3.4		4.5		1.6		2.3	
Pre SD	5.28		4.50		2.67		1.78	
Post SD	5.90		8.59		3.06		4.30	

The T-S comparison shows a non-significant difference in pre-test means ($F=1.89$, $.10 < p < .25$) in favor of group T. The pre-post ANCOVA shows a strong trend ($F=3.41$, $.05 < p < .10$) favoring T. The post ANOVA shows a significant difference favoring T at the .05 level. The I.Q.-post ANCOVA shows a significant difference at the .01 level. The item gain difference favors T by on 1.6 items on a 48-item test where both groups are correctly responding to less than half the items. In view of the small item gain difference, the pre-test differences, and the non-significant pre-post ANCOVA, the indicated significant differences probably represent only a slight indication of possible treatment effects.

TABLE 12

SDAT PRE AND POST-TEST SCORES, TEST 4, DECIMAL, FRACTION AND PER CENT COMPUTATION (POSSIBLE SCORE = 48)

	T		S		TH		SH	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	15.4		13.7		22.2		18.5	
Post	20.5*	20.5*[a]	17.2	17.2[a]	27.4*	27.1*[a]	21.6	21.8[a]
Gain	5.1		3.5		5.2		3.1	
Pre SD	7.75		7.50		6.68		7.37	
Post SD	9.06		9.19		9.22		10.08	

	TM		SM		TL		SL	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	13.9		12.8		10.1		9.6	
Post	18.4	18.1	17.0	17.4	15.7	15.5	12.7	12.9
Gain	4.5		4.2		5.6		3.1	
Pre SD	5.78		6.37		5.14		5.92	
Post SD	6.36		8.87		7.04		5.97	

*Post, T vs S, ANOVA, $F=5.20$, $.01 < p < .025$

*Post, T vs S, ANCOVA, $F=7.82$, $.005 < p < .01$

*Post, TH vs SH, ANOVA, $F=4.83$, $.025 < p < .05$

*Post TH vs SH, ANCOVA, $F=4.99$, $.025 < p < .05$

[a]Adjusted by I.Q.

The TH-SH comparison is basically identical to that for T-S, except for larger pre-test mean differences and a larger item gain difference of 2.1.

The TL-SL comparison showed a strong trend in favor of TL on both ANCOVA analyses. The pre-test mean differences for these groups did not approach significance. TL also made the largest item gain of any group and gained 2.5 items more than SL.

This test yields results that indicate some possible evidence of treatment effects in favor of the tutor group. If in fact such treatment effects exist, they are accounted for by the TH and TL groups.

The greatest differences favoring T occurred on the following 11 items: 1 on decimal fraction addition, 1 on decimal fraction subtraction, 1 on decimal fraction multiplication, 1 on decimal fraction division, 6 on finding a given per cent of a number, and 1 on finding what per cent one number is of another. Differences favoring TH occurred on 2 decimal fraction problems involving multiplication or subtraction and 5 per cent problems.

Computation Summary

The computation results for the high and middle groups were disappointing. Neither group made normally expected gains during the pre-post period. Both low groups gained a full school year during the pre-post period which indicates that both treatments were successful in helping the low achievers. The low skills kit group showed superior retention of computational achievement which may be reflecting the repetition of the skills kit work. This was the only test analysis that favored any of the S groups.

The tutees did significantly better on the multiplication subtest of SDAT, Test 2 and an examination of the test items showed that

problems involving zero probably accounted for most of the difference. It may well be that the learning of troublesome computational topics is better facilitated by help from someone who knows how to perform the algorithms correctly, rather than doing many problems patterned after a few correct examples.

It was interesting that the differences in favor of the T group and the tutors on the decimal fractions and per cent computation test was largely due to per cent problems. All of the T groups outgained their comparisons on this test and the tutees showed a strong trend toward significance with an F ratio of 3.94 on the post ANCOVA. The items favoring the tutees were primarily per cent items. Per cent problems are always a difficult topic in arithmetic and we may again be seeing an instance where verbal interaction between tutor and tutee is beneficial to both and superior to an individualized approach without an interaction component.

Another fact that is apparent from the computation results is that the time spent by the tutors in helping others results in as good or better computational achievement than does the performance of more difficult mathematics tasks related to the regular instructional program.

Concepts

The test results on concepts as measured by the SAT, Test 2 are summarized in Table 13. The only significant difference occurred in the TH-SH comparison in favor of TH; however, trends were evident in favor of T on three post-test analyses.

The TH-SH comparison showed trends favoring TH on the post

ANOVA ($F=3.14$, $.05 < p < .10$), the I.Q.-post ANCOVA ($F=3.31$, $.05 < p < .10$), and the pre-retention ANCOVA ($F=3.05$, $.05 < p < .10$). The pre-post ANCOVA was significantly in favor of TH ($F=7.06$, $.01 < p < .025$). TH gained 3 more items during the pre-post period than did SH. Both groups declined during the post-retention period which is the opposite of what took place on the computation test. This pattern held for all of the T groups and SH while S, SM, and SL made very small gains. The TH item gain during the pre-post period corresponded to 16 school months as opposed to a 10 month gain by SH. The middle and low groups all gained approximately 6 school months during the treatment period. There appears to be little doubt that some factor inherent in the tutoring process results in greater concepts achievement than does performing supplementary work tasks. This certainly lends support to Glasser's [1969] contention that better students should be required to help slower students.

TABLE 13

SAT PRE, POST, AND RETENTION TEST SCORES, TEST 2, CONCEPTS (POSSIBLE SCORE = 40)

	T		S		TH		SH	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	11.1		11.5		13.8		14.1	
Post	15.5	15.6	14.4	14.3	21.1	21.3*	18.4	18.3
Ret	14.4	14.6	14.5	14.3	19.6	19.7	18.0	17.8
Post Gain	4.4		2.9		7.3		4.3	
Ret Gain	3.3		3.0		5.8		3.9	
Pre SD	4.14		4.91		4.71		5.11	
Post SD	5.70		6.36		4.87		6.26	
Ret SD	5.55		6.23		5.38		7.33	

Table 13--Continued

	TM		SM		TL		SL	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	10.3		10.8		9.4		9.2	
Post	13.7	13.8	13.8	13.7	11.6	11.6	10.6	10.6
Ret	12.9	13.0	14.4	14.3	10.9	10.8	10.7	10.7
Post Gain	3.4		3.0		2.2		1.4	
Ret Gain	2.6		3.6		1.5		1.5	
Pre SD	3.36		4.92		2.83		3.19	
Post SD	3.34		6.05		3.67		3.86	
Ret SD	3.54		5.13		3.22		3.08	

*Post, TH vs SH, ANCOVA, $F=7.06$, $.01 < p < .025$

Table 14 summarizes the test results for concepts achievement on the SDAT, Test 1. The T-S comparison shows significant differences in favor of T on the post ANOVA at the .025 level, and both post ANCOVA at the .0005 level. The TH-SH comparison shows significant differences in favor of TH on the post ANOVA at the .01 level, the post ANCOVA at the .001 level, and the I.Q.-post ANCOVA at the .005 level. The TM-SM and TL-SL comparisons are similar. Both show trends in favor of TM and TL on the post ANOVA and significant differences in favor of the TM and TL on both ANCOVA analyses at the .05 level.

The evidence of treatment effects favoring T and its subgroups is rather overwhelming. There can be little doubt that some factor (or factors) inherent in the tutor-tutee and group relationships provides for superior concepts achievement as opposed to the supplementary work, skill kit groups. The SDAT, Test 1 requires no verbal recognition of properties, operations, patterns, or place value

concepts other than the naming of each place, so this would not be a factor in the noted differences.

TABLE 14

SDAT PRE AND POST-TEST SCORES, TEST 1, ARITHMETIC CONCEPTS (POSSIBLE SCORE = 56)

	T		S		TH		SH	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	34.1		33.6		41.7		40.7	
Post	41.1*	40.8*	37.1	37.3	48.1*	47.8*	43.4	43.7
Gain	7.0		3.5		6.4		2.7	
Pre SD	9.83		10.47		5.75		7.78	
Post SD	9.39		9.99		5.65		6.65	

	TM		SM		TL		SL	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	33.8		33.3		27.0		26.1	
Post	39.5	39.3*	35.9	36.1	35.6	35.2*	31.5	31.9
Gain	5.7		2.6		8.6		5.4	
Pre SD	8.86		9.92		8.60		8.32	
Post SD	8.82		9.50		8.70		9.99	

*Post, T vs S, ANOVA, $F=6.72$, $.01 < p < .025$

*Post, T vs S, ANCOVA, $F=19.57$, $p < .0005$

*I.Q.-Post, T vs S, ANCOVA, $F=14.45$, $p < .0005$

*Post, TH vs SH, ANOVA, $F=7.97$, $.005 < p < .01$

*Post, TH vs SH, ANCOVA, $F=12.44$, $.0005 < p < .001$

*I.Q.-Post, TH vs SH, ANCOVA, $F=9.47$, $.001 < p < .005$

*Post, TM vs SM, ANCOVA, $F=4.86$, $.025 < p < .05$

*I.Q.-Post, TM vs SM, ANCOVA, $F=4.95$, $.025 < p < .05$

*Post, TL vs SL, ANCOVA, $F=5.12$, $.025 < p < .05$

*I.Q.-Post, TL vs SL, ANCOVA, $F=4.38$, $.025 < p < .05$

The SDAT, Test 1 is composed of two subtests, one deals with number systems, their properties and operations, while the other deals with decimal place value concepts. These tests are analyzed separately.

Table 15 summarizes the test results for number systems and operations concepts. The T-S comparison shows significant differences in favor of T on the post ANOVA at the .025 level, the post ANCOVA at the .0005 level, and the I.Q.-post ANCOVA at the .001 level. The TH-SH comparison shows results very similar to the T-S comparison. The TM-SM comparison shows no significant differences. The TL-SL comparison shows a trend ($F=2.96$, $.05 < p < .10$) in favor of TL on the post ANOVA and significant differences in favor of TL on both ANCOVA tests at the .05 level. The test for equality of slopes on the TL vs SL post ANCOVA showed a significant difference existed ($F=4.23$, $.025 < p < .05$).

TABLE 15

SDAT PRE AND POST-TEST SCORES, TEST 1A, NUMBER SYSTEMS AND OPERATIONS (POSSIBLE SCORE = 30)

	T		S		TH		SH	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	18.8		18.7		22.1		22.1	
Post	21.8*	21.8*	19.9	19.9	25.3*	25.3*	22.7	22.8
Gain	3.0		1.2		3.2		0.6	
Pre SD	5.06		5.10		2.67		3.67	
Post SD	4.67		5.11		3.15		3.86	

Table 15--Continued

	TM		SM		TL		SL	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	19.1		18.7		15.0		15.0	
Post	21.0	20.8	19.8	20.0	19.1	19.1*	17.0	17.0
Gain	1.9		1.1		4.1		2.0	
Pre SD	4.78		4.94		4.74		4.07	
Post SD	4.52		4.83		3.97		5.02	

*Post, T vs S, ANOVA, $F=5.87$, $.01 < p < .025$

*Post, T vs S, ANCOVA, $F=12.90$, $p < .0005$

*I.Q.-Post, T vs S, ANCOVA, $F=12.29$, $p < .001$

*Post, TH vs SH, ANOVA, $F=7.11$, $.01 < p < .025$

*Post, TH vs SH, ANCOVA, $F=9.73$, $.001 < p < .005$

*I.Q.-Post, TH vs SH, ANCOVA, $F=8.04$, $.005 < p < .01$

*Post, TL vs SL, ANCOVA, $F=5.45$, $.01 < p < .025$

*I.Q.-Post, TL vs SL, ANCOVA, $F=5.54$, $.01 < p < .025$

It is interesting to note that the performance of TM on this subtest contributed little to the overall superior performance of the whole T group on Test 1 and that TL made the largest item gain of any group on this subtest. The tutor-tutee relationship clearly results in superior attainment of number system and operation concepts than does group work, supplementary work, or skills kit work.

Groups T and S showed the greatest differences on the following test items: 5 fill-in-the-blank types, one related to the inverse relation of addition and subtraction, one related to the distributive property, one related to the inverse relation of multiplication and division, and two related to multiplication or division

being mixed with addition or subtraction in the same number sentence; 3 complete a conditional sentence type, one involving naming k divided by k, and two involving the inverse relation of addition and subtraction.

The summary of test results relative to decimal place value concepts is found in Table 16. The T-S comparison shows significant differences on the post ANOVA at the .025 level, the post ANCOVA at the .005 level, and the I.Q.-Post ANCOVA at the .001 level. The TH-SH comparison shows significant differences on all three analyses at the .025 level. A strong trend in favor of TM was evidenced on the post ANOVA test and significant differences at the .025 level favoring the middle T group were shown on both ANCOVA analyses.

