1968

A Study of the Effectiveness of an Individualized Sixth Grade Arithmetic Program

Alan James Hokenstad
Central Washington University

A STUDY OF THE EFFECTIVENESS OF AN INDIVIDUALIZED SIXTH GRADE ARITHMETIC PROGRAM

A Thesis

Presented to

the Graduate Faculty

Central Washington State College

In Partial Fulfillment

of the Requirements for the Degree

Master of Education

---

by

Alan James Hokenstad

August, 1968

APPROVED FOR THE GRADUATE FACULTY

____

Daryl Basler, COMMITTEE CHAIRMAN

____

Alan R. Bergstrom

____

Frank B. Nelson

ACKNOWLEDGEMENTS

Sincere appreciation is expressed to Dr. Daryl Basler for his help and guidance as committee chairman.

A special note of thanks is extended to Dr. Alan Bergstrom and Dr. Frank Nelson, committee members, for their constructive criticisms and suggestions.

The writer especially wishes to thank his wife, Marion, for her patience and encouragement throughout the duration of this study.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

Since the start of formalized schooling, educators have sought ways of developing each individual to his fullest potential. They recognized that every child has traits and characteristics which make him unique. These individual differences include physical, mental, emotional, and philosophical variations. One frequently discussed method of dealing with individual differences in the classroom is through a variety of grouping procedures. The objective of most grouping plans is to divide the pupils into smaller sections for more specialized instruction. Many studies have dwelled upon a variety of types of grouping for instruction in the elementary classroom, but the results are contradictory and inconclusive.

One type of organizational plan for teaching arithmetic has been used to a limited extent by some educators. It is an individualized arithmetic program which is adapted to fit the needs of all individuals in the classroom.

I. THE PROBLEM

Statement of the Problem

It was the purpose of this study to test the effectiveness of an individualized sixth grade arithmetic program.

Both the pupil achievement levels and attitudes toward arithmetic were measured and statistically analyzed.

Importance of the Study

The subject of arithmetic has been important in many studies of classroom organization for instruction because of its importance in the school curriculum and applications in adult life. Also, there is a cummulative effect as many mathematical concepts are dependent upon those which were previously learned. This tends to stretch out the range of individual differences within the typical sixth grade classroom.

This writer has used an individualized arithmetic program in his classroom for several years. The pupils seemed enthusiastic about the study and appreciation of arithmetic while using the individualized method. According to achievement test scores, the pupils made satisfactory progress in their understanding of the sixth grade arithmetic subject matter. However, there was no valid evidence that this method was superior to other instructional methods. For this reason the individualized program was tested to check its effectiveness when contrasted with a traditional method of teaching an entire heterogeneous class at once.

The implications of this study are important. It is essential that educational research be directed toward finding more effective methods of instruction which meet each child's needs. Every improvement in the quality of instruction will prepare the pupils for broader educational experiences and a more productive adult life.

II. DEFINITIONS OF TERMS USED

Individualized Arithmetic Program

An instructional plan that is organized to meet the needs of each separate child is an individualized arithmetic program. In this study, the individualization took place only within the sixth grade curriculum. Few materials above or below the sixth grade level were utilized in order to control the study more closely.

Heterogeneous Group

A group of people who are placed together on a random basis without regard for the differences which make them unique is defined as a heterogeneous group. For the purposes of this study, a heterogeneous group consisted of pupils who were all at the same grade level as determined by the school system.

Homogeneous Group

A homogeneous group consists of a number of people who are placed together on the basis of one or more characteristics which are common to all of them. In this study, homogeneous groups were formed as part of the individualized instruction program to help individuals on a particular concept or skill. These groups were determined by the daily evaluation of each pupil's work.

Other Definitions

Any other meanings or definitions given to specific educational terms in this paper are those listed for the corresponding terms in:

Good, Carter V. (ed.) Dictionary of Education. New York: McGraw-Hill Book Company, Inc., 1959.

CHAPTER II

REVIEW OF RELATED LITERATURE AND RESEARCH

A review of the literature was made with regard to various instructional methods used in the classroom to benefit the individual. The nature of the problem is further understood through research in the areas of arithmetic curriculum, interaction between the teacher and his pupils, and the physical surroundings.

I. CRITERIA FOR THE DEVELOPMENT OF THE ELEMENTARY SCHOOL ARITHMETIC CURRICULUM

Objectives in the Teaching of Arithmetic

As guidelines for educators, certain objectives must be maintained in the teaching of arithmetic in the elementary school. Morton (17:21) lists three general criteria which will serve as standards for more specific objectives: (1) A "logical criterion" emphasizes the structure and organization of arithmetic as a science. There is a logical progression from one concept to a related one and the foundations are laid for more complex understandings. (2) The "social criterion" is concerned with the application of all arithmetic concepts to past, present, and future life experiences. (3) The "psychological criterion" relates to a concern for the individual child and his growth and development.

Psychologists offer much help to educators by explaining the learning process. With this knowledge, experiences can be planned for the child which will strengthen his understanding of arithmetic.

More specific goals in elementary school arithmetic involve improving computational skill and manipulative facility along with the development of understanding and insight. This applies to the study of all areas of mathematics content (9:51-2).

Arithmetic Readiness

In consideration of individual differences, teachers recognize that all pupils are not ready for introduction to a specific concept at the same time. A variety of factors might influence a given individual's readiness for learning. Generally, all these factors can be placed under the label of "maturation." One authority has defined maturation as a complex process in which "the natural growth of the physical bases for mental functions conditions the ability to learn" (14:248).

It becomes the task of the teacher to consider arithmetic objectives and readiness principles in the daily instructional process. Another ingredient in this process is the application of sound teaching methods in presenting arithmetic content as the teacher and his pupils interact in the learning situation.

II. INTERACTION BETWEEN TEACHERS AND PUPILS IN THE LEARNING PROCESS

Organization of the Self-contained Classroom

Within the framework of the self-contained classroom, the elementary school teacher must provide for the development of all educational experiences which are sponsored by the school. Consideration must be given to flexibility, integration of experience, and the correlation of all subject matter. Special attention toward the growth, development, and guidance of each child is important (10:565).

The importance of individual differences. Educators have consistently agreed that all children in a typical class are not prepared to learn with the same degree of proficiency. As early as 1916, the psychologist, Louis M. Terman discussed the possibility of flexible instruction in allowing a child "to progress at the rate normal for him, whether that rate be rapid or slow." In this way, the child's mental ability would be considered in regulating the standards which would be expected of him (7:9-10).

Wrightstone (23:6-7) found that children who have the same I. Q. may vary widely in achievement in many subjects including arithmetic. Factors which account for achievement differences include motivation, attitudes, interests, and variances in teaching practices.

Whitaker pointed to the expanding gap which continues to separate children of different ability levels (21:135). The low achievers experience continual frustration as they pass from grade to grade. Much insight into the learning process is lost and their educational disability eventually becomes permanent. At the same time, there is a real danger that the above-average student who continues to learn rapidly can become conditioned to boredom. He wants to learn more, but becomes frustrated and resentful while waiting for the rest of the class. Three factors have tended to maintain the "class-as-a-whole" approach to teaching: textbooks which make no allowance for individual differences; a curriculum which is rigidly structured; and probably the most important factor, the traditional views of teachers. All of this evidence leaves one discouraging result. All children were forced toward the center of the class distribution under traditional teaching methods. This resulted in an average education for everyone (21:136).

