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A Study of the Effectiveness of Certain Methods of Teaching Selected Topics in Mathematics to a Class of Twenty-Five Seventh Grade Students at Fisher High School, Athens, Texas

Gladys Sweeney Lewis

A STUDY OF THE EFFECTIVENESS OF CERTAIN METHODS OF TEACHING SELECTED TOPICS IN MATHEMATICS TO A CLASS OF TWENTY-FIVE SEVENTH GRADE STUDENTS AT FISHER HIGH SCHOOL, ATHENS, TEXAS

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By

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DEDICATION

To my beloved husband, this thesis is dedicated.

G. S. L.

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A STUDY OF THE EFFECTIVENESS OF CERTAIN METHODS OF TEACHING SELECTED TOPICS IN MATHEMATICS TO A CLASS OF TWENTY-FIVE SEVENTH GRADE STUDENTS AT FISHER HIGH SCHOOL, ATHENS, TEXAS

In order to meet the educational objectives as set forth by the Educational Policies Commission--self-realization, civic responsibility, human relationships, and economic efficiency--[1] it is important that teachers employ the most effective methods of teaching. They must develop techniques that will aid them in getting across to their pupils facts which will enrich their lives, facts which will aid their pupils to develop well-adjusted personalities. There must be ways and means of teaching elementary mathematics that will contribute both meaning and vitality to social and effective living.

" It should be the desire of each teacher

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[1]Educational Policies Commission, Policies for Education in American Democracy (Washington, D.C.: National Educational Association, 1946). Pp. 192, 212, 226, and 240.

of our future citizens to keep in touch with modern trends and techniques in education and experiment with the uses of various methods with a view of improving classroom instructions."[1]

The teacher, therefore, must take advantage of all opportunities that may arise that will help to make the work meaningful to the child and to use the student's own experiences to their greatest extent.

Stokes underscores the importance of a teacher's being thoroughly familiar with the learning process.

> It is important that the teacher understand how the student learns and what his capabilities are in the different stages of his intellectual development. Experience plays a great part in learning. The skillful teacher builds her program and her activities upon this foundation. Everyday activities which are concerned with quantitative aspects of the student's own environment will become an integral part of the curriculum. Vital experiences which the child can relate to himself offer the bases for the most productive action.[2]

Learning is a change in behavior. The phases

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[1]Thomas A. Doyle, Education Is Living (New York: Columbia University Press, 1954), p. 10.

[2]Newton C. Stokes, Teaching The Meaning of Arithmetic (New York: Appleton-Century-Crofts, Inc., 1951),pp. 36-37.

of mental action involved in building a thought pattern constitute a behavior. Behaviors result from an introductory stimulus, a disposition to respond to the stimulus, a response-stimulus, and a consequential end-result. Behaviors produce meanings, or identify relations which constitute meanings. When these are comprehended the individual possesses concepts. Mathematical concepts emerge from differentiation, discrimination, and integration-they depend upon experience. Therefore, learning is operative when it is available for continued use-operative learning is the program of experiencing. A mode of thinking is thus developed whereby the learner is able to deal effectively with quantitative relations, exercise judgment, conceptualize, infer while making judgments to his quantitative environment. Hence learning is facilitated by building larger concepts, whole closures, integration, use and re-appearance, and utilizing the potentialities of intelligence and maturation. Thus a well-organized program of mathematics education includes experiences of social, sensory-aids and mathematical aspects. These experiences should proceed from the natural direct experience to the continued experience, and to the activity experience.[1]

The difficulties pupils experience in mathematics may be traced to a variety of causes. Menger states that many difficulties encountered in learning mathematics are caused by a confused system of symbols and terminology. He cites an example of this: "An eminent legal authority, renowned for the acumen of his analytic mind (the type so necessary for success in mathematics!) said almost wistfully, 'Mathematics is a field in which I wasn't any good in school. I never understood what x meant.' "[2]

Donovan A. Johnson discovered upon an examination of three seventh grade textbooks that they had a grade reading of 8, 7.5, and 9, respectively.[3] When one realizes that the average seventh grade pupil probably is not reading on the assigned grade level, the readibility of his textbooks becomes an important factor in his learning.