It is interesting to note that the tutees' performance on this subtest, while not significantly higher than that of the low skills kit group, did show the largest item gain of any group. The middle T group which did not achieve significantly higher on the 1A subtest over the middle skills kit group, did do significantly better on this subtest. It is again quite clear that a student interaction format is superior to an individual work approach in the achievement of concepts.

The greatest differences favoring T occurred on the following 7 items: 2 items involving a picture of a place value board, 1 item on the number of digits in the decimal system, 2 items involving multiplication or division by multiples of 10, and 2 items involving exponents.

TABLE 16

SDAT PRE AND POST-TEST SCORES, TEST 1B,
DECIMAL PLACE VALUE CONCEPTS
(POSSIBLE SCORE = 26)

	T		S		TH		SH	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	15.4		14.8		19.5		18.6	
Post	19.3*	19.1*	17.2	17.4	22.9*	22.7*	20.6	20.8
Gain	3.9		2.4		3.4		2.0	
Pre SD	5.27		5.95		3.49		4.57	
Post SD	5.18		5.56		3.08		3.79	

	TM		SM		TL		SL	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	14.6		14.7		12.1		10.9	
Post	18.5	18.5*	16.1	16.1	16.5	15.9	14.6	15.2
Gain	3.9		1.4		4.4		3.7	
Pre SD	4.80		5.63		4.60		5.08	
Post SD	4.72		5.37		5.33		5.64	

*Post, T vs S, ANOVA, $F=6.40$, $.01 < p < .025$

*Post, T vs S, ANCOVA, $F=10.73$, $.001 < p < .005$

*I.Q.-Post, T vs S, ANCOVA, $F=11.61$, $.0005 < p < .001$

*Post, TH vs SH, ANOVA, $F=6.18$, $.01 < p < .025$

*Post, TH vs SH, ANCOVA, $F=6.37$, $.01 < p < .025$

*I.Q.-Post, TH vs SH, ANCOVA, $F=6.61$, $.01 < p < .025$

*Post, TM vs SM, ANCOVA, $F=5.96$, $.01 < p < .025$

*I.Q.-Post, TM vs SM, ANCOVA, $F=6.23$, $.01 < p < .025$

Table 17 summarizes the test results on understanding common fractions. The only significant differences exist in the high ability group comparison. There is a significant difference ($F=4.61$, $.025 < p < .05$) on the pre-test favoring TH. This difference is reflected in the post ANOVA, which favors TH significantly ($F=6.42$, $.01 < p < .025$). The pre-post ANCOVA indicates only a weak trend ($F=1.79$, $.10 < p < .25$) favoring TH. The I.Q.-post ANCOVA significantly ($F=6.77$, $.01 < p < .025$) favors TH. All groups made an average gain of three items.

TABLE 17

SDAT, PRE AND POST-TEST SCORES, TEST 3A,
UNDERSTANDING COMMON FRACTIONS
(POSSIBLE SCORE = 22)

	T		S		TH		SH	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	8.6		7.3		13.5*		10.7	
Post	11.8	11.2	10.7	11.2	16.6*	15.7	13.8	14.7
Gain	3.2		3.4		3.1		3.1	
Pre SD	5.42		5.27		4.70		4.93	
Post SD	5.28		5.50		3.36		4.51	
	TM		SM		TL		SL	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	7.1		6.7		5.2		4.2	
Post	10.6	10.4	10.7	10.8	8.1	7.8	7.3	7.6
Gain	3.5		4.0		2.9		3.1	
Pre SD	3.95		5.50		3.63		2.75	
Post SD	4.33		5.56		4.12		4.42	

*Pre, TH vs SH, ANOVA, $F=4.61$, $.025 < p < .05$

*Post, TH vs SH, ANOVA, $F=6.42$, $.01 < p < .025$

*I.Q.-Post, TH vs SH, ANCOVA, $F=6.77$, $.01 < p < .025$

Table 18 summarizes the results relative to the understanding and computation of common fractions. The two subtests of SDAT, Test 3 have already been analyzed. Test 3A was analyzed under the section on concepts and Test 3B under computation. No significant differences were shown by any of the analyses.

TABLE 18

SDAT PRE AND POST-TEST SCORES, TEST 3,
UNDERSTANDING AND COMPUTATION
OF COMMON FRACTIONS
(POSSIBLE SCORE=50)

	T		S		TH		SH	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	14.0		12.0		24.0		18.9	
Post	20.6	19.6	18.8	19.8	32.3	30.3	26.5	28.5
Gain	5.6		6.8		8.3		7.6	
Pre SD	11.5		10.0		12.0		10.5	
Post SD	12.4		12.9		10.4		12.1	

	TM		SM		TL		SL	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	11.4		10.9		6.7		5.8	
Post	18.3	18.1	18.3	18.5	11.1	10.9	11.2	11.4
Gain	6.9		7.4		4.4		5.4	
Pre SD	8.42		9.50		5.34		3.62	
Post SD	9.09		13.5		6.44		7.67	

Table 19 summarizes the test results for arithmetic applications. None of the comparisons show significant differences. Neither treatment appears to affect applications achievement.

TABLE 19

SAT PRE-, POST AND RETENTION TEST SCORES
TEST 3 - ARITHMETIC APPLICATIONS
(POSSIBLE SCORE = 36)

	T		S		TH		SH	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	10.5		10.4		12.9		12.7	
Post	12.2	12.2	11.7	11.7	14.4	14.4	14.2	14.3
Ret	12.1	12.0	11.8	11.9	16.1	16.0	14.3	14.4
Post Gain	1.7		1.3		1.5		1.5	
Ret Gain	-0.1		0.1		3.2		1.6	
Pre SD	3.71		3.90		3.90		4.11	
Post SD	4.12		4.76		5.06		5.63	
Ret SD	5.11		4.58		5.01		5.58	

	TM		SM		TL		SL	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	9.9		10.0		8.7		8.4	
Post	12.0	12.1	11.7	11.7	10.2	10.1	8.9	9.0
Ret	10.1	10.1	11.2	11.2	10.0	10.0	9.8	9.8
Post Gain	2.1		1.7		1.5		0.5	
Ret Gain	-1.9		-0.5		-0.2		0.9	
Pre SD	3.08		3.41		2.90		2.84	
Post SD	2.44		4.13		3.33		2.27	
Ret SD	4.37		3.62		3.36		2.88	

Concepts Summary

The significant difference favoring T over S on the SDAT, Test 1 must be considered in relation to the following two facts: 1) two items on SDAT, Test 1B were biased toward the T group, since they involved a picture of a place value board and the skills kit contained no such picture. The difference in the full T group's score on these items was primarily attributable to the TL group, which did not show a significant difference over SL on this particular subtest; 2) a slight bias may have existed in favor of the T group, since the format of some of the SDAT, Test 1 may have been more familiar to the T group than to the S group.

There can be little doubt that the tutors performed significantly better in relation to concepts achievement than did the supplementary work group. This was not only evidenced on the SDAT where some bias may have existed, but also on the SAT where no evidence of a bias is present. The time spent by high-achieving students in helping others appears to be much better spent in this activity than in just doing more difficult mathematics related to the regular instructional program. The evidence would certainly support the contention that one very good way to better learn a subject is to attempt to teach it to someone else.

The middle and low T groups did not achieve significantly more than the S groups on the SAT. This fact, coupled with the possible bias on the SDAT, may modify the significant differences shown by the middle group on Test 1B and the low group on Test 1A. The level of significance in each case was .025 on both ANCOVA tests and it

is the writer's opinion that the possible bias was not so strong as to nullify this significance. If this is in fact the case, a strong argument can be made that the human interaction of the tutor/tutee relationship, as well as that of the group work, contributes greatly to the understanding of arithmetic concepts. It is also interesting that the items on which the groups differed most were ones normally considered to be more difficult conceptual items, namely, inverse relations, the distributive property, and a mixture of operations.

Student Attitudes

The test results for mathematics attitude as measured by the Aiken-Dreger mathematics opinionnaire are summarized in Table 20. None of the comparisons show significant differences on any of the tests.

The attitudes of all groups remained relatively stable during the treatment period and all groups exhibited favorable attitudes. A score above 60 indicates a favorable attitude and the scores ranged from a low of 61.4 to a high of 76.2 on the post test. It is quite interesting to note how well the three ability-achievement groups are defined in terms of the post-test attitude scores.

In order to judge student feelings about the treatment and group in which they participated, the writer constructed an opinionnaire for each group. The construction of the opinionnaire was guided by Robert F. Mager's [1968] suggestion:

> "Sometimes the direct approach is the quickest, least expensive, and most valid. Probably the best way for me to find out whether you like pistachio nuts is to come right out and ask you." (page 72)

TABLE 20

AIKEN-DREGER ATTITUDE SCALE - PRE AND POST-TEST SCORES
MATHEMATICS OPINIONNAIRE
(POSSIBLE HIGH SCORE=100
POSSIBLE LOW SCORE=20)

	T		S		TH		SH	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	69.5		68.7		77.4		76.4	
Post	68.6	68.3	67.3	67.6	76.2	75.9	74.0	74.4
Gain	-0.9		-1.4		-1.2		-2.4	
Pre SD	16.8		19.1		15.9		20.3	
Post SD	18.4		18.1		17.0		20.7	

	TM		SM		TL		SL	
	M	AdjM	M	AdjM	M	AdjM	M	AdjM
Pre	69.2		64.8		62.0		64.3	
Post	65.9	64.5	65.9	67.4	63.6	64.5	61.4	60.5
Gain	-3.3		1.1		1.6		-2.9	
Pre SD	16.7		17.5		14.4		17.5	
Post SD	17.9		13.8		18.3		17.2	

The opinionnaires were administered after 20 sessions and again after the treatments were concluded. The complete set of opinionnaires is in Appendix A.

Five statements were comparable for all groups and their tables will be given first. The blanks in each question hold the place for the group name or description of the action associated with a particular group. The meaning of the abbreviations is as follows: SD - strongly disagree; D - disagree; U - undecided; A - agree;

SA - strongly agree. The number of favorable responses was determined by simply adding the A and SA responses together. This number was used in calculating the percent of favorable response.

The results for statement 1 are given in Table 21. The results are clearly favorable for all groups. It is interesting to note that the tutees were nearly unanimous in their favorable response with none taking an unfavorable stand and only two being undecided. Each group except TM responded more favorably at the end of the treatment than after 20 sessions. These results would support the contention that both treatments were viewed as being useful by the participants with the tutor/tutee groups being slightly more positive.

It is interesting that this trend is in agreement with the achievement results.

TABLE 21

STUDENT RESPONSE TO STATEMENT 1, "_____ HAS INCREASED MY KNOWLEDGE OF MATHEMATICS"

	Group	SD	D	U	A	SA	% of Favorable Response
February 18	T	2	1	16	44	18	76.5
	S	1	5	21	33	18	65.3
	TH	1	0	3	15	8	85.1
	SH	0	2	9	10	6	59.2
	TM	1	1	7	14	4	66.6
	SM	0	1	9	9	7	61.5
	TL	0	0	6	15	6	77.7
	SL	1	2	3	14	5	76.0

TABLE 21--Continued

	Group	SD	D	U	A	SA	% of Favorable Response
April 10	T	2	4	9	44	22	81.4%
	S	3	6	10	45	14	75.6
	TH	1	1	2	12	11	85.1
	SH	1	2	4	14	6	74.0
	TM	1	3	5	12	6	66.6
	SM	0	2	6	12	6	69.2
	TL	0	0	2	20	5	92.5
	SL	2	2	0	19	2	84.0

The results for statement 2 are given in Table 22.

TABLE 22

STUDENT RESPONSE TO STATEMENT 2, "_____ HAS PROVIDED ME WITH A MUCH BETTER UNDERSTANDING OF THE MATHEMATICAL CONCEPTS AND COMPUTATIONS THAT I STUDIED IN GRADE SCHOOL"

	Group	SD	D	U	A	SA	% of Favorable Response
February 18	T	1	5	19	42	14	69.1%
	S	4	7	15	39	13	66.6
	TH	0	1	3	17	6	85.1
	SH	1	4	5	10	7	62.9
	TM	1	2	9	12	3	57.6
	SM	1	2	6	14	3	62.9
	TL	0	2	7	13	5	66.6
	SL	2	1	4	15	3	72.0

TABLE 22--Continued

	Group	SD	D	U	A	SA	% of Favorable Response
April 10	T	1	5	11	43	21	79.0%
	S	1	9	14	37	17	69.2
	TH	1	0	1	14	11	92.5
	SH	0	3	3	13	8	77.7
	TM	0	5	7	11	4	55.5
	SM	0	2	8	11	5	61.5
	TL	0	0	3	18	6	88.8
	SL	1	4	3	13	4	68.0

The results are all favorable, although the TM, SM and SL groups were slightly less favorable at the end of the treatment period than at the end of 20 sessions. Similar to the result of Statement 1, the tutor/tutee groups were the most positive in their responses and none of the tutees responded unfavorably at the end of the sessions. There results would again support the contention that both treatments were viewed as being useful by the participants with the tutor/tutee groups being a good deal more positive. It is again interesting to note how well the student attitudes agree with the prior achievement data. This is particularly evident in relation to TH and TL.