As a further indication of the vast number of individual differences in the average class, Wrightstone (23:13) found a range of three to four years in the average first grade. Sixth grade classes were found to have an ability range of seven to eight years. This study was based upon tests of reading comprehension, vocabulary, mechanics of English, and facility in the use of arithmetic. Other experts have found similar ranges in most self-contained classrooms. It is apparent from these findings that the classroom teacher has an extremely complex task in planning an instructional program which will provide for such a range of individual differences.

The role of the classroom teacher. The most important factor in the organization of a self-contained classroom is the teacher--the guiding force in the instructional program. He must have an awareness of the particular child and his value as a contributing individual. There must be genuine communication between the child and his teacher which is evidenced by mutual enthusiasm, interest, and understanding. The teacher must be "sensitive to time and timing" (7:76) in determining the right moment to discuss certain ideas or concepts. He must create an atmosphere in which children feel accepted, where ideas and interests can be developed, and where exploration and discovery are encouraged. "The teacher acts to release pupils; to free them for increasingly active involvement in the world" (7:97).

Even if the teacher concentrates on individual differences among the pupils, little progress will be made in an atmosphere for learning which is not carefully regulated. Five criteria for the evaluation of the classroom environment are:

1. Realistic standards of performance with attainable

individual goals are emphasized.

2. Self-evaluation is encouraged.

3. Opportunities are provided for cooperative undertakings in group settings.

4. Competition between pupils who are unequally equipped is not employed as a means to education.

5. An atmosphere of mutual interest and respect is established by the teacher as he works with pupils (20:245-6).

A desirable emphasis in the classroom environment is the encouragement of self-discovery. The pupils must be taught to accept their strengths and limitations in order to stimulate progress and development (14:250).

The effect of a wholesome classroom environment may stimulate many favorable attitudes in each pupil. Positive attitudes toward each other foster feelings of worth and status as each individual's self-concept is developed. Also, wholesome attitudes toward differences promote feelings of belonging and acceptance. These differences may enrich the experience of all the pupils and make life more interesting for them. Finally, receptive attitudes toward discovery and learning may appreciably elevate the roles of both the teachers and pupils (7:99-102).

Methods of Organization in the Instruction of Arithmetic

In organizing the classroom for arithmetic instruction, the teacher can choose between teaching the class altogether, separating it into ability groups, or working out a program of individualized instruction. While much educational research has been reported, little agreement is found among the researchers. Nevertheless, many valid points are offered which will influence this study.

Heterogeneous grouping. In most school systems, pupils are assigned to classes on a random basis by the principal, with some effort given to creating heterogeneous grouping. Teachers can expect a range in abilities from the superior pupil to the very slow pupil which gives the class an interesting intellectual and social composition. A teacher who instructs the entire class together must adapt his methods to fit the range of the particular group. This is the easiest instructional approach for the teacher to use. It involves fewer decisions and less paper work.

Those who teach all pupils in the class at once argue that it is best for the following reasons: the slow learner is stimulated by the faster ones, it economizes the use of the teacher's time, and it offers fewer discipline problems. Many teachers using this approach believe that it is just as good as any other method of teaching arithmetic. However, such teachers may be unaware of other procedures (2:311-12).

Homogeneous grouping. In a pattern of homogeneous grouping, the class is divided into sections or groups based upon achievement in arithmetic. Guidelines such as standardized achievement tests or teacher-prepared tests are often used. In a survey of Ohio teachers, Brewer (2:310) found that thirty-three per cent use homogeneous grouping in arithmetic.

Many research studies have tested the effectiveness of homogeneous grouping with the results showing that its true efficiency is in question. In separate studies, Provus and Dewar (18:394; 6:268) concluded that below-average pupils made some improvement, average pupils showed no change, and above-average pupils made quite significant gains in comparison with matched control groups. It was observed that class size is one important determinant of success in a grouped situation. If the class is large, it is difficult for all children to get the individual attention which is necessary for their advancement.

Wrightstone (23:8) concluded that homogeneous ability grouping shows only a slight gain over teaching the entire class at once. He found it to be most effective with slower children.

In two other studies, different evidence was presented. Davis and Gibb (5:17; 10:582) found no significant difference in improvement of reasoning or computational skills in comparing the two methods of organizing the classroom for instruction. Instead, the teacher's background, attitude and teaching ability were deemed more important than methods of grouping.

Those who favor grouping by ability cite several important advantages: realistic goals are established, pupils work at their own level of competency with opportunities for review or enrichment as needed, and progress is more rapid than it would be in a heterogeneous situation.

Taking the opposite viewpoint, Cummins argues that grouping by ability will result in more harm than good for the child. She is especially concerned with the child's social adjustment:

> An important aspect of our daily life is to accept an individual for what he is. Those placed in special groups are deprived of the very valuable association with persons of varying abilities, aptitudes, and interests (4:20).

She further states that in later years students will voluntarily group themselves as they take elective courses in the secondary schools which suit their interests and abilities. Instead, there should be a variety of differentiated assignments, and extra-curricular activities to provide for individual differences.

In supporting her argument, Cummins says, "there is really no such thing as a homogeneous group." No matter how it is selected, it will still have a wide diversity of interests and abilities. A tendency toward even greater heterogeneity will exist in any group where there is good teaching. Research shows that when classes are divided into three levels, there is only a fifteen to seventeen per cent smaller range in abilities; with two levels, the range is only reduced seven to ten per cent. Thus, the teacher is still faced with a wide range of individual differences (4:19-20).

"No plan of grouping has yet been developed that makes teaching and learning in the classroom a simple matter," explains Wrightstone (21:7). The review of opposing viewpoints and research findings in previously studied approaches to grouping leaves the investigator with no solid recommendations to follow. Hence, the individualized approach in teaching the self-contained classroom will be examined. Care will be taken to see if this method assures the effective teaching of arithmetic to each individual child in the classroom.

Individualized instruction. In organizing the classroom for individual instruction in arithmetic, the teacher works toward the goal of releasing the human potential which is within each individual child. He strives to develop an:

> openmindedness concerning each learner's potential, together with a sense of obligation to help each learner realize his potential, which is in conformity with his own best interests and with social ideals (7:13-14).

Each child is taught at his own level of achievement which is a proficiency level that is operative within the individual pupil.

Methods of individualizing arithmetic instruction in the classroom vary with each teacher and class situation but some elements of the program are common to most approaches. Pupils are encouraged to work at their own rate of speed in using the texts and other materials as guides to their daily progress through the curriculum. As assignments are completed, they are immediately checked by the pupil using prepared answer keys. Corrections are made and the child is responsible for maintaining records of his progress. The teacher assumes a vital leadership role in the environment of the classroom as instruction takes place at a specific level of competency for each child. Homogeneous groups are formed for the instruction of those who need help on a new concept or to review one which was previously covered. Such groups may vary in size from one to the total number of students in the class (23:17). Pupils may help each other or seek help from the teacher when difficulties are encountered. The teacher and each pupil have frequent conferences concerning the pupil's progress (21:135).

Many advantages have been found in working with a program of individualized instruction in arithmetic, one of which is the opportunity for pupils to function at their own rate of progress. They work as fast as they can, but do not go from one concept to another until the first one is understood. Each individual is able to check his own answers and work to correct mistakes. Since there are no due dates for assignments, pupils who are absent are not hopelessly confused upon their return to school. There is no problem with late papers and the pupil's fear of not getting assignments complete on time.