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[1] Ibid., Chapters 1-6.

[2] Karl Menger, "Why Johnny Hates Mathematics," The Mathematics Teacher, Vol. XLIX, No. 8(December, 1956), 578-585.

[3] Donovan A. Johnson,"The Readibility of Mathematics Textbooks," The Mathematics Teacher, Vol. L, No.2 (February, 1957), 105-110.

Parrish concludes that the reason for a shortage of mathematicians is due to the persistent emphasis upon computation, that is, the student being a comptometer tends to destroy interest rather than encourage it in many students. Many mathematics students do rebel at the deadly computational diet and manifest their rebellion as indifference. What is needed is a "literature" for mathematics, an anthology of stories, poems, and anecdotes that would utilize the language of mathematics in the telling and also help to reinforce the basic skills and concepts that we are currently trying to teach.[1]

Numerous studies have been conducted which reveal certain of the typical errors and difficulties pupils encounter in arithmetic.[2] These studies have led some teachers of arithmetic to attempt to improve their teaching procedures.[3] Still other investigations have shown that inadequate study habits rather than failure to master subject matter, are often the cause

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[1]Clyde E. Parrish, "Junior High School Mathematics and the Manpower Shortage," The Mathematics Teacher, Vol. XLIX, No. 8 (December, 1956), 611-616.

[2]Mathematics in General Education. A Report of the Committee on the Function of Mathematics in General Education (New York, 1940).

[3]National Council of Teachers of Mathematics, The Place of Mathematics in Secondary Schools, Fifteenth Yearbook (New York, 1941).

of failure to achieve in mathematics, and that it is necessary to pay as much attention to the development of effective study habits as to the procedure for presentation of instructional materials.[1]

There is not much transfer of learning from one situation to another (except meaningful experiences) while many things must be accented toward the needs, interests, and problems of the learner.[2] While few people would doubt the value of developing the social significance of mathematics, the need for developing mathematical meanings does not appear to be as readily apparent. This is especially true of developing abilities in reading, reasoning, concept formation, closure, and the meanings of mathematics.[3]

Statement of the Problem

The problem of this study has been centered around the methods and techniques used in teaching mathematics to a group of seventh grade students of

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[1] What Research Says about Arithmetic. (New York: Association for Supervision and Curriculum Development, 1952).

[2] The Learning Process. (Washington, D.C.: Department of Classroom Teachers and American Educational Research Association, 1954.)

[3] Ibid.

the Fisher High School, Athens, Texas. The problem further presents itself in determining whether certain methods and techniques will help the student gain a better understanding of, and, a greater appreciation for mathematics.

Purpose of Study

The purpose of the present study is to determine by means of various evaluative instruments the relative merits of certain motivational devices as applied to selected topics in seventh grade mathematics.

Scope of Study

The scope of the present study covers the teaching of whole numbers, fractions, decimals, common measures, percentage, graphs, charts, ratios, form, and measurements, on the seventh grade level, as they relate to twenty-five pupils of the Fisher High School.

In order to prevent possible misinterpretation and to render the findings more valid, it is necessary to recognize certain limitations by which this study bound; namely, the content has, more or less, been determined by the course of study prescribed by the

Athens (Texas) Board of Education and the local school administration. The study is further limited because the text books are designated by the school administration; the material contained therein must be covered within a designated length of time. Topics thus explored during the school year were circumscribed by time limits imposed by administrative regulations. At times this posed a very real handicap.

The achievement tests were selected by the city supervisor without recommendations from the teachers. Therefore, the tests were not necessarily suited to all classes concerned, particularly to those classes that were not reading at their assigned grade level. There was another difficulty experienced here in that the second achievement test was given in April, and neither at the close of a particular six-week period nor at the close of the second semester.

Assumptions

Children grow and develop according to a definite pattern. The rate may vary, but they eventually all go through the same growth experiences. In order to reach these children in their varying stages of development, successful teachers employ the basic principles of learning which are as follows:

1. Purposeful learning follows a developmental sequence.

2. Motivation is essential to purposeful learning.

3. Direct experience is needed to acquire concepts.

4. Practice is necessary in acquiring skills.

5. Insight facilitates efficient problem-solving.

Identifying figures enhance the development of attitudes and values.