The results for Statement 3 are given in Table 23. The results in relation to Statement 3 are not as definitive as the previous ones. The groups all responded favorably but only the SL group showed any large change, with six additional students moving to the favorable category by the end of the treatment period. The T group again was slightly more favorable in response to the statement than was the S group.

TABLE 23

STUDENT RESPONSE TO STATEMENT 3,
"I REALLY ENJOY _____"

	Group	SD	D	U	A	SA	% of Favorable Response
February 18	T	0	9	13	34	25	72.8
	S	3	12	17	27	19	58.9
	TH	0	1	2	12	13	88.8
	SH	2	2	4	12	7	70.3
	TM	0	6	7	8	6	51.8
	SM	0	8	4	8	6	53.8
	TL	0	2	4	14	7	77.7
	SL	1	2	9	7	6	52.0

	Group	SD	D	U	A	SA	% of Favorable Response
April 10	T	2	9	12	33	25	71.6
	S	4	11	10	38	15	67.9
	TH	0	1	4	9	13	81.4
	SH	1	4	3	15	4	70.3
	TM	2	4	4	10	7	62.9
	SM	2	4	5	13	2	57.6
	TL	0	4	4	14	5	70.3
	SL	1	3	2	10	9	76.0

The results for Statement 4 are given in Table 24.

TABLE 24

STUDENT RESPONSE TO STATEMENT 4, "_____ HAS INCREASED MY DESIRE TO LEARN MORE MATHEMATICS"

	Group	SD	D	U	A	SA	% of Favorable Response
February 18	T	1	10	23	36	11	58.0
	S	1	12	27	20	18	48.7
	TH	1	3	11	9	3	44.4
	SH	1	5	6	7	8	55.5
	TM	0	5	8	13	1	51.8
	SM	0	4	13	4	6	38.4
	TL	0	2	4	14	7	77.7
	SL	0	3	9	9	4	52.0

	Group	SD	D	U	A	SA	% of Favorable Response
April 10	T	2	14	15	33	17	61.7
	S	4	15	15	29	15	56.4
	TH	2	6	6	8	5	48.1
	SH	2	4	3	12	6	66.6
	TM	0	4	5	11	7	66.6
	SM	0	5	12	7	2	34.6
	TL	0	4	4	14	5	70.3
	SL	2	6	0	10	7	68.0

The results in relation to Statement 4 indicate that the treatments affect the desire to learn mathematics very little. This is the only statement to which any group responded below the 50 per cent favorable mark and the final percentages for the full T and S groups are the lowest recorded for any statement. The TM and SL groups, however, did show a favorable change of four students each.

The results for Statement 5 are given Table 25.

TABLE 25

STUDENT RESPONSE TO STATEMENT 5, "I REALLY ENJOY MY MATHEMATICS CLASS THIS YEAR"

	Group	SD	D	U	A	SA	% of Favorable Response
February 18	T	4	4	14	30	29	72.8%
	S	5	5	21	23	24	60.2
	TH	2	0	4	10	11	77.7
	SH	2	2	3	8	12	74.0
	TM	0	2	8	9	8	62.9
	SM	2	1	9	8	6	53.8
	TL	2	2	2	11	10	77.7
	SL	1	2	9	7	6	52.0

	Group	SD	D	U	A	SA	% of Favorable Response
April 10	T	3	5	17	28	28	69.1
	S	4	9	10	29	26	70.5
	TH	2	1	5	5	14	70.3
	SH	2	2	1	12	10	81.4
	TM	1	4	4	12	6	66.6
	SM	1	4	7	7	7	53.8
	TL	0	0	8	11	8	70.3
	SL	1	3	2	10	9	76.0

The results in relation to Statement 5 are all positive. This is the first statement with the S group responding with a higher favorable percentage than the T group. This may be somewhat misleading, however, since 13 S students responded unfavorably, as opposed to eight T students, while seven more T students were undecided than were the S students. It is noteworthy that six more SL students

responded favorably at the end of the treatment period and no TL students responded in the unfavorable category.

The results for Statement 6 are given in Table 26. Only the tutors and tutees responded to this statement.

TABLE 26

STUDENT RESPONSE TO STATEMENT 6, "I HAVE BEEN SUCCESSFUL IN HELPING MY FELLOW STUDENTS LEARN MORE ABOUT MATHEMATICS" OR "MY HELPER (OR HELPERS) HAS BEEN SUCCESSFUL IN HELPING ME LEARN MORE ABOUT MATHEMATICS"

	Group	SD	D	U	A	SA	% of Favorable Response
Feb. 18	TH	1	1	6	15	4	70.3%
	TL	0	1	0	16	10	96.2
Apr. 10	TH	0	1	9	13	4	62.9
	TL	0	0	1	17	9	96.2

The results in relation to Statement 6 clearly show that the tutees were much more favorable about the help they received than were the students supplying the help. In fact, by the end of the treatment period only one tutee was undecided and none responded unfavorably. Most studies of tutoring have concluded that tutees are positive in their response toward the tutors'teaching effort. The results in relation to Statement 6 clearly support this contention.

The results for Statement 7 are given in Table 27. Only the T group responded to this statement.

TABLE 27

STUDENT RESPONSE TO STATEMENT 7, "THE PROCESS OF HAVING A HELPER OR BEING THE HELPER GROUP HAS PROVIDED ME WITH A MUCH BETTER UNDERSTANDING OF MY FELLOW STUDENTS AS UNIQUE INDIVIDUALS"

	Group	SD	D	U	A	SA	% of Favorable Response
Feb. 18	TH	0	0	4	17	6	85.1
	TM	0	5	8	13	1	51.8
	TL	0	1	7	14	5	70.3
Apr. 10	TH	0	0	2	16	9	92.5
	TM	0	4	5	11	7	66.6
	TL	0	2	3	16	6	81.4

The results in relation to Statement 7 are all positive, with each group being slightly more favorable at the end of the treatment period. The tutor/tutee groups responded much more favorably than the students working in groups. Most studies of tutoring have indicated that the positive socializing value of the process should make it a useful addition to most instructional programs. These results are certainly in agreement with that contention.

Summary

At the end of the treatment period the full T and S groups responded favorably to each statement. Only the statement concerning the desire to learn more mathematics was met with minimal favorable support. The T group responded more favorably to each statement but

number 4 and this was due to a larger number being undecided rather than to their responding unfavorably. The results seem to support the conclusion that from the students' viewpoint both treatments were useful and reasonably enjoyable with the tutor-group treatment having a slight edge on both counts. Support was found in the response to Statements 6 and 7 for the contentions that tutees view the effort of tutors very favorably and that the tutor/tutee relationship has merit as a positive socializing influence. The TH and TL groups felt they had achieved a better understanding of mathematics than did their comparison groups and this was, in fact, the conclusion previously derived from the achievement data.

The students were asked after the retention tests were finished to write a brief, anonymous statement concerning any feelings they had about the treatment in which they participated. The verbatim statements have been reported as nearly as possible in Appendix B. Spelling was often anyone's guess and teachers' names have been deleted.

Teacher Reactions

In order to assess teacher reactions to the treatments, the writer constructed and administered a series of questions labeled "Teachers' Report." The administration times corresponded with those of the writer-constructed opinionnaire for students, namely, after 20 sessions and again at the end of the experiment. For those questions involving responses relative to the cognitive and affective domains, the terms are used in their normal sense of differentiating between

types of behavior. Some of the statements are, however, rather broad and the possible distinctions may not have always been clear in the minds of the teachers.

Teacher responses have been identified on the teacher report by "a", "b", and "c" for responses given after 20 sessions, and by "A", "B", and "C" for responses made at the end of the experiment.

The results of the teacher report are listed in Table 28.

TABLE 28

REPORT OF RESPONSES TO THE TEACHERS' REPORT

DIRECTIONS: Please circle the numeral that in your opinion indicates best the degree of contribution made by each listed item in Questions 1 - 4. The 0 - 5 scale carries the following weights: 0 - don't know; 1 - 5 range upward from 1 - none to 5 - the highest degree of contribution; 2, 3, and 4 indicate intermediate degrees of contribution between the 1 and 5 extremes.

February Opinion - a, b, c
April Opinion - A, B, C

1. When viewed as a supplement to your normal classroom management procedures, to what degree have the following parts of Treatment A contributed to your opportunities to make full use of your teaching skills?

	0	1	2	3	4	5
Achievement test data		A	a_B	$b_C c$		
Diagnostic test data		A	a	B,C	b,c	
Activities associated with the selection of group membership	a	A		b	$c_{B,C}$	
Activities associated with facilitating the helper group process	a	A		b	$c_{B,C}$	

2. When viewed as a supplement to your normal classroom management procedures, to what degree have the following parts of Treatment B contributed to your opportunities to make full use of your teaching skills?

	0	1	2	3	4	5
Achievement test data		A	$a_B{}^c$	b_C		
Skill kit test data		A	a,b	B	c_C	
Activities associated with the supplementary work phase.	a	A		$b_B{}^c$	C	
Activities associated with the skill kit work phase.		A		$a_B{}^b$	c_C	

3. To what degree has Treatment A provided you with a better understanding of your students when contrasted with your prior classroom experiences?

	0	1	2	3	4	5
As regards their development in a cognitive sense?			a	$A,^b_B$	c_C	
As regards their development in an affective sense?				$a_A;^b_B$	c_C	

4. To what degree has Treatment B provided you with a better understanding of your students when contrasted with your prior classroom experiences?

	0	1	2	3	4	5
As regards their development in a cognitive sense?			a_A	b_B	c_C	
As regards their development in an affective sense?			a_A	b_B	c_C	

	0	1	2	3	4	5
5. The groups in Treatment A are working effectively with a minimum of teacher guidance.						
Cognitive				a,b,c A,B,C		
Affective			A	C	a,b,c B	
6. The student helpers in Treatment A are successfully fulfilling their leadership roles.						
Cognitive				A,B,C	a,b,c	
Affective				A,C	a,b,c B	
7. The students being helped in Treatment A are exhibiting positive behaviors toward the student helper group process.						
Cognitive			a A	b,c B,C		
Affective		a	A	B	b,c C	
8. The students of average achievement in Treatment A, who are working in groups without designated helpers, are ex-						

	0	1	2	3	4	5
hibiting positive behaviors toward the group work.						
Cognitive			A	a,b B,C	c	
Affective			A	a,b	c B,C	
9. The students doing skill kit work in Treatment B are working effectively with a minimum of teacher guidance.						
Cognitive				b,c B,C	a A	
Affective			B	b A,C	a,c	
10. The students doing supplementary work in Treatment B are working effectively with a minimum of teacher guidance.						
Cognitive				b A,C	a,c B	
Affective			A	b B,C	a,c	

	0	1	2	3	4	5
11. The students doing skill kit work are exhibiting positive behaviors toward the skill kit program.						
Cognitive				B,C	a,b,c A	
Affective			B	b C	c A	a
12. The students doing supplementary work are exhibiting positive behaviors toward their work.						
Cognitive		A		b	a,c B,C	
Affective		A	b	a B	c C	

The responses to questions 1-4 would appear to give a slight edge to the tutor-tutee-group work treatment. Teacher A seemed to find none of the test data or activities to be of much value. This teacher was the least experienced of the three teachers and possibly not aware of how to make profitable use of this information. It is interesting that the positiveness of responses correlates exactly with the years of experience of the teachers on most of the questions.

Responses to questions 5-12 show that the teachers felt the students were accomplishing the identified behaviors about one-half of the time. Teacher A is less positive in relation to treatment T and

supplementary work group of treatment S than are the other teachers, but is fairly positive in regard to the skills kit workers.

The teachers were also asked to put in written form any additional comments that related to the questions on the Teacher Report or any other phase of the experiment. This was done after 20 sessions and at the end of the experiment. Some opinions that the writer thought were of particular interest will be briefly discussed. The verbatim report is in Appendix B.

It was interesting that the teachers felt some of the groups were responding negatively to their respective situation, while the anonymous student opinionnaires indicated this was not the case. It seems apparent that teacher opinions about student attitudes were formed quite independently of the actual student attitudes. Teacher A felt that both treatments had "mainly reinforced" opinions already held. These opinions appear to differ more with the reported student opinions than do those of teachers B and C. This may again be a reflection of the inexperience of Teacher A.

It was pointed out that the treatments were too concentrated and might have achieved better results overall if they had been conducted once or twice a week for the entire school year. This may well be the case. It is also possible that the teachers were reacting to following a time schedule not of their own choosing.