There also appear to be other benefits from the individualized arithmetic program. In helping each other, the students can reinforce learnings through the process of explaining a concept to a friend who is having trouble. Skill is attained in following directions along with growth in reading and reasoning abilities. And finally, the pupils learn to be responsible for their own progress and soon understand that they are "learning for learning's sake" in order to help themselves--not their parents or teachers. Browning (3:14) cites some other advantages of individualized arithmetic including improvements in self-reliance, good study habits, accuracy, neatness, good logical writing and spacing of problems, and class citizenship.

Some disadvantages to the program have also been cited. A large portion of teacher time is required in preparing lessons and checking the pupil's papers and general progress. Also, some educators suggest that those children who have a reading disability or a poor understanding of arithmetic concepts may have trouble in this program (21:135).

Although few research studies have been conducted on individualized arithmetic instruction, two will be discussed at this point. In a modified approach involving presentation of material to the entire class at the same time followed by individualized practice by half of the students, Moench (16:328) notes the following results. There was no significant difference between the experimental and control groups at the end of the test period. However, in follow-up tests one year later, the experimental group scored substantially better. "Somehow, the pupils in the experimental group had developed either a better approach to work study or better work study habits than did the controls" (16:328).

Graham (12:234) studied a class in Florida with an exceptionally high mean I. Q. of 115. This group of sixth graders was administered the Iowa Tests of Basic Skills at the beginning and end of the program. Their November median grade level score was 6.4 and the follow-up test in May showed a median grade level score of 8.0. This resulted in a gain of 1.6 years growth in arithmetic reasoning and computational skills. Graham concludes that there are many advantages to the individualized approach to arithmetic. It brought about a heightened interest in the subject among the students. They established greater independence in working. And finally, through working at their own level of achievement, they were able to push back the restraints of the traditional structured learning approach to release their potential for optimum achievement.

After discussing the arithmetic curriculum and the interaction of the teacher and his pupils, brief mention should be made of the physical requirements essential to a healthy learning situation.

III. THE PHYSICAL ENVIRONMENT IN THE CLASSROOM

In implementing an instructional program in education, the curriculum and teacher-pupil interaction are vitally important. However, for optimum results, close attention must be given to the physical resources which are available for use by the teacher and pupils.

The room should have good lighting and ventilation systems, allowing maximum comfort of all its occupants. It should be equipped with adequate chalkboards, bulletin boards, cupboards and other storage areas. The desks and chairs should be movable so that seating arrangements can be made in relationship to the individual needs of the pupils. Often these needs will change, so flexibility in seating arrangements is necessary.

Pupils should have all the tools necessary for arithmetic work. Basic items include pencils, paper, rulers, compasses, and protractors. In cases of a hardship where a pupil can not supply these items, an effort should be made to get them through school district sources.

The textbooks should be modern in scope and in methods of presentation. They should be selected for their ability to satisfy the curricular and instructional criteria established by the local school district and experts in the area of arithmetic. Adequate enrichment materials should also be provided to assure maximum effectiveness in the teaching of arithmetic in the classroom.

IV. SUMMARY

In the review of literature and research, three main aspects in the establishment of an elementary school arithmetic program have been examined: (1) the criteria for the development of the elementary school arithmetic program; (2) the interaction of the teacher with his students in the learning process; (3) the physical environment in which the teacher and his pupils function. When each of these three aspects is satisfied, more effective elementary school arithmetic programs may be established.

Although some research has been done toward evaluating the effectiveness of individualized arithmetic programs, further support and clarification is desirable. In Chapter Three, the specific method of this study is explained.

CHAPTER III

STRUCTURE OF THE STUDY AND THE EXPERIMENTAL DESIGN

Following a consideration of the cited literature and research findings, the writer developed a program of individualized arithmetic instruction for use in the sixth grade. The specific method or approach to the program will first be introduced; then two methods of evaluation will be discussed.

I. THE STRUCTURE OF THE INDIVIDUALIZED ARITHMETIC PROGRAM

The most important characteristic of this program is that the *pupils work at their own speed*. Each child works in the district-adopted textbook at a rate commensurate to his own potential. In the Franklin Pierce School District, Tacoma, Washington, where this study was conducted the standard textbook for sixth grade is:

Morton, Robert Lee, *et. al.* *Modern Arithmetic Through Discovery, Book 6*, Morristown, New Jersey: Silver Burdett Company, 1963.

Specialized Materials Which Were Used

For each specific assignment in the textbook, there was a corresponding *Answer Key* which was prepared on heavy paper by the teacher.[1] The Answer Keys were kept in a box

[1]Examples of two Answer Keys will be found in Appendix A.

which was easily accessible for all pupils. At the bottom of the key was a place for any specific directions which might be applied to the succeeding lesson by the teacher. When a lesson was completed, the pupil used the proper Answer Key to correct his paper. After determining the quality of his work, the key was returned to the box for use by another pupil. The assignment was placed in a special folder for the teacher to check at a later time.

A <u>Work Sheet</u> was maintained by each pupil showing his progress in terms of the concept or skill being studied, the current assignment, the date started, date completed, and the number of problems missed.[2] Each pupil was responsible for carefully recording all the information on the Work Sheet and turning it in to the teacher. When a Work Sheet was completed, a new one was started.

The <u>Individual Pupil Check Sheet</u> was maintained by the teacher each day.[2] The names of all pupils were listed, and a progress report was noted. Roll call was taken during the last five minutes of each arithmetic period and the following information was noted for each pupil: the page he was working on at the end of the period, whether he was ready for a unit test, or whether he was "stuck" on a specific

---

[2]Examples of a Work Sheet and Individual Pupil Check Sheet will be found in Appendix A.

problem or concept. This daily check was invaluable to the teacher in evaluating the day's work and in planning for the succeeding day's lesson.

The Review Assignment Sheet was used by the teacher in giving a specific review assignment to a pupil who had difficulty with a particular concept or skill.[3] The teacher listed the review assignments, and the pupil kept track of his own progress on the Review Assignment Sheet until all assignments were completed. After mastering the area of difficulty, the pupil returned to the regular curriculum as structured in the textbook.

The Teacher's Responsibilities

In the instructional process, the teacher worked with groups of pupils who needed help on the same concept or skill. The size of a group varied from one pupil to the entire class. This teaching concerned the introduction of a new topic or a review of one to which the group had already been exposed. The basis for instruction was determined by the needs of the class as seen through observation, questions, quality of work, and information gained through the Individual Pupil Check Sheet. Time was allotted for individual conferences with the pupils when possible.

---

[3]An example of the Review Assignment Sheet will be found in Appendix A.

The teacher evaluated the work of the pupils in terms of the potential possessed by each individual. This was done by carefully checking completed daily assignments, and through general observations of a pupil's study habits and interest. A pupil's contributions in helping fellow pupils as well as good class citizenship and behavior were also noted.

The teacher administered and corrected tests after each unit. Review assignments were given to correct deficiencies and adequately challenge all pupils in terms of their potential and motivation. The general curricular objectives for teaching arithmetic were followed as carefully as possible.