7. Meaningful learning is retained and it transfers.

8. Differences in students affect learning outcomes.

9. Learning is enhanced when students help plan some details of their work.[1]

10. Learning is facilitated when the individual is successful, at least to some extent,

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[1]Herbert J. Klausmeier, Teaching in Secondary Schools (New York: Harper & Brothers, 1958), p. 66.

in his efforts to acquire knowledge. A corollary to the preceding statement recognizes also that from unpleasant and unsuccessful experiences, children learn to dislike mathematics and to shun the subject. Likewise, they learn to dislike teachers of subjects in which they have unfortunate experiences in this instance, mathematics teachers.

With these assumptions in mind, the writer, therefore, sets forth the hypothesis that a variety of techniques and methods employed by a teacher of mathematics is useful and desirable in facilitating problem-solving.

Methodology and Procedures

The investigation approach was used to determine the effectiveness of certain teaching techniques in mathematics with a group of twenty-five seventh grade pupils of Fisher High School, Athens, Texas, for two semesters, divided into six six-week periods, of the school year, 1957-1958. The teaching technique to be employed was the unit method which included several approaches such as projects, group activities, individual reports, audio-visual materials, and teacher and/or pupil-led discussions.

The class was given an achievement test, which was also used as a diagnostic test, at the beginning of the first six-weeks period. At the end of the first, second, third, fourth, fifth, and sixth six-week period, a teacher-made progress test was administered.

At the end of the second six-weeks a check-list and a questionnaire were used to evaluate the progress of the class. The other evaluating instruments which were employed during the length of the study included the following:

1. The Gray-Volaw-Rogers General Achievement Test, which was administered to the seventh grade, September 12, 1957, and again, April 24, 1958.
2. Jiffy tests, also teacher-made, were administered at least once during each six-weeks period.

Organization of the Study

This thesis is written in four chapters which will contain information that discusses, supports, and develops the problem. Chapter I deals with the statement of the problem, its scope and limitations, the procedures used in collecting pertinent data, and definition of terms. In Chapter II, a review of related literature is given. Chapter III is devoted to the analysis and interpretation of the data collected during the school year. Chapter IV contains the summary, conclusion, suggestions for further study, and bibliography.

Definition of Terms

The term trends is interpreted throughout the report as meaning a current development in the educational progress of elementary mathematics.

Techniques shall mean a specific step or means of achieving a result in the teaching of elementary mathematics.

Method shall be interpreted as meaning a general systematized procedure used in solving problems.

Skill shall mean the development of an acquired ability.

Device refers to a scheme or project.

Jiffy Quiz is a teacher-made test given during each of the six-weeks period. Its purpose is to check on competency of performance in subject matter.

Mastery refers to the ability to show accuracy and skill which indicates a permanence of learning.

Mathematics is used interchangeably with arithmetic.

The unit method refers to the varied activities in the mathematics program which are developed around a central theme or purpose, clear and significant to the student.

CHAPTER II

REVIEW OF LITERATURE

The fundamental objectives of the modern elementary school is to develop the whole individual. The realization of this objective necessitates a kind of situation that will foster the total growth of the individual mentally, physically, socially, and emotionally.

Mathematics represents a dynamic rather than a static body of knowledge; therefore, the curriculum must be kept flexible and adaptable to the needs of each particular group of children. The mathematics curriculum places emphasis on (1) the selection of significant units which will help to give students an understanding and appreciation of the present day mathematics; (2) the selection of units of experience which contribute to society in maintaining the school; (3) the development of techniques of instruction that promote the spirit of cooperation.