The teachers seemed to feel that the skills kit group were definitely learning better how to compute. The actual data indicated, however, that both low groups gained one full year on the SAT computation test, while the high and middle group gains were small. Not a

single teacher indicated an awareness that conceptual gains were taking place in Treatment T that were superior to those for Treatment S. Either these gains were not evident during student-teacher interaction to the regular instructional program or the teachers were not able to recognize instances of them.

The teachers indicated that providing supplementary work was difficult and time consuming. This may be a valid concern, yet, it is difficult for the writer to not regard this as a necessary part of the teachers' role, particularly in attempting to individualize instruction. Neither is it clear why the task must be unduly time consuming.

It would appear that Teachers B and C slightly favor Treatment T, while Teacher A favors only the skills kit work of Treatment S. How much the teacher biases affected the achievement or attitude of the students is not known. It is known that teacher opinions of student attitudes would not have been good predictors of student attitudes.

The teachers were asked to guard against letting their attitudes concerning any of the treatment groups become known to the students. It is the writer's opinion that for the most part, this was done successfully.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this chapter is to present a brief review of the problem, the findings, and the conclusions that can be drawn from them. Included are the restatement of the problem, the limitations of the study, the findings and conclusions, and discussion.

Restatement of the Problem

The study was designed to examine the effects on mathematics achievement and attitude of two supplementary programs of instruction. One program utilized high-achieving students as tutors for low-achieving students with students of middle achievement working in groups of two to four. The other program had high-achieving students doing teacher-assigned supplementary work, while the middle- and low-achievement groups worked in a commercially-prepared skills kit. The study attempted to evaluate the effectiveness of same age tutoring within the confines of the regular classroom as opposed to a supplementary work/skills kit approach.

Forty sessions of thirty minutes each between January 5, 1971 and March 31, 1971 comprised the actual treatment period, or approximately one-ninth of the available classroom time in a normal school year.

Limitations of the Study

Limitations associated with this study include:

1. The sample was not large, with only three classes per treatment.

2. The students were all drawn from a small school in a mining-ranching environment.

3. The average I.Q. of approximately 94 represents a weak average group.

4. The population is approximately 80 percent bilingual.

5. The amount of assistance the teacher provided students in both treatments was not strictly controlled.

Findings and Conclusions

Question 1

How does the mathematics achievement of students in a tutor/tutee group work program (T) compare with that of students in a supplementary work/skills kit program (S)?

For the Stanford Achievement Test (SAT) on computation, there were no significant differences on the post or retention tests. The pre-post school months gain was only two months for group T and four months for group S.

For the Stanford Diagnostic Arithmetic Test (SDAT), Test 2, which is composed of three subtests on whole number computation, there were no significant differences on any of the tests and no trends were evidenced in favor of either group.

For the SDAT test on fraction computation, there were no significant differences or trends on any of the tests.

For the SDAT test on decimal fraction and percent computation, there was a trend ($p<.25$) in favor of the T group on the pretest

analysis of variance (ANOVA). The post-test ANOVA showed a significant difference ($p<.05$) in favor of the T group. The pre-post analysis of covariance (ANCOVA) indicated a trend ($p<.10$) in favor of the T group, while the I.Q.-post ANCOVA was significantly ($p<.01$) in favor of the tutor/tutee group treatment.

Conclusion 1

Treatments T and S were comparable overall. Neither resulted in large computation gains.

Conclusion 2

For decimal fraction and percent computation, the tutor/tutee group process is slightly superior to the supplementary work/skills kit approach. The difference was mainly due to problems on percent, which may indicate that the verbal interaction inherent in the T group process facilitates the learning of percent.

For the SAT on concepts, there were no significant differences; however, there were trends in favor of the T group on the post ANOVA ($p<.25$), the pre-post ANCOVA ($p<.10$), and the I.Q.-post analysis of covariance ($p<.25$).

The SDAT, Test 1 on concepts is composed of two subtests. For the complete test, the T group achieved significantly better than the S group on the post ANOVA ($p<.025$), the pre-post ANCOVA ($p<.0005$), and the I.Q.-post ANCOVA ($p<.0005$).

For subtest IA on number systems and operations, the tutor/tutee group treatment was significantly better than the supplementary work/skills kit approach on the post ANOVA ($p<.025$), the pre-post ANCOVA ($p<.0005$), and the I.Q.-post ANCOVA ($p<.001$). The main item difference

occurred on items that are normally considered to be more difficult arithmetic concept items.

For subtest 1B on decimal place value, there were again significant differences in favor of the T group on the post ANOVA ($p<.025$), the pre-post ANCOVA ($p<.005$), and the I.Q.-post ANCOVA ($p<.001$).

For the SDAT, Test 3A on understanding common fractions, there were no significant differences between the T and S groups.

Conclusion 3

The tutor/tutee group process results in better achievement of arithmetic concepts than does the supplementary work/skills kit approach.

Conclusion 4

The T group process is superior to the S group approach in the achievement of some of the more difficult conceptual items related to arithmetic operations.

For the SAT on applications, there were no significant differences and the item gains were quite small for both groups.

Conclusion 5

Neither treatment has any effect on the achievement of arithmetic applications.

Question 2

How does the mathematics achievement of students who tutored (TH) compare with that of students who did supplementary work (SH)?

For the SAT on computation, there were no significant differences on any of the tests. The pre-post ANCOVA did show a trend in favor of the tutors ($p<.10$).

For the SDAT, Test 2 on computation, there were no significant

differences among the groups. On subtest 2A involving whole number addition and subtraction, there were significant differences in favor of TH on the post ANOVA ($p<.05$) and the I.Q.-post ANCOVA ($p<.05$). The pre-post ANCOVA showed a trend ($p<.10$) in favor of the tutors. The item difference was quite small (0.4) with both groups missing less than two of the 20 problems on the test. On subtest 2B involving whole number multiplication and subtest 2C on whole number division, there were no significant differences.

For the SDAT test on fraction computation, there were no significant differences between the tutors and the supplementary work students.

For the SDAT test on decimal fractions and percent computation, there were significant differences favoring the tutors on the post ANOVA ($p<.05$) and the I.Q.-post ANCOVA (.05). A difference in pretest means existed ($p<.10$) and the adjustment on the pre-post ANCOVA left a weak trend ($p<.25$) in favor of the tutors. The difference between these groups was attributable to a difference in the achievement of percent problems.

Conclusion 6

There were no major differences overall between the tutors and the supplementary work students on computation. When there were instances of significant difference, they were in favor of the tutors.

Conclusion 7

For decimal fraction and percent computation, it appears that the tutoring process is slightly superior to the supplementary work approach. The difference was mainly due to problems on percent, which

may indicate that helping others learn how to do percent problems is of significant benefit to the tutor.

For the SAT on concepts, the tutors were significantly better on the pre-post ANCOVA ($p<.025$). Trends in favor of the tutors were noted on the post ANOVA, I.Q.-post ANCOVA, and retention ANCOVA ($p<.10$).

The SDAT, Test 1 on concepts is composed of two subtests. For the complete test, the tutors were significantly better than the supplementary work students on the post-ANOVA ($p<.01$), the pre-post ANCOVA ($p<.001$), and the I.Q.-post ANCOVA ($p<.005$).

For subtest 1A on number systems and operations, the tutors were significantly better on the post-ANOVA ($p<.025$), the pre-post ANCOVA ($p<.005$), and the I.Q.-post ANCOVA ($p<.01$). The item difference was primarily on items involving inverse relations of operations, order of performing operations, and the distribution property.

For subtest 1B on decimal place value, there were again significant differences in favor of the tutors on the post-ANOVA ($p<.025$), the pre-post ANCOVA ($p<.025$), and the I.Q.-post ANCOVA ($p<.025$).

For the SDAT, Test 3A on understanding common fractions, there was a significant difference in pretest means ($p<.05$). The pre-post ANCOVA indicated a weak trend ($p<.25$) in favor of the tutors. The post-ANOVA and I.Q.-post ANCOVA significantly favored the tutors ($p<.025$). The item gain (3.1) was the same for each group.

Conclusion 8

The process of tutoring results in better achievement of arithmetic concepts than does the supplementary work approach.

Conclusion 9

Tutoring appears to be superior to supplementary work in the achievement of conceptual ideas concerning inverse relations of operations and the distributive property.

For the SAT on applications, there were no significant differences and the item gains were small for both TH and SH.

Conclusion 10

Neither tutoring nor supplementary work has any appreciable effect on the achievement of arithmetic applications.

Question 3

How does the mathematics achievement of students who worked in groups (TM) compare with that of students who worked basically in a skills kit (SM)?

For the SAT on computation, there were no significant differences on any of the tests. A very weak trend ($p<.25$) was evidenced in favor of SM on both the pre-post and I.Q.-post ANCOVA.

For the SDAT, Test 2 on computation, there were no significant differences. A weak trend ($p<.25$) existed on the pre-post ANCOVA in favor of the middle ability skills kit students. On subtest 2A involving whole number addition and subtraction, on subtest 2B involving whole number multiplication, and on subtest 2C involving whole number division, there were no significant differences.

For the SDAT test on fraction computation, there were no significant differences.

For the SDAT test on decimal fractions and percent, there were no significant differences.

Conclusion 11

There exist no differences on arithmetic computation between students working in groups and students working in a skills kit.

For the SAT on concepts, there were no significant differences between the TM and SM groups. Both groups gained approximately six school months during the treatment period.

The SDAT, Test 1 on concepts is composed of two subtests. For the complete test, the TM students were significantly better on the pre-post ANCOVA ($p < .05$) and the I.Q.-post ANCOVA ($p < .05$).

For subtest 1A on number systems and operations, there were no significant differences between the groups.

For subtest 1B on decimal place value, there were significant differences in favor of the students working in groups on the pre-post ANCOVA ($p < .025$) and the I.Q.-post ANCOVA ($p < .025$).

For the SDAT, Test 3A on understanding common fractions, there were no significant differences between the middle ability groups.

Conclusion 12

There was little difference between the middle ability groups overall on achievement of concepts. What differences were found favored TM.

Conclusion 13

For middle ability students, working in groups results in superior achievement of decimal place value concepts as opposed to working in a skills kit.

For the SAT on applications, there were no significant differences on any of the tests.

Conclusion 14

The evidence shows that neither group work nor skills kit work affects the achievement of arithmetic applications for middle ability students.

Question 4

How does the mathematics achievement of students who were tutored (TL) compare with that of students who worked in a skills kit (SL)?

For the SAT on computation, there were significant pretest differences ($p<.025$) favoring the tutees. The post ANOVA, pre-post ANCOVA and the I.Q.-post ANCOVA tests did not show significant differences. The pre-retention ANCOVA was significantly ($p<.05$) in favor of the low skills kit students and both the post ANOVA and the I.Q.-retention ANCOVA trended ($p<.25$) in favor of SL. Both groups made a substantial gain of approximately nine school months during the treatment period.

For the SDAT, Test 2 on computation, there were no significant differences between TL and SL. A weak trend ($p<.25$) was evidenced on the pre-post and I.Q.-post ANCOVA tests in favor of the tutees. On subtest 2A involving whole number addition and subtraction, there were no significant differences. TL answered 79 percent of the items correctly, while SL answered 73 percent correctly. On subtest 2B involving whole number multiplication, there was a significant difference ($p<.05$) in favor of the tutees on the pre-post ANCOVA. A weak trend ($p<.25$) favored TL on the post ANOVA and the I.Q.-post ANCOVA. Items involving zero appeared to account for the difference. On subtest 3B involving whole number division, there were no significant differences.

For the SDAT test on fraction computation, there were no significant differences.

For the SDAT test on decimal fractions and percent, there were no significant differences between TL and SL. Trends were evidenced in favor of the tutees on the post ANOVA ($p<.25$), the pre-post ANCOVA ($p<.10$), and the I.Q.-post ANCOVA ($p<.10$).

Conclusion 15

There was little difference between TL and SL on computation skills. The pre-post differences that did exist were in favor of the tutees. Both groups made a good computation gain of one school year.

Conclusion 16

The low ability skills kit group exhibited superior retention of computation facts in relation to the tutees.

For the SAT on concepts, there were no significant differences between the TL and SL groups.

The SDAT, Test 1 on concepts is composed of two subtests. For the complete test, the tutees were significantly better on the pre-post ANCOVA ($p<.05$) and the I.Q.-post ANCOVA ($p<.05$).

For subtest 1A on number systems and operations, there were significant differences in favor of the tutees on the post ANCOVA ($p<.025$) and the I.Q.-post ANCOVA ($p<.025$). The post ANOVA showed a trend ($p<.10$) in favor of the TL group.

For subtest 1B on decimal place value, there are no significant differences between TL and SL. The post ANOVA and the I.Q.-post ANCOVA show weak trends ($p<.25$) in favor of the tutees.

For the SDAT, Test 3A on understanding common fractions, there are

no significant differences between the tutees and the skills kit students.