The Pupils' Responsibilities

The pupils were encouraged to assume much of the responsibility for their own learning. This was accomplished when they saw the purpose for learning and the practical applications of arithmetic. Since a specified quantity of work was not required, the pupil was able to learn in a more relaxed atmosphere. Each pupil was helped to assess his own strengths and weaknesses in the understanding of arithmetic. This attribute of self-analysis took time to develop but was an important part of the program.

The pupils were responsible for maintaining their

Work Sheets and accurately correcting their daily assignments. Attempts at cheating were usually recognized by the teacher during daily evaluations and in test results. The pupils learned that this type of behavior would not help their understanding of arithmetic.

Pupils were allowed to help others who had difficulty with daily work providing that the rest of the class was not disturbed by the talking. This served three purposes: (1) The individual being helped did not have to wait for the teacher (who might have been working with a group). (2) The helper reinforced the concept in his own mind as he explained the problem to his friend. (3) Good citizenship attributes of mutual help and cooperation were established.

In the teacher's testing program it was possible to evaluate each individual's attitudes and arithmetic achievement in comparison to the rest of the class. An evaluation of each pupil's progress in terms of his own ability was also practical. However, it was difficult to evaluate the individualized method of arithmetic instruction in comparison with a traditional method without using systematic experimental methods and controls.

II. EVALUATION OF THE PROGRAM

In evaluating this method of individualized arithmetic instruction, two primary null hypotheses were tested. Each of them had three secondary hypotheses. The null hypotheses regarding achievement were: (1) There is no significant difference between the achievement level of pupils who have been instructed in an individualized arithmetic program and pupils in a traditional instructional program in arithmetic as measured on a valid test.

1a. There is no significant difference between the achievement level of high achievers in the individualized program and high achievers in a traditional program.

1b. There is no significant difference between the achievement level of average achievers in the individualized program and average achievers in a traditional program.

1c. There is no significant difference between the achievement level of low achievers in the individualized program and low achievers in a traditional program.

The null hypotheses regarding attitudes were: (2) There is no significant difference between the attitudes of pupils who have been instructed in an individualized arithmetic program and pupils in a traditional instructional program in arithmetic as measured on a valid attitude scale.

2a. There is no significant difference between the attitudes of high achievers in the individualized program and high achievers in a traditional program.

2b. There is no significant difference between the attitudes of average achievers in the individualized program and average achievers in a traditional program.

2c. There is no significant difference between the attitudes of low achievers in the individualized program and low achievers in a traditional program.

From this point on, the individualized instruction class will be referred to as the "experimental group" and the traditional class will be referred to as the "control group."

The Selection of the Experimental and Control Groups

Each of the two groups involved in this research was a separate sixth grade class at Harvard Elementary School in the Franklin Pierce School District, Tacoma, Washington. The pupils were randomly assigned to classes by three teachers prior to the experiment without any help or consultation from the experimenter. The class that had arithmetic in the afternoon was the experimental group, while the morning class was the control group.

The actual number of pupils in each class was twenty-five. However, the experimenter decided to eliminate two individuals from the study because of unusual circumstances in each case. One was an above-average girl in the experimental group who was absent from school about half of the time. The other was a boy in the control group who was a recent immigrant from Cuba. He had a language disability which made it too difficult for him to participate in a regular arithmetic program. Specialized programs were adapted to fit the needs of these two individuals. Therefore, for the purposes of the study, twenty-four pupils were used in each class.

The Iowa Tests of Basic Skills were administered to all pupils in both classes by the school librarian to assess the arithmetic background of each individual in the study. On the basis of data collected from this test, pupils in each class were ranked in order from the highest score to the lowest.[4] Those pupils ranking in the top third of each class were designated as "high achievers." Those pupils ranking in the middle third were classified as "average achievers." And those pupils ranking in the lower third were classified as "low achievers."

The null hypothesis that there was no significant difference between the means of the classes or the means of the subgroups was tested. Criteria for acceptance was the .05 level of significance. Table I summarizes the statistical analysis of the arithmetic subtest data on the Iowa Tests of Basic Skills. The "t test" for the independence of the means for the two classes yielded a "t" of 1.072 (2.069 was required with 23 degrees of freedom). The "t test" for the independence of the means of the experimental and control subgroups yielded the following "t" values: high achievers, 1.418; average achievers, 1.474; low achievers, 1.662 (2.365 was required for all three subgroups with 7 degrees of freedom). Since none of the obtained "t"

---

[4]Raw Scores from the Iowa Tests of Basic Skills are listed in Appendix B.

TABLE I

MEAN DIFFERENCES OF INDIVIDUALIZED AND TRADITIONAL CLASSES AND SUBGROUPS FOR ARITHMETIC SUBTEST ON THE IOWA TESTS OF BASIC SKILLS

Group	Number of Cases	Obtained Means	Obtained "t"	Required "t"
Individualized Class	24	65.21	1.072	.05 > 2.069
Traditional Class	24	61.79		
Individualized High Achievers	8	77.00	1.418	.05 > 2.365
Traditional High Achievers	8	74.38		
Individualized Average Achievers	8	65.00	1.474	.05 > 2.365
Traditional Average Achievers	8	62.00		
Individualized Low Achievers	8	53.63	1.662	.05 > 2.365
Traditional Low Achievers	8	49.00		

values reached the required "t" at the .05 level of significance, the null hypothesis was retained. Therefore, it was determined that any differences in arithmetic background between the classes or achievement groups were not significant and only attributed to chance.

A pre-test of an attitude scale was also given prior to the start of the experiment.[5] This was used to appraise the subjects' feelings toward arithmetic in an objective manner. The null hypothesis that there was no significant difference between the means of the classes or the means of the subgroups was tested. Criteria for acceptance was the .05 level of significance. A summary of the statistical analysis of the attitude scale pre-test data is included in Table II. The "t test" for the independence of the means for the two classes yielded a "t" of .044 (2.069 was required with 23 degrees of freedom). The "t test" for the independence of the means for the experimental and control subgroups yielded the following "t" values: high achievers, .132; average achievers, .444; low achievers, .063 (2.365 was required for all three subgroups with 7 degrees of freedom). Since the obtained "t" values did not reach the required "t" at the .05 level of significance, the null hypothesis was retained. Therefore, it was determined that any differences

[5]Attitude scale raw scores are listed in Appendix B.

TABLE II

MEAN DIFFERENCES OF INDIVIDUALIZED AND TRADITIONAL CLASSES AND SUBGROUPS FOR ATTITUDE SCALE PRE-TEST

Group	Number of Cases	Obtained Means	Obtained "t"	Required "t"
Individualized Class	24	61.96	.044	.05 > 2.069
Traditional Class	24	61.16		
Individualized High Achievers	8	62.50	.132	.05 > 2.365
Traditional High Achievers	8	67.13		
Individualized Average Achievers	8	67.75	.444	.05 > 2.365
Traditional Average Achievers	8	53.13		
Individualized Low Achievers	8	57.63	.063	.05 > 2.365
Traditional Low Achievers	8	59.63		

in attitudes toward arithmetic between the classes or achievement groups were not significant and only attributed to chance. The construction of the attitude scale will be detailed later in this chapter.

The Treatment Conditions Given Each Class

The experimenter taught both classes, one at a time, in order to prevent a possible problem of having two teachers with different personalities introducing an uncontrollable variable into the study. Every possible precaution was taken to keep all personal bias out of the teaching situation. This was done by following preplanned lessons and through regular self-evaluation by the experimenter.