The present day situation in the world of science without a doubt presents the greatest challenge and the gravest responsibility ever faced by the educators in America with increasing emphasis given to the fact that mathematics programs must be adapted to the needs of the children.[1]

Wilson and Stone state that there is an increasing emphasis upon the use of child growth and development data in planning the mathematics program. Topics are being placed at levels where adequate background exists to assure a more adequate learning. Implications of child growth characteristic of improving mathematics are being analyzed by special committees. Evaluation of mathematical learning is being geared to the development levels of pupils, not arbitrary standards of achievement unrelated to the school program or to the needs of the group.[2]

The community is the student's laboratory for learning. The problems developed in the student's community are his frame of reference for considering the ways of living in other communities. Sound planning with attention to flexibility to meet individual needs is replacing both incidental and formal approaches, with much emphasis being placed upon

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[1]James R. Overman, Principles and Methods of Teaching Arithmetic (New York: Lyons and Carnahan Company, 1956), p. 5.

[2]Guy Wilson and Mildred Stone, Teaching the New Arithmetic (Chicago: Sanborn and Company, 1949), p. 44.

the child's environment.

Brueckner and Grossnickle state that

> the teacher should recognize the possible contribution instruction in arithmetic can make to the social objectives of all education. Many of the experiences pupils have in school that are rich in application of number can be designed as experiences in democratic living. Here the teacher can conduct the learning program so that intelligence which forms the basis of actual practice in solving problems of daily life that are of concern to the pupils. The problem-solving is a most valuable type of experience in democratic living. In most instances arithmetic makes valuable contributions to these experiences. [1]

At the seventh grade level there is an enormous amount of objective material available that discusses classroom techniques and devices as they are revealed by objective data. Although there are numerous studies in specific phases of general psychology ,but there appears to be need for experimentation with masses of media as related to daily classroom activity on the content of seventh grade arithmetic. Obvious needs seem to be indicated in the desirability of securing information concomitant of certain aids and the teaching process.

Van Engen observes that the use of letters of the alphabet in mathematics can be most confusing to a child. The introduction of formulas should be

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[1] W. Brueckner and F. Grossnickle, How to Make Arithmetic Meaningful (Philadelphia: Lippincott, 1954), p. 513.

postponed until the pupils has grasped in part, at least, the fundamental idea of how variables are used in mathematics. This can be done, and it should be done in the seventh grade.[1]

Casewell and Foshay cite the need for consideration of the whole child. A teacher cannot teach arithmetic alone, or spelling, or reading. Subject matter cannot be considered apart from the children and in every experience the whole child is affected. A teacher may ignore attitudes, effects on character, and the like when teaching mathematics, but the effects are there.[2]

As early as 1938, Buswell, Brownell, and John demonstrated that much use should be made of directing the child toward the learning of a particular process or fact through performance of a carefully planned series of steps involving concrete experiences followed by identification of certain characteristics. This procedure helps to foster the development of independence and self-reliance

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[1]H. VanEngen, "If Its Good Mathematics, Its Easier to Learn," The Mathematics Teacher, Vol. L, No.2(February, 1957), 174-176.

[2]Hollis J. Casewell and A. Wellesley Foshay, Education in Elementary School (New York: American Book Company, 1950), p. 35.

character traits which are so necessary for the maturing child.[1]

In teaching mathematics, it is essential to base the instructions as far as possible on laboratory experiences involving testing by hypothesis, creating, constructing, performing, criticizing, and evaluating.[2]

The development of the laboratory method in teaching mathematics has gradually gained momentum. Visual aids, which create interest or help to develop concepts in junior high school mathematics, make the study of this subject enjoyable for both pupils and teachers. Pupils in junior high school are at that stage when they are no longer children nor are they adults, and yet they resemble the former one minute, and the next minute, the latter. They need help and guidance to bridge the gap between elementary and secondary mathematics.[3]

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[1] G.T. Buswell, W.A. Brownell, Lenore John, Daily Life Arithmetic, Grade Six (Boston: D.C. Heath Co., 1938), pp. 47-48.

[2] Stokes, op. cit., p. 55.

[3] National Society for the Study of Education, Emerging Practices in Mathematics Education, Twenty-Second Yearbook (Washington, D.C.: The National Council of Teachers of Mathematics, 1954), pp. 134-135.