Conclusion 17

The tutees' achievement of number system and operations concepts was superior to that of the low skills kit students.

Conclusion 18

The TL and SL groups did not differ greatly overall on concepts, but where differences did occur they were in favor of TL.

For the SAT on applications, there were no significant differences.

Conclusion 19

The evidence shows that neither being tutored nor working in a skills kit has any noticeable effect on the achievement of arithmetic applications.

Question 5

How do the treatments affect the attitudes of both treatment groups and their respective subgroups?

For the Aiken-Dreger attitude opinionnaire, there were no significant differences on the pre- or post-test scores. All groups exhibited positive attitudes and the degree of positive response was closely correlated with the level of ability and achievement of the groups.

For the writer constructed opinionnaire, the following findings appear to be of value: (1) Students in each Treatment and subgroup felt that their respective activities had increased their overall knowledge of mathematics. The response of groups TH and TL were the most positive and this is in agreement with the findings of the actual achievement

data; (2) All of the groups reported that they enjoyed their particular activities with the tutors being most favorable; (3) The experiment increased the desire to learn more mathematics, to an appreciable degree, only on the part of the low skill kit students, the middle groups and the supplementary work students; however, the tutees had the highest favorable response; (4) All of the groups responded quite favorably in regard to enjoying their mathematics class. The supplementary work students and low skills kit students exhibited the greatest percentage of favorable response; (5) The tutees were 96 percent favorable toward the help they received from the tutors, while only 63 percent of the tutors felt they had been successful; and (6) 92 percent of the tutors, 67 percent of the group workers, and 81 percent of the tutees felt that their treatment experiences had given them a better understanding of their fellow students.

Conclusion 20

There were no differences between groups T and S in their attitudes towards mathematics.

Conclusion 21

The students all responded favorably to their respective activities and all thought they increased their knowledge of mathematics, particularly the tutors and tutees.

Conclusion 22

Low achieving seventh grade students respond very favorably to receiving help from high achieving seventh grade students.

Question 6

How do the teachers view the usefulness and success of the two

treatments?

For the writer-constructed opinionnaire and the teachers' comments, the following findings appear to be of value: (1) The positiveness of response towards both treatments correlates positively with the years of teaching experience of the teachers, with treatment T having a slight edge; (2) Teachers' views about student attitudes towards their respective treatments do not agree with the students' factual attitudes; (3) The teachers' views concerning cognitive student achievement were not in agreement with the actual achievement data; and (4) The teachers did not view either treatment with great enthusiasm; but, on the other hand, they were not strongly opposed to either treatment.

Conclusion 23

The teachers did not view either treatment, as experienced under the experimental conditions, as being an especially helpful supplement to the regular instructional program.

Discussion

The results of the study show that same-age, in-class tutoring is a viable and fruitful supplementary classroom practice at the seventh grade level. Little time was spent training the tutors for their task of helping low achievers. Neither were they aided by the use of well-designed learning materials for slow achievers. It seems reasonable to speculate that with either or both of these additional aids, the tutoring program would be even more successful.

The time spent by the tutors in helping others resulted in higher achievement scores than did time spent by equally intelligent, high-

achieving students doing additional work tasks directly related to the regular program. This negates arguments against tutoring that assume the time tutors spend helping others cannot be justified on the basis of the achievement of the tutors.

Students working in groups appeared to need more direction in their efforts. Overall they had lower achievement gains and had a less positive attitude toward the experiment than did the high and low students. These students probably needed more specific work tasks and more help from the tutors or the teacher.

The full school year computation gain by both low groups was much better than should be normally expected. This is based on the fact that the treatment periods constituted one-sixth of a school year and the pre-post test interval was approximately four school months. This would seem to demonstrate that it is possible to provide increased computational gains for low achieving students without elaborate or expensive programs.

It seems reasonable to believe that, if either treatment had been of a school year duration and had considerably more teacher input, the results would have been better. In view of the findings of this study, a program that combined tutoring and materials similar to the skills kit should result in very positive achievement gain for all students.

It was very interesting that the students' views of how they were achieving agreed quite well with their actual achievement data. The teachers' views concerning student achievement and attitude were not as accurate. Possibly this affords a degree of proof for the often-stated

student complaint that we (teachers, adults) don't really listen to what the students say or think.

The main objective that the supplementary programs sought to achieve consisted of three parts: (1) Identify, prescribe treatment for, and alleviate individual student computational deficiencies; (2) Provide for normally expected achievement in the regular program; and (3) Meet with positive affective response from both students and teachers.

For Part 1, the results of the study indicate that deficiences were identified and that the prescribed treatment was effective to a fair degree considering the time frame. For Part 2, the results indicate that the supplementary programs contributed positively to the regular program. For Part 3, the students were positive towards the supplementary programs, in fact, much more so than were the teachers. The teachers' attitudes can probably be best described as somewhat undecided.

APPENDIX A

OPINIONNAIRES

T4

Date_____

Opinionnaire No:____for Helpers

Directions: Each of the following statements on this opinionnaire expresses a feeling which a particular person has toward some phase of the work he has been doing in this class. You are to express, on a five-point scale, the extent of agreement between the feeling expressed in each statement and your own personal feeling. The five points are: Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), Strongly Agree (SA). You are to encircle the letter which best indicates how closely you agree to disagree with the feeling expressed to each statement as it concerns you.

1. I have been successful in helping my fellow students learn more about mathematics.	SD	D	U	A	SA
2. Being a helper has increased my knowledge of mathematics.	SD	D	U	A	SA
3. The process of being a helper has provided me with a much better understanding of the mathematical concepts and computations that I studied in grade school.	SD	D	U	A	SA
4. I really enjoy helping other students.	SD	D	U	A	SA
5. The process of being a helper has given me a much better understanding of my fellow students as unique individuals.	SD	D	U	A	SA
6. The process of being a helper has increased my desire to learn more mathematics.	SD	D	U	A	SA
7. I really enjoy my mathematics class this year.	SD	D	U	A	SA

T6

Date_____

Opinionnaire No:_____for Students Working in Groups

Directions: Each of the statements on this opinionnaire expresses a feeling which a particular person has toward some phase of the work he has been doing in this class. You are to express, on a five-point scale, the extent of agreement between the feeling expressed in each statement and your own personal feelings. The five points are: Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), Strongly Agree (SA). You are to encircle the letter which best indicates how closely you agree or disagree with the feeling expressed to each statement as it concerns you.

1. The helper group process has increased my knowledge of mathematics.	SD	D	U	A	SA
2. The helper group process has provided me with a much better understanding of the mathematical concepts and computations that I studied in grade school.	SD	D	U	A	SA
3. I really enjoy working in a helper group.	SD	D	U	A	SA
4. The helper group process has given me a much better understanding of my fellow students as unique individuals.	SD	D	U	A	SA
5. The helper group process has increased my desire to learn more mathematics.	SD	D	U	A	SA
6. I really enjoy my mathematics class this year.	SD	D	U	A	SA

T5

Date_____

Opinionnaire No:_____for Students Receiving Help

Directions: Each of the statements on this opinionnaire expresses a feeling which a particular person has toward some phase of the work he has been doing in this class. You are to express, on a five-point scale, the extent of agreement between the feeling expressed in each statement and your own personal feeling. The five points are: Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), Strongly Agree (SA). You are to encircle the letter which best indicates how closely you agree or disagree with the feeling expressed to each statement as it concerns you.

1. My helper (or helpers) has been successful in helping me learn more about mathematics.	SD	D	U	A	SA
2. The helper group process has increased my knowledge of mathematics.	SD	D	U	A	SA
3. The process of having a helper has provided me with a much better understanding of the mathematic concepts and computations that I studied in grade school.	SD	D	U	A	SA
4. I really enjoy being helped by other students.	SD	D	U	A	SA
5. Having a helper has given me a much better understanding of my fellow students' as unique individuals.	SD	D	U	A	SA
6. The process of being helped by fellow students has increased my desire to learn more mathematics.	SD	D	U	A	SA
7. I really enjoy my mathematics class this year.	SD	D	U	A	SA

T7

Date_____

Opionnaire No:_____for Students Doing Supplementary Work

Directions: Each of the statements on this opinionnaire expresses a feeling which a particular person has toward some phase of the work he has been doing in this class. You are to express, on a five-point scale, the extent of agreement between the feeling expressed in each statement and your own personal feeling. The five points are: Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), Strongly Agree (SA). You are to encircle the letter which best indicates how closely you agree or disagree with the feeling expressed to each statement as it concerns you.

1. The supplementary work I have done has increased my knowledge of mathematics. SD D U A SA

2. The study of supplementary topics has provided me with a much better understanding of the mathematical concepts and computations that I studied in grade school. SD D U A SA

3. I really enjoy doing the supplementary work. SD D U A SA

4. The study of supplementary topics has increased my desire to learn more mathematics. SD D U A SA

5. I really enjoy my mathematics class this year. SD D U A SA

T8

Date_____

Opinionnaire No:_____for Students Doing Skill Kit Work

Directions: Each of the statements on this opinionnaire expresses a feeling which a particular person has toward some phase of the work he has been doing in this class. You are to express on a five-point scale, the extent of agreement between feeling expressed in each statement and your own personal feeling. The five points are: Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), Strongly Agree (SA). You are to encircle the letter which best indicates how closely you agree or disagree with the feeling expressed to each statement as it concerns you.

1. The skill kit work I have been doing has increased my knowledge of mathematics. SD D U A SA

2. The study of the skill kit has provided me with a much better understanding of the mathematical concepts and computations that I studied in grade school. SD D U A SA

3. I really enjoy doing the skill kit work. SD D U A SA

4. The study of the skill kit work has increased my desire to learn more mathematics. SD D U A SA

5. I really enjoy my mathematics class this year. SD D U A SA

THE AIKEN-DREGER MATHEMATICS ATTITUDE OPINIONNAIRE

Name_____

School_____

Opinionnaire

Directions: Please write your name in the upper right hand corner. Each of the statements on this opinionnaire expresses a feeling which a particular person has toward mathematics. You are to express on a five-point scale, the extent of agreement between the feeling expressed in each statement and your own personal feeling. The five points are: Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), Strongly Agree (SA). You are to encircle the letter which best indicates how closely you agree or disagree with the feeling expressed to each statement as it concerns you.

1.	I do not like mathematics. I am always under a terible strain in a math class.	SD	D	U	A	SA
2.	I do not like mathematics, and it scares me to have to take it.	SD	D	U	A	SA
3.	Mathematics is very interesting to me. I enjoy math courses.	SD	D	U	A	SA
4.	Mathematics is fascinating and fun.	SD	D	U	A	SA
5.	Mathematics makes me feel secure, and at the same time it is stimulating.	SD	D	U	A	SA
6.	I do not like mathematics. My mind goes blank and I am unable to think clearly when working math.	SD	D	U	A	SA
7.	I feel a sense of insecurity when attempting mathematics.	SD	D	U	A	SA
8.	Mathematics makes me feel uncomfortable, restless, irritable, and impatient.	SD	D	U	A	SA

9.	The feeling that I have toward mathematics is a good feeling.	SD	D	U	A	SA
10.	Mathematics makes me feel as though I'm lost in a jungle of numbers and can't find my way out.	SD	D	U	A	SA
11.	Mathematics is something which I enjoy a great deal.	SD	D	U	A	SA
12.	When I hear the word math, I have a feeling of dislike.	SD	D	U	A	SA
13.	I approach math with a feeling of hesitation--hesitation resulting from a fear of not being able to do math.	SD	D	U	A	SA
14.	I really like mathematics.	SD	D	U	A	SA
15.	Mathematics is a course in school which I have always liked and enjoyed studying.	SD	D	U	A	SA
16.	I don't like mathematics. It makes me nervous to even think about having to do a math problem.	SD	D	U	A	SA
17.	I have never liked math, and it is my most dreaded subject.	SD	D	U	A	SA
18.	I love mathematics. I am happier in a math class than in any other class.	SD	D	U	A	SA
19.	I feel at ease in mathematics, and I like it very much.	SD	D	U	A	SA
20.	I feel a definite positive reaction to mathematics; it's enjoyable.	SD	D	U	A	SA

APPENDIX B

TEACHER AND STUDENT WRITTEN RESPONSE

Teacher Comments in Relation to Treatment A

Teacher A

February: Most of the helpers are very good about leading the others. I have the most trouble with several of the girls in the middle group. They want to do nothing but gossip, so I am constantly checking their work to see if they are doing anything. Four of the boys being helped are very bad. They will not pay attention to the helpers, no matter who the helper is.

Treatment A has mainly reinforced opinions I had about students, although one of the tutors has been much better than expected. The tutors and a few of the middle group take responsibility very well. The rest haven't changed. The students are really willing to help each other. They are not afraid to ask each other for help. Some of the tutees have become 'pests' and refuse to work for the tutors.