The study ran for a period of nine weeks and covered Units Five and Six in *Modern Arithmetic Through Discovery, Book Six*. This material included the introduction and use of decimal numbers. Forty-seven pages of text material were included. Some of the specific concepts studied were: place value, adding and subtracting, rounding with decimals, multiplication, expressing fractions as decimals, division, and many other related ideas.

On the first day of the study the experimental group was introduced to the individualized instruction method. All forms and materials were discussed so that the pupils could learn their function. From then on, the entire group followed the method which was described earlier in this chapter.

<u>Evaluation of Achievement and Analysis of Data</u>

After all individuals in the experimental and control group had completed Unit Five, the comprehensive test from page 169 of the pupils' text was administered. No time limit was imposed upon the pupils and no help was given any of them. In a similar way, after Unit Six was completed by all individuals, the comprehensive test on page 195 of the pupils' text was administered. After sufficient time was taken to discuss both tests and review any questions which the pupils asked, a short final test was given both groups. The total number of items in the entire test battery was one hundred.[6]

In comparing the results of the achievement test battery which was administered to the experimental and control groups, the criteria for rejection of the null hypothesis was the .05 level of significance. A "t test" for the independence of the means of the classes and achievement groups was used to analyze the data.

---

[6]Raw scores from the achievement test battery are tabulated in Appendix B. All three parts of the test are located in Appendix C.

<u>Evaluation of Attitudes Toward Arithmetic</u>

An attitude scale was constructed using "The Method of Summated Ratings" as described by Edwards (8:149-71). The scale was used to measure the attitudes toward arithmetic of subjects in the experimental and control groups before and after the treatment condition.

<u>Attitude scale construction</u>. In constructing an attitude scale, short concise statements concerning emotional attitudes toward arithmetic were presented to each subject. They were phrased so that they could be unambiguously interpreted. Statements with which everyone might agree or disagree were not used because they would not discriminate between the subjects. In order to avoid confusion, all statements were worded in a positive direction.

Thirty-five tenative statements were tested for validity on a group of 124 sixth grade pupils who were not involved in the actual experiment. Each item was responded to in terms of a five part rating scale with various point values of which the students were not aware:

Strongly Agree	4 points
Agree	3 points
Uncertain	2 points
Disagree	1 point
Strongly Disagree	0 points

The attitude scales were scored and the subjects' raw scores were ranked in order from the highest to lowest. An item analysis was made of responses made by pupils in the top quarter of the distribution (31 subjects). This was compared with an item analysis of responses made by those in the bottom quarter of the distribution (31 subjects). A "t test" was made for each statement to evaluate the independence of the means of the top group from the means of the bottom group. Only those items which met the .05 level of significance on the "t test" (2.042 with 30 degrees of freedom) could be considered to discriminate effectively between positive and negative attitudes. Of the thirty-five items on the validity test sampling distribution, thirty-four of them met the criteria which was established. The twenty-five statements with the highest "t" scores were used in the completed attitude scale which was entitled, "What Do You Think About Arithmetic?"[7] It was administered as both a pre-test and post-test to both the experimental groups. The total possible number of points was 100 which would be the most positive attitude. On the other hand, the lowest score would be zero--the most negative attitude toward arithmetic.

<u>The analysis of data</u>. In comparing the results of the experimental and control groups' attitude scale scores, the criteria for rejection of the null hypothesis was the

---

[7]The completed attitude scale will be found in Appendix C.

.05 level of significance. A "t test" for the independence of the means of the classes and achievement groups was used to analyze the data.

III. SUMMARY

This chapter dealt with the specific method of individualized arithmetic instruction which was used in this study. The materials used and the roles of both the teacher and pupils were described. There was a definition of the sample groups and treatment conditions.

Two methods of evaluation were used. Achievement was measured with a comprehensive battery of tests involving 100 items. Attitudes toward arithmetic were measured with an attitude scale and criteria for building a valid attitude scale were reviewed. All the data which was collected will be reported and analyzed in Chapter Four, and the null hypotheses will be rejected or retained on the basis of the statistical evidence.

CHAPTER IV

RESULTS OF THE STUDY

I. STATISTICAL ANALYSIS OF ACHIEVEMENT

Of primary concern in any instructional practice is the amount of learning which takes place. The achievement test battery which was administered after the treatment condition provided the evidence necessary for evaluation. Table III gives a summary of achievement score means for both the individualized (experimental) class and subgroups and the traditional (control) class and subgroups. For the whole classes there was a significant difference in the means which yielded an obtained "t" of 3.035 which was above the required "t" of 2.069. On the basis of this evidence, the first null hypothesis was rejected. A significant difference between the two classes after the treatment condition did exist.

In looking at the achievement groups, those who were designated as "high achievers" showed only a small difference in their mean scores. The obtained "t" of 1.258 was below the required "t" of 2.365. Therefore, the null hypothesis was retained and it was concluded that there was no significant difference between the groups.

The "average achievers" showed some difference in

TABLE III

MEAN DIFFERENCES OF INDIVIDUALIZED ARITHMETIC ACHIEVEMENT SCORES AND TRADITIONAL ARITHMETIC ACHIEVEMENT SCORES FOR ENTIRE CLASSES AND SUBGROUPS

Group	Number of Cases	Obtained Means	Obtained "t"	Required "t"
Individualized Class	24	70.83	3.035*	.05 > 2.069
Traditional Class	24	52.75		
Individualized High Achievers	8	81.75	1.258	.05 > 2.365
Traditional High Achievers	8	73.13		
Individualized Average Achievers	8	68.63	2.245	.05 > 2.365
Traditional Average Achievers	8	50.75		
Individualized Low Achievers	8	62.13	2.737*	.05 > 2.365
Traditional Low Achievers	8	34.38		

*Significant at .05 level

their mean scores, but the obtained "t" of 2.245 was less than the required "t" of 2.365. Therefore, the null hypothesis was retained and it was concluded that there was no significant difference between the groups.

The "low achievers" showed a substantial difference in their mean scores. The obtained "t" of 2.737 was more than the required "t" of 2.365. Therefore, the null hypothesis was rejected and it was concluded that a significant difference between the groups did exist.

II. STATISTICAL ANALYSIS OF ATTITUDES TOWARD ARITHMETIC

Using the attitude scale which was described in the previous chapter, the experimenter measured the attitudes of pupils in both classes after the treatment condition. As will be noted in Table IV the difference between the means of the classes was very small. The "t test" resulted in an obtained score of .430 which was far below the required "t" of 2.069. On the basis of this evidence, the second null hypothesis was retained and it was concluded that there was no significant difference between the two groups.

The "high achievers" showed only a small difference in their mean scores. The obtained "t" of .664 was below the required "t" of 2.365. Therefore, the null hypothesis was retained and it was concluded that there was no significant difference between the groups.

TABLE IV

MEAN DIFFERENCES OF INDIVIDUALIZED AND TRADITIONAL CLASSES AND SUBGROUPS FOR ATTITUDE SCALE POST-TEST

Group	Number of Cases	Obtained Means	Obtained "t"	Required "t"
Individualized Class	24	60.63	.430	.05 > 2.069
Traditional Class	24	59.00		
Individualized High Achievers	8	62.75	.664	.05 > 2.365
Traditional High Achievers	8	67.63		
Individualized Average Achievers	8	61.63	2.129	.05 > 2.365
Traditional Average Achievers	8	50.75		
Individualized Low Achievers	8	57.50	.180	.05 > 2.365
Traditional Low Achievers	8	58.62		

The "average achievers" showed the largest mean difference of any of the groups which was tested for variations in attitudes. However, the obtained "t" of 2.129 did not reach the required "t" of 2.365. Therefore, the null hypothesis was retained and it was concluded that there was no significant difference between the groups.