Curry-Porter asserts that the application of scientific methods embracing the scientific attitudes and habits to solution of mathematics problems is most effectively promoted through many opportunities for practicing their application in the solution of such problems.[1]

Teachers are regularly in use of many techniques at once and at the same time because different children may better learn the same thing through different methods. First hand experiences aim at the child's actual use of actual events and a wealth of material for use as a learning method. If the teacher would use more of the many resources which are provided through a study of their own community, pupils might become better informed and understand more clearly many of the mathematics problems.[2]

The types of activities by which children classify concepts of how people live and work together call for certain procedures that have definite values. These procedures vary with the center of interest and the needs of any particular group.

Instruction in mathematics are for the purpose of developing responsible, sensitive, and

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[1] J. Curry-Porter, Applied Business Arithmetic (Cincinnati: Southwestern Publishing Company, 1955),p.7.

[2] Ibid.

courageous citizens who will participate intelligently in solving problems growing out of human relationships. To accomplish these ends, the teacher must employ methods that can bring about this achievement in a course of study that places emphasis upon desired growth in children.[1]

To catch and harness the curiosity of children requires several units that run more or less side by side. These plans are unified, comprehensive, and may include such topics as units on fractions, decimals, and percentage.[2]

The unit method encourages the learner to perceive various related experiences in terms of the pattern or design which is an intellectual act of the highest order.[3]

Unit organization presents a center for the planning and control of learning experiences. It strives to achieve unity and wholeness in teaching and learning based upon a real concern of the learner. The unit is addressed to a realistic problem using

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[1] Edward Grim, William Gruhn, and Harold Anderson, Principles and Practices of Secondary Education (New York: The Ronald Press Company, 1951), p. 45.

[2] J. G. Umstaftd, Secondary School Teaching (Dallas: Ginn and Company, 1948), p. 89.

[3] Ibid.

information and knowledge from any relevant source.[1]

According to Barnes, all of the new techniques of teaching are applicable to the unit method and may in time result in even better ways to organize learning experiences. Improvements in classroom practices are due as much to the development of specific teaching as they are to the unit conception, itself.[2]

Research has established that the help of audio-visual aids has contributed to children's learning more rapidly and retaining longer what they have learned. These aids are helping them to understand charts, graphs, fractions, decimals, percentage, and geometric figures.[3]

Audio-visual materials provide common experiences which will be a spring board for discussions and in turn lead to solving problems. These aids stimulate interest and curiosity; they sum up briefly the main points of a subject that has been discussed; and they are not time consuming.[4]

Wiles points out that in order to have continual growth, one must engage in a constant process

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[1] Ibid.

[2] Fred P. Barnes, "The Classroom As A Learning Labortory," Childhood Education, Vol. XXX1 (Dec., 1954) 164-165.

[3] Alberta Meyer and Harriet Brick, "Children, Teachers, and Tools," Childhood Education, Vol. XXI (March, 1955) 327-331.

[4] Ibid.

of experimentation. One must recognize that his present teaching represents the best working hypothesis that he has been able to formulate and that will change only as a result of additional experiences as he continues to analyze it critically.[1]

Teachers believe that the ability of a student to solve mathematics problems is dependent upon how deep his understanding of mathematics is; the student's ability to solve problems also depends upon understandings, attitudes, and skills concerning problem-solving to be of help to the student.[2]

As a word of caution, the teacher is reminded that he should not teach students a specific method which can be used only for a particular problem-or worse, has to be unlearned when other problems are studied.[3]

Brownell emphasizes the relatedness of ideas in arithmetic and gives a place to instructional influences as factors affecting readiness. He states that a "child is ready to learn a new concept when

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[1]Kimball Wiles, Teaching for Better Schools (New York: Prentice-Hall, Inc., 1952), p. 397.

[2]The Learning of Mathematics, Twenty-First Yearbook (Washington,D.C.: The National Council of Teachers of Mathematics, 1953), p. 266.