April: Treatment A definitely helped me know the irresponsible ones. Kids this age are not mature enough to handle a situation with minimum supervision. There are one or two who have learned to take responsibility well. Some of the girls in the middle group and boys in the low group have taken this as an opportunity to do nothing, no matter how hard the other students and I push them. It is hard for me to say if Treatment A has done more for the students than the regular program or less. Sometimes the program was a hindrance to me because

it was too rigid. Some of the regular lessons couldn't be taught in 30 minutes and there wasn't enough time to work on my assignments.

I don't see much effect from either treatment. I cannot truthfully say that the students seem much different than if they had been in the regular program entirely.

Teacher B

February: Most seem to enjoy the treatment. Most of the helpers seem to enjoy helping. One helper is too impatient and bossy. One other just doesn't want to help anyone and has to be prodded. Most tutees are responding positively to the treatment. Some of the slower learners gain very slowly, but I feel they are gaining. Only one boy balks at being helped. The boys working in groups seem to be achieving more than the girls. The girls like to giggle and talk if I don't get them started.

The students have learned to work together and know each other better. Probably the helpers and those being helped have benefited most. The students in the tutoring sessions never feel that they have enough time in the session. Many have expressed the desire to do the session one full period and a regular class one full period so that one doesn't cut in on the other and they would have time to finish.

If Treatment A were spread over a longer period of time, I feel it would be a good way to provide for individual differences in a classroom with too many students for the teacher to help individually when they need it.

April: The children enjoyed working in groups. Most of the helpers tried hard to help the other students. Most of the students

enjoyed working together.

I'm not sure whether or not the Treatment A students gained as much in cognitive skills as they would have in my regular classroom procedure and using the groups for specific problems and not on a scheduled basis. If I could use this as a supplementary aid and not as a specified program, I feel it would be very effective. The treatment was too concentrated.

The Treatment A students enjoyed the experiment and, of course, this helped with their attitude towards mathematics as a class. Treatment B did not enjoy it and were glad to get back to the regular program.

Teacher C

February: It seems to be working pretty good for most. Some I have to watch or they loaf on me. Leaders chosen have worked out very well with the exception of one. Most like to be helped, but some prefer certain people to help them. Middle students working in groups have been a big surprise; most are doing very well, except for losing papers from folders. The tutor group has given me more time to observe students in their work and give them help as they need it. I believe Treatment A has helped all the boys and girls to work together. Some have really benefited from this experience.

April: The group work did need some help from the teacher but I think this was to be expected from children this age. The student tutors as a rule seemed to enjoy their role; of course, some were a little lax and tended to gossip.

The Treatment A students have learned to accept some

responsibility. The good students have established good rapport with the other students. Socially, the good students are not separated from the others. Some wanted to use the treatment period as a time killer but most seemed to learn to work together and were of help to those in need of help. Some did refuse to do the work and some of the girls wanted to gossip.

Some days it would have been better to spend a full period on the treatment and then spend the next full period on the regular program.

Teacher Comments in Relation to Treatment B

Teacher A

February: Treatment B hasn't given me any better understanding of my students; it has mainly reinforced my previous opinion. It is definitely helping some of the students who were very low on computation.

It is difficult to challenge the supplementary students individually and keep an eye to see if the skill kit group is doing the proper thing.

April: The sharper ones working in the skill kit definitely feel a sense of accomplishment which their work reflects. The supplemental work group have a negative attitude. This attitude is mostly my fault because I had a hard time making worthwhile assignments for them.

Teacher B

February: Most of the skill kit students still come and ask what to do next, even though they have been through the process several times.

The students doing supplementary work prefer ditto sheets to exercise in the book. Only one or two are very enthusiastic about the program. The skill kit students started off the program with a bang but are now tiring of it. I think having to sometimes have four sessions a week has killed their interest. Perhaps once or twice a week would work better. The students working in groups in Treatment A have sustained interest much more than those in skill kits.

For two or three weeks some of the poorer students who hated to work in the book really worked in the skill kits. A few have learned to read the cards of explanation and work on their own. Some still must have constant help and direction from the teacher. Many in the supplementary work group cannot work on their own effectively. The skill kit does allow for individual needs and lets each student work at his own speed. The skill kit work does not free the teacher, as was originally planned, and planning and providing supplementary work is also time-consuming.

April: Some of the skill kit students worked hard and I hope they improved their skills. The students often became tired of so much computing that the kits may have lost their effectiveness. I do think, though, that they could be effective as an aid to computation practice for those who need it.

Teacher C

February: Almost all the skill kit students work very well. Some had a hard time following the skill kit instructions. The students doing supplementary work like the teacher made problems better than those in the textbook. A couple of the supplementary work students tend to

play so I have to remind them to get busy more than those in the skill kit. Some do seem to be growing tired of the skill kit work, but I do think it has given some of them confidence in themselves.

April: The students who were willing to work seemed to accomplish quite a bit in the skill kit program. Even some of the lowest students learned a few skills. Most working in the skill kits want to work too fast. Some of the skill kit students seemed to tire a little. Maybe one or two days a week would be better.

The students get along better than in the old ability-grouped classes. They accept each other more and the discipline problem is reduced.

Student Written Response

Teacher A, Group T

Tutors

I like being a helper because I like helping someone. I did not like some of the people that I help becaus the did not pay attention to me because I was the same age as them. They tought that they was better than I was but I like it. (TH)

Essay

This year I was a helper. I didn't like the achievement tests. I didn't like the helper business but I still learned something. (TH)

THE END

This year in my Math class I was a helper. And it was a lot of fun because I didn't have to do much work. All I did was help the person that was assigned to me and I tried to get something through their head (although sometimes it didn't work). But still I tried hard to teach them what they needed to learn. (TH)

Being a helper was fun, cause I like helping other people. It helped me to learn more than what I new, and helped me to know I was able to help students that needed help. (TH)

I liked it but I didn't Sometimes it was fun, and others it was so boring I almost fell asleep. especially if I had to keep showing him how to do it over and over again or the timing was bad, and I taught the same thing all the time, but to different people If the person really tried, it was fun. (TH)

I liked helping other people, I have always liked helping people in anything I can. Besides helping other people they helped me so I learned things too. I liked everything about it except some people didn't want to listen to you or something. What I didn't like about it was that you only had half of the period for it. It would have been better if we could have had it about two or three times a week even though it would mean to miss our regular classes. (TH)

I really did not like the helping sessions because, when we had some extra time in class to do some homework we would always have to the helping sessions and some of the people were so dumb that I could not make them understand. (TH)

During the helpers session. I learned many things that I had never learned in the 6th grade. Even though I was the helper I tryed all I could to help my fellow students. There was some times when me and my partner could not figure out but (the teacher) was a big help. Some of my partners did not pay attention, but I did not listen to them and still went on. and thats what I thought of the seccions. (TH)

Helper Group

Although I was a helper, I learned alot in the sessions. I think that if you continue to use this method that it will help many more people than the other way. This way you hardly ever get bored and if you do their is always somebody to talk to. Sure, there is always somebody to mess everything up, but mostly all the people help each other and listen to what they have to say. All in all I'd say that every session was greater than the one before. So I hope you do it every year, cause I'm sure everyone will like it. (TH)

Group Workers

ESSAY

I was in a group that just helped each other. I think I learned from it a little sometimes we talked and to tell you the truth it was really fun. It wasn't so boring as when we didn't have it. (TM)

I was in the middle group and I think what you did helped me to understand my math even better I learned much more things and I understood them much better than when I was in elementary. Now I know how to work my math beter than I did. (TM)

I liked the group thing we had I learned to do my problems a little bit better also to understand them. A little more than I knew how to do.(TM)

Helper Group

I guess I enjoyed the helper group cause it helped me a lot and I hope other people learned as much as I did. I enjoyed it because I like Math a lot and because almost all of my friends are in thes particuler class and they helped make it enjoyable. . .! (TM)

i was in the middle group. sometimes i liked it because i would work and learn alot and, i also liked it because i got to know more about my friends. Sometimes i got put in a group that wouldn't work so i didn't work either but i learned alot. (TM)

I was in the group that helped each other and I really enjoyed it very much. What I didn't like was a person that would not work. I do admit I was a little lazy at times. But when (the teacher) found out (the teacher) gave me something to really work on. (TM)

Tutees

I did not like it because we would work hard and I would not learn things becaus it went in one ear and came out the outher but it was ok cause I learned something. (TL)

Sometimes I enjoyed it very much and I learned a lot of things I didn't understand sometimes I fairly liked it and I fairly learned sometimes it was bad. I didn't like the way they explained or something and I wouldn't learn anything.

I kind of liked it. But sometimes I didn't cause the person I was working with was boring. But most of the time it was o.k. because I liked the person I was working with. (TL)

Well when we started doing those things of helping each other I really enjoyed some of it and some of it I didn't But there was one girl who wouldn't explain it right to me But the other helpers I had they sure taught me alot of things and I really learead a wholelot But sometimes I'd forget But I really leared a whole lot. (TL)

It was fun being helped but sometimes it was boring. It wzsn't hard. (TL)
Thank you.

helpless Mr. X

I didn't rilly like the test. But being helped didn't bother me a bit. It gave us a canch to talk with our nabor. We didn't have to do any thing in our math books. (TL)

I like to have this time to tell you how I felt about the test. To tell you a honest question I didn't really enjoy it, but still I learned more about fraction now I can do them without any problem. (TL)
THANK YOU MR. CRANDLE

I really enjoy my Math class this year. I enjoy getting help from other student. The teacher was relly kind and nice. I wish the teacher wouldn't leave. We would like to have (the teacher) next year. (TL)

Math

math a fun for 4 period. is fun. To lunch after lunch. We go 4 period. (TL)

Teacher B, Group T

Tutors

I was a helper. I thought that helping other people is very useful but sometimes I thought it was boring. Becouse on some days, like Mondays I really didn't feel like doing anything. But I thought that helping other students would help the student or maybe even me learn more things than what I knew before. Yet I don't remember how many students I helped. But I hope that those students learned something. Also I got some that I didn't even talk to, but know it's different. That is what I think of being a helper. (TH)

Well first of all I enjoyed being a helper and I liked the helper group session. It was fun I liked helping the other people. I like to help people that really want to learn, because some people just don't want to learn and the helpers just wast their time. But I really liked and enjoyed and liked the group sessions. (TH)

What I take a balout the sacan some a lake the sacan and soma tame I de not lake the sacan and I wacec we would have one hlepr. (TH)

I liked this year because of the group sessions. It was alot of fun helping others to try to learn about math. But I wish we could stay with only one partner instead of alot of them because I think I can help one an a lot of things than alot on one thing. (TH)

I really liked the group sessions that we had it was fun. I thought I really learned more even though I was a helper. I wish that we could only help one peron, all through it in sted of changing partners all the time its more complicated to keep changing. (TH)

It depeded on the person that I worked with some of them understub and others didint I liked being a helper becase it was being helpful. I liked it because we had less work. Some times I didn't like It because the person I wac working with didn't understand. (TH)

The helper sectom was a perty cool thing. I would like to do this next year if I was here. It would be a neat thing for the seventh and eighth. I think they would like it. (TH)

"me"

I liked the session especially being a helper. I sort of feel that I have in away helped my fellow class mates. I also feel that It has also helped me quite a bite. My favorite partner or the one I helped the most was Eloy because when I first got him as a he really didn't know anything. But after I got him he really improved so it make me feel better to know I help someone!!!

I like it because my partness were nice and some really want'd to know what they were doing wrong. What I didn't like was that the Boys, that had wouldn't pay attention and would be playing around. And because everyone was alway talking. (TH)

Group Workers

What I learned this year abaut the helper group - nothing. (TM)

I think it was kinda fun and I learn alot of things but sometimes I didnt like it because the people in my group pushed me around and they wouldn't da an gething and the other people would monkey thaw thing around (the teacher) would go out of the roam but stell I learned something. (TM)

I liked it very much and I think that a larnd alot doring that time and I also thnk that if you do it to the 6th grand they will injoy it to it is fun and you larnd quite alot. I had lots of fun working with my frends and it was worth it because it is fiffererte than what we do every day.