The "low achievers" showed a very small difference in their mean scores. The obtained "t" of .180 was far below the required "t" of 2.365. Therefore, the null hypothesis was retained and it was concluded that there was no significant difference between the groups.

It is interesting to note that no consistent pattern was established regarding the relationship of the individualized group means to the traditional group means. In two cases the individualized group means were slightly higher, while in the other two cases they fell a little below the traditional group. Again it is pointed out that there were no significant differences between any of the group means on the attitude scale.

CHAPTER V

SUMMARY, CONCLUSIONS, DISCUSSION, AND RECOMMENDATIONS

I. SUMMARY

The purpose of this study was to determine the effectiveness of an individualized sixth grade arithmetic program. An experimental group of twenty-four pupils used the individualized program, and their progress was compared with a like number of pupils in a control class. The control class was conducted in a traditional manner where all pupils were taught simultaneously. Criteria for evaluation were measurements of achievement test results and attitudes toward arithmetic. An attitude scale was constructed by the experimenter. The classes were divided into three subgroups of equal size, based upon a standardized test which was given prior to the study. The subgroups were designated "high achievers," "average achievers," and "low achievers."

II. CONCLUSIONS

The following conclusions can be made on the basis of the statistical evidence:

1. Achievement of the individualized class was significantly greater than that of the traditional class.

2. Achievement of the individualized "low achievers"

was significantly greater than that of the traditional class.

3. There were no significant differences between the individualized and traditional "average achievers" and "high achievers."

4. There were no significant differences between the individualized and traditional classes or subgroups in attitudes toward arithmetic.

III. DISCUSSION

This study suggested that the individualized arithmetic program was of value to the pupils who used it. The achievement scores for the experimental class indicated a significant superiority of performance, when compared with a traditional class. However, it was inferred from the statistical evidence that the study had no measureable effect upon the pupils' attitudes toward arithmetic.

One explanation for the success of the "low achievers" could be in the removal of some of the barriers to learning which handicap many pupils who have difficulty in academic work. The strenuous competition which is characteristic of most classes was reduced substantially. Also, these pupils did not face assignment deadlines which frequently frustrate those who have difficulty. And finally, it seems certain that the "low achievers" received more individual help and recognition than did their counterparts in the traditional group. This was an outgrowth of the individualized system which allowed the teacher and superior pupils to help those who needed assistance.

The failure of the "average" and "high achievers" to do significantly better is of interest. Possibly it was because they were already working at their maximum potential within that particular setting and could do no better than that. Perhaps some of these individuals were conditioned to working in a traditional class situation which stressed extrinsic motivation. If the orientation of some pupils was toward a structured approach to learning, they might have lacked the self-motivation to push themselves harder.

One might wonder about the effect of having pupils help their peers. Psychologists and educators have talked much about the principle of reinforcement and the concept of "learning by doing." These two ideas would seem to justify having one student help another. Yet the gains which were derived by the helping student could not be measured in this study. There was no way of factoring out the specific things which contributed to the achievement of an individual. It is the opinion of the experimenter that the time spent by high achieving pupils in helping others was well used. The value to these helpers may not have been in terms of achievement, but rather may have been benefits related to the democratic ideals of helpfulness and cooperation.

The results of the attitude scale showed no significant difference between the groups. A variety of stress producing situations are commonly found in traditional methods of teaching. It was hoped that the removal of stresses would be reflected in a greater liking for arithmetic. Possibly the scale was insensitive to attitudinal changes in this setting, or the study might not have lasted long enough to provide definite changes. Attitudes formed over a long period of time may take an equally long time to be modified. It will be remembered that Moench (16:328) found that his experimental group did significantly better than the control group in performance tests conducted during a follow-up study one year after his basic research had been completed. This was attributed to "a better approach to work study or better study habits" (16:328). Possibly any influence which this study had on the attitudes of the individualized pupils will not be evident for some time to come.

IV. RECOMMENDATIONS FOR FURTHER STUDY

In order to more effectively individualize an arithmetic program, more suitable materials should be developed and published. Text materials need to incorporate several levels of reading ability and comprehension. Commercially produced answer keys and other supplementary materials to correlate with the texts would improve their adaptability to the typical school setting.

The full effects of this program need further study over a longer period of time with a larger sampling distribution. This would enable future researchers to evaluate the program's effectiveness in a variety of class situations with teachers of varying educational philosophies. Any lasting effects of the program could be assessed through longitudinal studies of the pupils. With such an extended study of individualized arithmetic, the validity of achievement and attitude measurements would be improved.

Team teaching and ungraded schools are becoming more numerous in the United States. The primary objective of these methods is to develop the potential of each individual to its fullest extent. It is entirely possible that individualized instruction will find a greater place as an instructional technique in these situations. In that case, the flexibility of the program will meet its greatest test. It is the opinion of the writer that individualized instruction will become an integral part of the school of the future.

REFERENCES

REFERENCES

1. Bradford, Leland P. and Dorothy Mial. "When is a Group?" Educational Leadership, 21:147-50, December, 1963.

2. Brewer, Emery. "A Survey of Arithmetic Intraclass Grouping Practices," The Arithmetic Teacher, 13:310-314, April, 1966.

3. Browning, V. W. "Grouping Plus Individualized Instruction Aids Arithmetic Understanding," School and Community, 50:14, October, 1963.

4. Cummins, Evelyn Wood. "Grouping, Homogeneous or Heterogeneous?" Educational Administration and Supervision, 44:19-26, January, 1958.

5. Davis, O. L. Jr., and Neal H. Tracy. "Arithmetic Achievement and Instructional Grouping," The Arithmetic Teacher, 10:12-17, January, 1963.

6. Dewar, J. A. "Grouping for Arithmetic Instruction in the Sixth Grade," The Elementary School Journal, 63:226-9, February, 1963.

7. Doll, Ronald C. (ed.). Individualizing Instruction. Washington, D. C.: Association for Supervision and Curriculum Development, 1964.

8. Edwards, Allen L. Techniques of Attitude Scale Construction. New York: Appleton-Century-Crofts, Inc., 1957.

9. Gaume, Ruth, (ed.). A Guide to the Intermediate Curriculum, Grades 4, 5, 6. Tacoma, Washington: Franklin Pierce School District No. 402, 1965.

10. Gibb, E. Glenadine, and Dorothy M. Matala. "Study on the Use of Special Teachers of Science and Mathematics in Grades 5 and 6: Final Report," School Science and Mathematics, 62:565-85, November, 1962.

11. Good, Carter V. (ed.). Dictionary of Education. New York: McGraw-Hill Book Company, Inc., 1959.

12. Graham, William A. "Individualized Teaching of Fifth and Sixth Grade Arithmetic," The Arithmetic Teacher, 11:233-4, April, 1964.

13. Grant, Jettye Fern. "A Longitudinal Program of Individualized Instruction in Grades 4, 5, and 6." Unpublished Doctoral Dissertation, The University of California at Berkeley, 1964.