My likes and dislikes about helper session

I liked and disliked the sessions. The session was fun and a good idea. When we got together we could learn easier because it was a kid teaching another kid and tha is more fun than being tought by a parent teacher There are many good reasons for having the sessions. There are sone reasons that sessions are bad. I think it interfres with school work with our books. It was good and bad but I think we out to change back and

and forth like one week book work and the next week sessions. I think this would be better. (TM)

If I were a helper I think I would like it. Why I think I would like is that some people don't care wether they learn something or not. But if the people who kare in learning something I would enjoy being a helper. If I were a helper I would enjoy helping only the people who want to learn. (TM)

I liked it because it helped me to learn more than what I knew I really don't know if I like it or not. I don't like it because everybody just talked and talked. And don't and Don't let anybody do what we are to do. (TM)

Tutees

It was fun having other students help me an I enjoyed it. I have learned more, and I wish we could have more sessions. (TL)

I'v like this group stuf becous I have learned all sort of thing in math that I have never learnd befor put what I didnt like was that we had to do math. I like my student that halp me and the work in the paper put I wish we have this thing agen next year. Put I wish we had one partner. (TL)

I think that herper group tott me alot, But I didn't like because it was boring. I learned how to diveded. But sonetimes it was fun because we didn't do nothing. I hop next year the kids will have the same apertentvee we had. Because at leaset we learn how to do desemeles and facenes. I didn't like the dinosent test we had because they were hard to do. (TL)

How I felt about the helping groups. I like it because I learned alot of things and I like some of the partners I had they were very nice and when I made a mustake they would help me with the same thing untill I learned all of it. I wish we could stay with 1 partner I like helping groups. (TL)

The helpers group helped me alot. It compared more better in the 7th grade than in the 6th grade because over their our math teacher didn't teach us much over their. Then aver here with the helpers group I learned alot more. The helpers group wasn't bad because these was always someone here to help you. And I enjoyed the helpers group 50 : 50. But in same case I didn't like the helpers group. and thats what I think about the helpers group. But I hated the sessions! (TL)

I hated to get in a session it was no good it made me feel dume and stupd to study in group is styed it is a no good progrm. (TL)

Well I did enjoy it but what brothered I was that I always was in a group and its boring. But it was neat for a 7th grader. It was fun having (the teacher) help us when we were struck. We had very smart helpers? But anyway I have enjoyed to be in a group. But seeing the same person it was sort of borin. I wouldn't mind it if we had another session in

the 8th grade. But all I can say is that it really helped me because when the test came up I new every thing on the test still say is that it was fun having (the teacher) as my teacher and hope I have (the teacher) next year if (the teacher) going too still teacher and I have enjoy the session this year. (TL)

I liked the session sometimes because in the beginning of the session they taught me alot. But getting close to the end they just played around. And it also got us out of out of our homework, and school work. I would rather have one perons every year. (TL)

Teacher C, Group T

Tutors

Well part of the time I liked it, but most of the time I didn't. The part or the reason I liked it was I got to help other people and try to make them understand what they did wrong. Also because some times I would get a problem wrong and they would get it right. So they would help me to understand what I did wrong, there were a couple of reasons why I didn't like it.

1. Sometimes the other people would get too loud, so with all that noise you wouldn't be able to help other people.
2. Sometimes you would get someone who wouldn't pay attention to you, as if (he or she didn't care). (TH)

It was kind of fun at the first, but after awhile it got boring. There were some I enjoyed helping but others were too far gone to help! I think we should only take up half the time as we did this year. It was kind of fun. Instead of working on it 3 or 4 times a week, we should have done 1 or 2. I think it would be best to have it the same length of time as this year and only work on it half as many days a week or only work half the length of time and twice as many days. If it has to be done. I think these are the best ways to do it. To tell you how I really felt about it, I didn't like it. Maybe other people liked it and maybe the 7th graders next year will. It really didn't go over to good with me. I thought it was a good idea though. (TH)

Well to tell you the truth, I didn't like it very much. For one thing it was too boring. I don't really like Math too well, but I don't mind doing it. But when we were working in the groups it was so boring! Probably one reason it was boring was because I didn't really know how to help the other kids. So I felt like a failure and just sat there doing nothing. The one I was supposed to be helping didn't like it very much either. Now don't get me wrong, I think it was a good idea, but I just couldn't do it the way you expected or the way I wanted, so I didn't like it. Because I don't like anything I can't do very well. So I feel like I shouldn't have been one of the helpers, because I don't think I did any good. Maybe in the near future I will be able to do what is expected of me. (TH)

I liked the Helper Group because I like helping others and others helping me. I also like it because the fact is that we get to learn a little more by helping each other. The thing I didn't like about it was that when a helper helps a person and that person doesn't care what they teach him or her. They don't care whether or not they learn. They just sit there looking around just hearing you talk your mouth off just trying to teach them something. Either that or they'll talk to somebody else in the room. What we should have done was that if the helpers were the teachers and they would make a record of what the kids do (like work) and if they wouldn't do what they were told to do the teachers (helpers) would give them a zero and then at the end of the session the helpers would turn in the report and the real teachers would record what the helpers put down. And I think it was a good idea because we would learn a little more. (TH)

I think group sessions are really O.K. I like helping people and I think and hope they learned as much as I did. I think the helpers got as much out of it as the ones being helped. Except when helpers are helping somebody who doesn't wanto follow ya. You know it really gets nausiating and all those big words, when your trying to explain and they are really quiet and don't ask any questions or anything. I also think the "GROUP SESSION" bit is great for the teachers. They have other things to do besides help each individual, with their problems. Thats all i can think of. (TH)

I realy felt this group session was neat. I liked it cause it made me feel good, also I got to know more of my class mates better. I also think they felt more free to ask me questions because some teachers just put them down, yell, or say their stupid. For one of us to learn our teacher must first be able to control us, he or she must also share our feelings and we'll share their's. One important thing is our teacher must be peppy or smile at least once in a while. I really feel this session helped all of us to understand what MATH is all about. (TH)

All in all it was a tremendous learning experience. The only thing I didn't like was the people that I helped, especially the boys, were not trying to do better or anything. They would just sit there and talk with the other kids, and franly I don't like to make them do anything so I couldn't get everything done. As for myself I learned quite a bit about math as a result of these sessions. I think though that they should be made more interesting so the kids won't say they are boring. Personally I don't think they could be made any more interesting. They are "cool" if you ask me. (TH)

I sometimes liked these helping groups but sometimes I got bored of this work. I got bored because the person I would be helping wouldn't pay attention to me. I sometimes liked these group sessions when the person I was working paid attention to me, so would be able to do some of the problems right. I liked to do some of the multiplication problems and some division problems. At first I didn't like to do percentage problems because I didn't understand them, but now I've learned more about them and I think I can do them better now. (TH)

Group Workers

I liked the helper group because it gave me a chance to learn things that I have forgotten over the past years. Also in my group I could help other people who needed help, to understand. Also they could help me to learn my math such as multiplying fractions and adding, subtracting, and also dividing fractions. I really enjoyed the group session. (TM)

I really didn't like it because of the group I was in. I really didn't like the people I was working with. At the start it was fun and something I had never done. If I could have worked with someone else. Like one of my friends it would have been better. I am not saying I disliked everybody I worked with some helped me learn lot. Another way to do it would be for each person to chose three or four people they would like to work with. And if the would not work you would have to put them in a different group. (TM)

I think it was really dum. After a while everybody got bored and the kids were actually glad when Friday came so they didn't haved to work on it. Also nobody wanted to work, just talk. As far as I'm concerned I didn't mind it much, it is a very good plan, though and it work better if it were started at the beginning of the year. (TM)

What I liked about it was that we could help each other in the problems they had in Math like fractions, multiply, divide and all that. What I also liked about it was that we could be with our friends and they could help us, talk with them and that would not be boring like other subjects are and We could also stand up when ever we wanted to. (TM)

1) What I liked: I like working in groups because more people can help you and in different type and methouds and you can do your work faster and the helper show you the errors you made.
2) What I didn't like: I didn't like it because people make fun of <u>me</u> and of what my Dad <u>works</u> in! and I don't like it because my perients don't know modern <u>math</u> and can't help me with my homework. (TM)

The groups were ok but we always got out of hand with (the teacher). But I realy enjoed math because (the teacher) had a nice way of teaching us. The least part that I didn't understand was dicimals was the most hardest thing to learn; and also ÷ ordered fractions but other wise it was all good. (TM)

Tutees

I think I learn alot about the test, the homework. But of all I learn what the helpers told me to learn. I learn the things that I did not learn before. When I don't understand it I ask them again and again until I get it. I think Math is fun to work with. I like the Math teachers. I think we should have less homework. I like working with fractions, numbers, etc. If a person does like Math he or she should get more in Math. Tell the teacher that you do not understand that problem do not be ashamed. I do not like the tests because some problems you do not know how to work it and sometimes it comes out of the five, or six grade book. (TL)

I didn't like it, because everytime I asked the teacher for help and (the teacher) gave it to me but I didn't understand. When I was doing my work in the folder I would ask the teacher for help on fractions and (the teacher) said wait we're getting into them in a couple of days. It was a good program but I didn't understand anything. (TL)

What I liked about the student helping was that I learned things I never knew, I also liked it because it was fun being helped and easier to work the problems. What I didn't like was that when I got a certain partner everyone would make fun of me, and also because it took too long and towards the end it was sorta boring. (TL)

I think that the helpers point of view was ugly. Because the student that is been help is sometimes somewhere in the room talking. But from my point, I like the test and the helpers. Because I learn the thing I missed and it wasn't the time spent, it was the spent in working to learn. (TL)

My S.A. is that I liked to work with Math but i sometimes don't understand it but i like been help by helpers and that gave me more confedence on what i am doing and what i didn't like was that one helper teach me one thing and the other helper would teach me something else. But Math is fun and if a teacher would explain a little better so that me or someone else we could do math very good. I do like been help by helpers. (TL)

I liked it in a way and way I didn't like it. I didn't like it very much cause I didn't know what I was doing. Sometimes I felt like I was in a very big mass of trouble. and the students that were helping I don't think learned anything out of it. And the other reason cause I liked it was that it made the time go faster. Oh we needed more time with it. It was to sort of the time. (TL)

I liked my helpers and I larnered a lot of thig helping ortheres and they helpong me I leked all my helpers that helped me and orthers I holp they liking me and they liking of the orthers and I liked my tachers and they were nice to me and my tachers were to not loght to me but to the orther boys and girls my helpers helped me lording a light and I enjoyed my class. (TL)

I liked the helper group, it helped me understand a few things that I did not know or understand. One of the things I didn't like was that I was working with one member of the group and were really making progress, but when they changed us, I didn't make as much progress with the others. But the rest I liked we learned some of what we didn't know. I think you shoud continue this onto next year, its a very good idea because it helps you it really does. (TL)

About the helper group it was a good thing but when you put us with some of my friends I didn't work. All I did was talk. I wish I would of studied because I sure did need it but when you put me with somebody like Gerildeon she sure made me work she dident leth me talk and I warent mad at her cause el had to learn and I couldent learn talking to my friends and I liked the idea of the group secion I really learned something. (TL)

Teacher A, Group S

Supplementary Work Students

I think all the people should of worked on the skill kets. I didn't learn anything. I didn't get to know how the skill kets were. (SH)

I have enjoyed doing sup. work. It was fun and interesting, it was fun in math. (SH)

I learned a lot of different ways to do my math, way I never knew how to. I learned what a lot of different words ment. These words were long and hard to pronounce, I learned a lot. (SH)

I was in the supplimentry group. I liked it sometimes and sometimes I didn't liked it. Sometimes I liked it because we did something I liked and enjoyed and understood how to do. Sometimes I didn't because I didn't understand it and sometimes it was boring. That's what I think about the supplimentry work. (SH)

I didn't work in the Skill Kit. I was one of the nine other one. It was fun sometimes and then other times it was boring I really didn't learn as much as I would have liked to have. At the time I wanted to learn more about fractions then I did. Sometimes I wondered if the people in the skill kits learned more then I did!!! (SH)

I think the skill kit was a great thing. Because people had a chance to learn and understand what they didn't know before, they also had all of the time they needed, the weren't pushed or hurried into something. But the people who weren't in the skill kit just wasted the whole three months or how ever long it was, not doing a blessed thing. I was not in the skill kit but the girl behind me was, and she is better in everything now, much better than I am. And I think everyone should be in the skill kit. (SH)

Middle Ability Skills Kit Students

I think it helped me learn more about fractions. I also think it would help the following students mo more about what they are doing in the subject of Math. Such as it did me. (SM)

I learned a lot from the skill-kit. The Skill-Kit has made me come back and remember the things I had forgotten. But really at first when they gave them to us that is the Skill work I thought it was a bunch of tests, but even though they were test I at least learned something. (SM)

In the skill kit I learned alot of things in Math I wasn't aware of. What I liked was doing the fractions. I enjoyed the subtracting & adding, but what I enjoyed most was multuplying and dividing fractions. (SM)

I like the skill kit because the problems they gave us and the things

they told us to do on them. I also liked it because it has fractions and I like fractions. (SM)

I liked the skill kit it helped me a little bit in everything I did but I really liked it. (SM)

I think the skill kit was pretty good sometimes but other times I hated it.
1. I liked it because I learned alot of stuff I didn't know before.
2. It was boring once in a while and sometimes I don't do Math. (SM)

The skill kit to me was very good! It was very helpful to me when I didn't understand what I needed to learn. I learned how to add, subtract, multiply and divide fractions which to me were very complicating when I did not know how to work them. I have learned them now and it is very easy for me no. THANKS FOR THE GREAT HELP!! (SM)

I learned to do more problems and how to do fractions demicals and other stuff. I liked it cause we didn't do so much math and the time went by faster than usual. What I didn't like was to do the progress test or the cards. But I liked them better than doing math all the whole hour. (SM)

I enjoyed working on the Skill kit and I learned a few things. But I think I would have learned more by taking the course on the subjects since the teacher could not explain how to do the problems on the skill kit. All we did was do the best we could. (SM)

Low Ability Skills Kit Students

I didn't like doing extra work. But I think I learned more about Math. It did help me alot. (SL)

I didn't like it casue it was very difficult for me and some problems were very hard. But the part I liked was where we had the decimals. and I didn't like the fractions cause I don't know how to reduce them and I think that I didn't really learn that much from them. (SL)

Well I think it helped me alot and it was fun but I didn't like some of it. I didn't like working on it so long because I got tired of it and I was glad when we were throw with it. but it did help me alot. (SL)

i fill that the skill kit helpt me allot i inprovd in math. (SL)

I think they were all right but I think you should wate until 2 mounts befour school is out and the studints know how to due desmals becous I dident know how to do them until about 3 weeks after we had finished the skill kits. (SL)

About the skill kit. I thing that I enjoyed it. It was very fun working in it. I enjoyed alot of work that I'd done befor. (SL)

I liked it becuase it was fun it was exciting and it helped me alot in working fractions now I know a little of fractions as I know now I was not so fun it you allready know how to do it but it was really fun if you didn't know it, it was fun and heplful. (SL)

To me the skill kit wasn't really that enjoyable. The reason I didn't like it was that if you didn't know how to something you didn't have anybody to ask for help. So you see if your stuck where do you do? I don't really care about the skill kit. (SL)

Teacher B, Group S

Supplementary Work Students

I believe the skill kit opperation was an excellent idea. It was an excellent project for learning. I have always enjoyed math and sometimes it comes easy for me but there are some who aren't as lucky and this project was wonderful because it helped these students increase their mathamatical ability. (SH)

One suggestion I would like to make was to give harder work to the advanced group but over in all, it was a wonderful group kind of project. I really enjoyed and approved of this project because of the help it offered and the experience it gave me. Thank you. (SH)

The thing I didn't like about Math was that they'd be giving lots of papers saying how did you like the achievement test do you like math that got boring doing it over & over. The thing I liked about Math was (the teacher) I think (the teacher) was a great teacher. (SH)

During the skillkit program I was in the upper group of children. A lot of the kids told me they enjoyed the program, to be honest I hated every second of math period. I feel it did help me my knolege of fractions and decimels has improved verry much. I do wish the teachers would have let us in the higher class help the people in the lower class instead of making us do extra work. I feel (the teacher) did a very nice job this year and in the program. (The teacher) helped me a lot. but I still hate math. I think the program was on excellent idea, and it did help. I think the organization in which the work for the upper group was presented could be improved, same of the work was very simple some was excemtionly hard. (The teacher) can teach, although I hate (the teacher) and I did learn. (SH)

Well to start with I sort of liked the test we had. They were a little easy in some parts. I will take any written test and I hope I'll enjoy it. (SH)

Middle Ability Skills Kit Students

I feel that the skill kit helped me in understanding math. Even iff I did not like it. I did not like it because we always had to be in a rush. Because we had to do to different things at one time. We

had to do the skill kit and our home woork esignment. I would get mixed up in the booth exercises. The exercised were easy but I still did not like it. (SM)

I like the skill kit because it helped me alot in fractions. Since it has helped me in math I have been doing better. (SM)

I liked the skill kit because it helped me with my fractions and decemils they thing I did not like was having to do our regular work in the math book and it took up too much of our time and it was (SM)

That skill kit was alright I guess. But sometimes I didn't Like the work. I real would just rather have just math and no skill kit or anything. Next year I hope we don't have to do anymore cause sometimes It gets boring. I think that just our ordinary math is enough without having 30 minutes of another, Thats what I think. (SM)

I like the skill test because It helped me revew what I learned in the elementary. (SM)

I didn't like the skill kits, they took up to much of our time and sometimes (the teacher) didn't like them either. We had 1/2 of the period to work and the other to work on the skill kits. I guess they were pretty good they helped me alot with my fractions and Decimals, you should have a day of working in the book. I guess if we need it we need it. Signed Mr. X. (SM)

I didn't like the skill kits. I hated to even think of doing them. I didn't like it because it was boring and wasn't a bit interesting to me. I'm glad that it's all over. The skill kits didn't do anything but make me hate math. I hope soeday I'll like Math better than I do now. (SM)

I think the skill kit work helped me alot in doing math. Afterwards it got a little boring but it still helped me. Sometimes I just wanted to tear them up but I am glad I didn't because they helped me a lot. Thank you. (SM)

I like it because you can learn more and can learn the things that you didn't know at first. I like it because I learn more. (SM)

Low Ability Skills Kit Students

I din't like the skell test because I don't to do mach abut because. I don't no how to do mutapchen. (SL)

I enjoyed working in the skill kit because it was fun and interesting. I learned more about Math. I hate Math but somehow when we started working in the Skill Kit I liked it. Its fun working in the Skill Kit, because you don't have to work orrally, and you don't get a grade. (SL)

I liked the skill kit skeon. I liked it because it helped me improve my math a little well not exelesky. (SL)

I never did like it. Sometimes aways did like the frickins. I like it in a way. Most of the time I did like it but then in a way (the teacher) mande it harddy. (The teacher) aways said that I was chety. I never chete. (SL)

The skill kit gave my more time to "goof" off. It was o.k. but, The work was not quite organized. The order we used it would easy, hard, very easy, very hard, etc. etc. etc. I finished in about five minutes and then I would throw dirty fingers at everyone, give the next 7hTH grade class the fun I had in math. Duh, Duh, Duh. But some of it was Damn hard and some was Damn easy. I am being honest mister. Besides, In the fun. I hated all the work. By, By! Miss X. (SL)

Now that we have worked on our skil kit I have learned more than what I use to know an when the frascitions cam I already know the fracitions already so I say the skill skits helped me vary much I enjoyed doing the skill kit vary much. (SL)

Well when we started the sillkit I liked it but sometimes I got stucked on the problems. All I got through was the multupication tables I did enjoyed it much. I did like it alot. (SL)

Well I liked it sort of because it helped me understand hard things like fractions, decimals and percent. But also I disliked it because it took up a lot of time, the tests were hard and some things I took I already knew. Much of the time there were to many prlblems to do and not enough time to learn the stuff. (SL)

During the "skill kit" experiment I was placed in the lower group. Some of the children said that they enjoyed the math secsion. But on my side of the veiw the the period, was YUCK. I didn't lean anything. half the tim I helped a higher grop girl. This can be (verified) by many people I think I would have did better if my teacher wasn't a ~~stuffed-shirt~~ (?) I think the program was based on a very exalint Idea. BUT, I didn't work for me the work was too easy. ta ta, now! (SL)

Teacher C, Group S

Supplementary Work Students

I thought the supplementary work was O.K. and I think it would be better if the ones doing the supplementary work should work on something different than what they did before the supplementary work. (SH)

Math is a subject what you have to take during 7,8,9 grade. What I thought about Math was that the teachers were going to be mean. But I was wrong especially (the teacher) honestly (the teacher) is the best teacher I ever had So i really like Math. (SH)

I enjoyed the supplumentary work I did. It was something different to do. I feel it helped me to expand my on what I knew and learn new things. As I said I enjoyed the work. (SH)

The supplymentary work helped me a lot. But sometimes I did not like it because it was a little bit hard. But it helped me enough to be like this. (SH)

I enjoyed the seplementary work. for about the first few days but after that it was fun. It helped me understand math more even though the work was a little hard I still enjoyed it. (SH)

I liked the suplamentary work more than the regular work because it was fun and actually you were doing something simular to the regular work. (SH)

I think that the supplementry work is good and bad. Good because it sort of helps you in rembering things of the past. It wasn't realy bad because you had something to do but I didn't like it as for the skill kit I think it was good for those who needed it. (SH)

I didn't like the suplinentry work. because you get very bored and tired. Its just like doing homework. The kids in the skill kits were doing something different and learning and I thought we were going to do something different to but we didn't we were just doing the same boaring thing. At first I wasn't learning anything because we were just doing what I had already learned in elementry all over again and it was just the same thing in the Suplimentry work. (SH)

Middle Ability Skills Kit Students

Why I liked the skill kit work: I liked the skill kit work because it helped me alot. I learned how to multiply fractions how to add and all those kinds of fractions. What I didn't no is how to divide but with the skill kit work I learnd. At last I no how to multiply, add, subtract, and divide fractions. That why I liked skill kit work. (SM)

Essay: It was a pretty good idea, as for my part it helped a lot. I thing more schools and classes sould have them. (SM)

I liked it but sometimes I was boring. when I was it in the skill kit. It was fun but when I was lazzy I would sleep and day dream. When (the teacher) was talking I would day dream. Sometime I did not like to came to class because I did not do my homework I like Math. (SM)

I liked the parts I could understand. It just showed the answer at the end. It didn't give step by step instructions on how to get the answer. (SM)

I liked the skill kit. I helped me a lot. I hope the ones next year enjoy it. (SM)

I think it was fun and bad. It was good in the way that we got smarter and the way it was bad is that it took up a lot of class time. But it was fun. (SM)

I didn't like it. It was too confusing. Too many cards to mess with. I feel it didn't help me. (SM)

I didn't like to work on the skill kit. I didn't enjoy it. I think it is better the math way then the skill kit way. The work I did in the skill kit did help me but I just I didn't like to. (SM)

I get a neative feeling to the whole idea. Its just a rutine that you have to go through even if you don't need it. For example I didn't know how to do fractions very well but after I looked at the card that told me how I understood it. But I still had to do a lot of problems. I probably needed practice but it gets tiring after a while so I thing you ought to make it more interesting and that you could decide when you understood and quit when you wanted to instead of just keep on working problems. (SM)

Low Ability Skills Kit Students

To me I really enjoyed working with the skill kit. I reall improved on my work. Even thow you told us that you din't mean we were dum but was trying to help us I couldn't help the way I felt. I kept saying, "Oh sure his just saying that so we don't get hur" but I was wrong. I admit it I don't like math or enything that has to do with it but I'm gonna need it later on. (SL)

I liked the skill kit work. It helped me to understand work that I didn't understand I wish we could work in it more than we did. (SL)

I was skill kit worker and I enjoyed some of the work and some of it I didn't. I think the skill kit taught me a great dill. For what I knew. Thats all I have to say. (SL)

I did not think it was fun working in the skill kits but I sure learned alot. I hardly understood subtraction and a lot of others but I learned how to do them right. And I think they should continue to use them they really help. (SL)

Well sometime I would like to work in the skill kit and sometime not well sometime the work was find and sometime not it was find working the skill kit. (SL)

I rilley thought it wasent gowing to halp But it rilley halped me. (SL)

The kit needes to be more keller in telling us what to do. In all I lerned a afellot and Is in howed it alout. (SL)

I really did like Math and the tests we had this year. It helped me alot, but only once in great while I had troubles, but then I got some

help from my friends, and my teacher. But I enjoyed being in this class this year and I enjoyed everything we had. Because this kind of tests and work that we had, this year it helped me alot. (SL)

APPENDIX C

TABLE 29

CONVERSION OF SAT RAW SCORES TO GRADE SCORES

Computation											
No. Right	1	2	3	4	5	6	7	8	9	10	11
Gr. Score	22	26	33	36	39	42	45	48	51	54	56
No. Right	12	13	14	15	16	17	18	19	20	21	22
Gr. Score	58	60	62	64	66	68	72	76	78	80	82
No. Right	23	24	25	26	27	28	29	30	31	32	33
Gr. Score	84	86	89	92	96	100	104	108	112	115	117
No. Right	34	35	36	37	38	39	40	41			
Gr. Score	119	121	123	125	127	129	129+				
Concepts											
No. Right	1	2	3	4	5	6	7	8	9	10	11
Gr. Score	20	24	31	36	40	44	48	51	54	57	60
No. Right	12	13	14	15	16	17	18	19	20	21	22
Gr. Score	63	66	69	72	76	78	80	82	85	88	92
No. Right	23	24	25	26	27	28	29	30	31	32	33
Gr. Score	96	99	103	107	111	114	116	118	120	122	124
No. Right	34	35	36	37	38	39					
Gr. Score	126	127	129	129+							
Applications											
No. Right	1	2	3	4	5	6	7	8	9	10	11
Gr. Score	23	27	31	36	40	44	49	53	58	63	67
No. Right	12	13	14	15	16	17	18	19	20	21	22
Gr. Score	72	74	79	82	85	91	98	104	108	111	113
No. Right	23	24	25	26	27	28	29	30	31	32	33
Gr. Score	116	119	121	123	125	127	129	129+			
No. Right	34	35	36								

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