14. Keffer, Eugene R. "Individualizing Arithmetic Teaching," The Arithmetic Teacher, 8:248-250, May, 1961.

15. Lerch, Harold J. and L. J. Loughlin, "Arithmetic Instruction Changes Pupils' Attitudes Toward Arithmetic," The Arithmetic Teacher, 8:117-19, March, 1961.

16. Moench, Laurel. "Individualized Practice in Arithmetic: a Pilot Study," The Arithmetic Teacher, 9:321-9, October, 1962.

17. Morton, R. L. Teaching Children Arithmetic. Morristown, New Jersey: Silver Burdett Company, 1953.

18. Provus, Malcolm M. "Ability Grouping in Arithmetic," Elementary School Journal, 60:391-98, April, 1960.

19. Searight, Franklyn. "You Can Individualize Arithmetic Instruction," The Arithmetic Teacher, 11:199-200, March, 1964.

20. Shuster, Albert H., and Milton E. Ploghoft. The Emerging Elementary Curriculum. Columbus, Ohio: Charles E. Merrill Books, Inc., 1963.

21. Whitaker, Walter L. "Individualized Arithmetic: an Idea to Improve the Traditional Arithmetic Program," The Arithmetic Teacher, 9:134-7, March, 1962.

22. ________. "Why Not Individualize Arithmetic," The Arithmetic Teacher, 7:400-3, December, 1960.

23. Wrightstone, J. Wayne. Class Organization for Instruction. What Research Says to the Teacher, No. 13. Washington, D. C.: Department of Classroom Teachers and the American Educational Research Association, National Education Association, 1957.

APPENDIX A

SPECIALIZED MATERIALS USED

EXAMPLES OF ANSWER KEYS

ANSWER KEY Page 185

1. T 3
2. T 1.4
3. T 20
4. T 1.02
5. T 1.02
6. Yes, Yes
7. (a) Yes
   (b) Yes
8. .8 2
   .08 .2
   .008 .02

Before continuing, re-read the last paragraph on this page.

ANSWER KEY Pages 186-187

1. 2.1 21 2.1 .21
2. 1.63 163 1.63 16.3
3. 2 1 yes yes .4
4. Yes, no, no, yes
5. 3.14 and 3.1400
   30 and 30.00
6. .2 3.75 2 .2 5
7. .5 .08 200 148 15
8. 6 .3 .2 .21 4.33
9. .4 .25 .45 .25 .31
10. .75 .301 .5 .81
11. Yes 36.0 72.00 23.60
    120 600 20
12. 120 80 220 5 40
13. 210 600 4,100 300
14. (b) No, no
    (c) Yes, .03
    (d) Yes
15. .02 50 .07

Remember to write number sentences for problems on Page 188.

WORK SHEET

Name_______________________

Concept or Skill Being Studied	Assignment or Pages	Date Started	Date Completed	Number Missed

Pupils:

You are responsible for completing all of the information on this sheet. When it is filled, turn the WORK SHEET in and start a new one. The column headed Concept or Skill Being Studied will not be filled in every day, but only when a new assignment is started. Always keep your record up to date so you can see your own progress.

INDIVIDUAL PUPIL CHECK SHEET

Students' Names	Date	Date	Date	Date	Date
	Page	Page	Page	Page	Page

REVIEW ASSIGNMENT SHEET

Name:______________________

Date:______________________

Concept or skill being reviewed:______________________

Assignments	Date Started	Date Completed

Pupils:

This sheet has assignments listed which will help you review a certain concept or skill. The Assignment column was filled in by the teacher while the Date Started and Date Completed columns are filled in by you. After the assigned work is complete, this sheet is turned in with the assignments which are completed and corrected.

APPENDIX B

RAW DATA FROM ACHIEVEMENT TESTS AND ATTITUDE SCALES

TABLE V

SUMMARY OF RAW SCORES ON IOWA TESTS OF BASIC SKILLS ADMINISTERED TO BOTH CLASSES PRIOR TO THE STUDY

Achievement Group Classification	Individualized Class		Traditional Class	
	Student	Score	Student	Score
High	1	80	1	78
High	2	80	2	77
High	3	80	3	77
High	4	80	4	76
High	5	77	5	76
High	6	74	6	74
High	7	74	7	69
High	8	71	8	68
Average	9	70	9	68
Average	10	68	10	66
Average	11	66	11	66
Average	12	66	12	65
Average	13	65	13	60
Average	14	63	14	58
Average	15	62	15	57
Average	16	60	16	56
Low	17	60	17	54
Low	18	60	18	54
Low	19	58	19	52
Low	20	56	20	51
Low	21	54	21	48
Low	22	52	22	46
Low	23	48	23	44
Low	24	41	24	43

TABLE VI

SUMMARY OF PRE-TEST ATTITUDE SCALE SCORES FOR BOTH CLASSES

Achievement Group Classification	Individualized Class		Traditional Class	
	Student	Score	Student	Score
High	1	62	1	79
High	2	46	2	74
High	3	60	3	52
High	4	74	4	67
High	5	86	5	69
High	6	75	6	90
High	7	51	7	55
High	8	46	8	51
Average	9	55	9	61
Average	10	81	10	59
Average	11	59	11	45
Average	12	95	12	44
Average	13	60	13	64
Average	14	58	14	31
Average	15	61	15	63
Average	16	73	16	58
Low	17	67	17	67
Low	18	74	18	61
Low	19	56	19	69
Low	20	44	20	83
Low	21	60	21	52
Low	22	57	22	63
Low	23	51	23	28
Low	24	52	24	54

TABLE VII

SUMMARY OF ACHIEVEMENT TEST BATTERY RAW SCORES FOR BOTH CLASSES

Achievement Group Classification	Individualized Class		Traditional Class	
	Student	Score	Student	Score
High	1	84	1	82
High	2	94	2	89
High	3	91	3	81
High	4	84	4	75
High	5	88	5	81
High	6	93	6	71
High	7	60	7	52
High	8	60	8	54
Average	9	82	9	71
Average	10	78	10	69
Average	11	56	11	43
Average	12	82	12	41
Average	13	88	13	47
Average	14	72	14	39
Average	15	55	15	59
Average	16	36	16	37
Low	17	81	17	39
Low	18	77	18	62
Low	19	83	19	30
Low	20	73	20	14
Low	21	55	21	58
Low	22	30	22	17
Low	23	56	23	49
Low	24	42	24	6

TABLE VIII

SUMMARY OF POST-TEST ATTITUDE SCALE SCORES FOR BOTH CLASSES

Achievement Group Classification	Individualized Class		Traditional Class	
	Student	Score	Student	Score
High	1	69	1	63
High	2	54	2	74
High	3	66	3	47
High	4	52	4	68
High	5	66	5	90
High	6	85	6	88
High	7	70	7	56
High	8	40	8	55
Average	9	53	9	47
Average	10	55	10	52
Average	11	48	11	49
Average	12	85	12	44
Average	13	51	13	51
Average	14	63	14	64
Average	15	69	15	41
Average	16	69	16	58
Low	17	40	17	69
Low	18	68	18	58
Low	19	52	19	66
Low	20	77	20	49
Low	21	67	21	48
Low	22	54	22	76
Low	23	49	23	65
Low	24	53	24	38

APPENDIX C

ATTITUDE SCALE AND FINAL ACHIEVEMENT TEST BATTERY

WHAT DO YOU THINK ABOUT ARITHMETIC?

Directions: Read each statement below. Then check the answer which is most nearly like the way you think. There are no right answers to this survey. Your answers will depend upon what you think.

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
I enjoy working arithmetic problems.					
I like to work arithmetic problems for my parents.					
Arithmetic is fun.					
Arithmetic story problems are interesting.					
I prefer arithmetic more than other school subjects.					
I like to take arithmetic tests.					
Arithmetic is very interesting.					
I like to help a friend who has trouble doing his arithmetic.					
I enjoy doing extra credit problems in arithmetic.					
Arithmetic tests are fun.					

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
Arithmetic is the most enjoyable subject I have taken.					
Arithmetic is easy.					
I would like to have arithmetic class for two hours a day.					
Arithmetic puzzles and riddles are interesting.					
I would like to take an advanced course in arithmetic during summer school.					
I never get tired of working with numbers.					
I am looking forward to taking arithmetic in Junior High.					
The arithmetic book should be made harder so that it will be more challenging.					
I enjoy discovering new things about numbers.					
It would be fun to be an arithmetic teacher.					
I think about arithmetic problems outside school and like to work them out.					
Arithmetic thrills me, and I like it better than any other subject.					

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
Sometimes I enjoy the challenge presented by an arithmetic problem.					
I would like to spend more time in school working arithmetic.					
Arithmetic is interesting.					

PART ONE OF FINAL ACHIEVEMENT TEST BATTERY

Test 169

If you make any mistakes, study the pages given at the right of the exercises.

1. Express each of the following as a decimal. 148–154

a. $\frac{38}{100}$ **b.** $3\frac{95}{1000}$ **c.** $\frac{5}{10{,}000}$ **d.** $4\frac{705}{1000}$ **e.** $5\frac{693}{10{,}000}$

2. Express as mixed or common fractions in simplest form.

a. 7.7 **b.** .09 **c.** .061 **d.** .06099 148–154

3. Copy and complete. 150–151

a. .73 = ? tenths + ? hundredths

b. .085 = ? tenths + ? hundredths + ? thousandths

4. Give the products in decimal form. 153

a. $7 \times \frac{1}{10}$ **b.** $3 \times \frac{1}{10} \times \frac{1}{10} \times \frac{1}{10}$ **c.** $9 \times \frac{1}{10} \times \frac{1}{10}$

5. Copy, and replace each frame. 148, 153, 155

a. $1.05 = \frac{\triangle}{100}$ **b.** $2.17 = \frac{\square}{100}$ **c.** $1.845 = \frac{1845}{\diamond}$

6. Copy, and replace each frame with a decimal. 154

a. $\frac{305}{100} = \square$ **b.** $\frac{1010}{1000} = \triangle$ **c.** $\frac{2125}{1000} = \diamond$

7. Find the sum or difference. 158–160

a. $2.3 + 6.5 = \square$ **b.** $.225 + .220 = \triangle$ **c.** $.999 - .334 = \triangle$

Copy and add or subtract. 158–160

	a	b	c	d
8.	4.37 +2.15	8.6 −3.9	33.94 −5.05	6.759 −3.526
9.	.65132 .21004 .18521	126.34 52.12 9.31 8.02	4.536 3.340 2.822	.25 9.75 13.09 .66

10. Round each of the following first to the nearest hundredth, then to the nearest tenth. 162–163

a. .629 **b.** .175 **c.** .064 **d.** .987

DISCOVERING MORE ABOUT NUMBERS: PAGES 326–328

If you make any mistakes, study the pages given at the right of the exercises.

Estimate the product first, then multiply. 170–173

	a	b	c
1.	$7 \times 3.09 = \diamond$	$1.87 \times 804 = \square$	$4.7 \times 2.79 = \triangle$
2.	$.81 \times 6.3 = \square$	$3.9 \times 5.2 = \triangle$	$2.43 \times 7.28 = N$

Find the products. 170–173

3.	$\begin{array}{r} .363 \\ \underline{.9} \end{array}$	$\begin{array}{r} 614 \\ \underline{.07} \end{array}$	$\begin{array}{r} .092 \\ \underline{1.06} \end{array}$

4. What does $10 \times .3125$ equal? 10×1.093? $100 \times .00052$? 100×16.85? $1{,}000 \times 16.85$? 177

Find the quotients. 182–187

	a	b	c	d
5.	$5\overline{)9.5}$	$.9\overline{)4.5}$	$.23\overline{)2.53}$	$.4\overline{).64}$
6.	$12\overline{)18.636}$	$.9\overline{)45}$	$1.2\overline{).0672}$	$.35\overline{)2.45}$

7. Express each fraction exactly as a decimal. 189–190

$\frac{7}{20}$ $\frac{8}{25}$ $\frac{3}{40}$ $\frac{7}{16}$

8. Express as decimals correct to the nearest thousandth. 190

$\frac{5}{12}$ $\frac{7}{9}$ $\frac{5}{8}$ $\frac{9}{16}$

9. Find the quotients correct to the nearest tenth. 190

$53\overline{)100}$ $3\overline{)100}$ $.26\overline{)4.8}$ $3.6\overline{)6.12}$

10. What does $16.09 \div 100$ equal? $5.67 \div 10$? $58.2 \div 1{,}000$? $.09 \div 10$? 192

11. Find the missing numerals. 172–173, 185–186

$3 \times \square = 3.6$	$\triangle \times .2 = .8$	$\diamond \times .2 = .08$	$4.5 \div .3 = \square$
$N = 1.5 \times .06$	$\triangle \div 2.3 = 4$	$\diamond \times 4.2 = 168$	$.01 \times .01 = \square$

DISCOVERING MORE ABOUT NUMBERS: PAGES 329–331

PART THREE OF FINAL ACHIEVEMENT TEST BATTERY

Do each problem as the signs tell you. Be careful where you place the decimal point in the answers.

1. $\begin{array}{r} 14.264 \\ 82.896 \\ 35.702 \\ +\ 69.084 \\ \hline \end{array}$ $\quad \begin{array}{r} 65.75 \\ -\ 35.89 \\ \hline \end{array}$ $\quad \begin{array}{r} .69 \\ \times\ 4.3 \\ \hline \end{array}$ $\quad \begin{array}{r} .009 \\ \times\ .04 \\ \hline \end{array}$

2. $\begin{array}{r} 45.51 \\ -\ 18.64 \\ \hline \end{array}$ $\quad 1.9\overline{)\,.95\quad}$ $\quad \begin{array}{r} 8.09 \\ \times\ .009 \\ \hline \end{array}$ $\quad \begin{array}{r} .26 \\ -\ .17 \\ \hline \end{array}$

3. $50\overline{)\,285\quad}$ $\quad .85\overline{)\,7.65\quad}$ $\quad \begin{array}{r} 2.39 \\ \times\ 382 \\ \hline \end{array}$

4. $\begin{array}{r} .035 \\ +\ .123 \\ \hline \end{array}$ $\quad \begin{array}{r} 74.146 \\ -\ 9.287 \\ \hline \end{array}$ $\quad \begin{array}{r} 24.1 \\ \times\ 8.1 \\ \hline \end{array}$ $\quad \begin{array}{r} .67 \\ +\ .33 \\ \hline \end{array}$

5. Round these decimals to the nearest hundredth:

.375 ________ 23.953 ________ 5.6666 ________