[3]*Ibid.*, p. 267.

he has control of all ideas and skills prerequisite thereto; when his previous experience has brought him to the stage where he can take on new learning."[1]

McGeoch, in discussing a typical process in learning states that the first step in learning is a problem situation and that the problem results from a lack of adjustment between an organism's motivating needs, its immediate environment and its reactive equipment.[2]

Drill,as a teaching technique, is being revived; however, the old concept of drill has been changed. Sueltz points out that during the past quarter century, the word "drill" has not only changed semantically but also, and, more important, the significance of drill has changed. Although the drill, during the period 1935-1945, fell into disrepute in educational circles, more frequently as a part of the learning process, it has gained respectivity. Its contribution to meaningful learning has become recognized. Drill must be employed with

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[1]W. A. Brownell, "A Critique of the Committee of Seven's Investigations on Grade Placement of Arithmetic Topics," Elementary School Journal, Vol. XXXVIII, (March, 1938), 505.

[2]J. A. McGeoch, Psychology of Human Learning (Chicago: Longmans Green Company, 1942), pp. 142-148.

artistry; it requires a high level of discernment in knowing when, how much, where, and how to apply.[1]

Practice should follow, not precede, understanding. Effective drill must emphasize the systematic character of number relations and of the number system.[2]

SUMMARY

In the related literature, the following facts were pointed out: (1) the pupil learns better when the situation is meaningful to him. (2) The whole child is involved in any learning situation. (3) Drill should follow understanding, and should be progressive in character. (4) The laboratory method of teaching is gaining popularity because of its success and appeal to children. (5) A problem only exists because there is a lack of adjustment between an organism's motivating needs, its immediate environment, and its reactive equipment. (6) The teacher should guide the pupil to think creatively allowing the pupil to make discoveries in the process and to prove that he is understanding what he discovers.

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[1] The Learning of Mathematics, Twenty-First Yearbook (Washington, D.C.: National Council of Teachers of Mathematics, 1950), p. 213.

[2] Ibid.

CHAPTER III

ANALYSIS AND INTERPRETATION OF DATA

In any functional mathematics program, a variety of teaching techniques are employed. Obviously, this is necessary in order to provide to individual differences both in ability to learn and in growth and development. To determine the effectiveness of the mathematics program of the seventh grade at Fisher High School, Athens, Texas, several teaching methods were utilized; namely, the unit method, which included group activities, individual reports, various projects, audio-visual meterials, and teacher and/or pupil-led discussions.

The fundamental textbook used in the present study was Making Sure Arithmetic[1]; the first unit to be studied was whole numbers, a telescoped presentation of fundamental processes taught either in the sixth grade or earlier. The teaching of this unit gave the pupils an opportunity to retrace

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[1]William L. Schaff, Making Sure Arithmetic (New York: Silver Burdett Company, 1948).

their thinking.

During this six-weeks period, the pupils were given an achievement test,which was also used as a diagnostic test, by an administrative consultant to ascertain just what number of abilities the seventh grade pupils had before formal work was undertaken. Table I shows the scores and ages of the pupils.

From this table, it may be seen that only four students tested above their assigned grade level. Of these four, one achieved the eleventh grade with an indicated educational age of sixteen years and six months. Thirteen achieved either sixth grade or seventh grade level, which indicates that at least half the class was working either at the assigned grade level or slightly below that point.

A diagnostic study of the errors revealed that most of the students could not add, subtract, multiply, and divide correctly. This result may be observed from Table I, for it will be noted that the scores were lower in arithmetic computation than in arithmetic reasoning. In addition to this deficiency, one-fifth of the pupils could not carry mentally. In subtraction, the same pupils could not

TABLE I. SCORES, AGE, AND GRADE PLACEMENT MADE BY TWENTY-FIVE SEVENTH GRADE PUPILS ON THE GRAY-VOLAM-ROGERS GENERAL ACHIEVEMENT TEST, SEPTEMBER, 1957.

Pupil	Sex	Age Yrs	Age Mos	Arith Reas	Arith Comp	Av Score	Ed Age	Ed Grade
A	M	12	2	88	66	77	13-10	8.6
B	F	11	11	73	64	68	11-10	6.7
C	F	12	3	86	87	86	16-6	11.4
D	F	13	3	50	46	48	9-6	4.4
E	M	12	6	84	72	78	13-10	8.6
F	F	14	2	50	56	53	10-0	4.8
G	F	14	5	40	40	40	9-1	3.9
H	M	13	7	81	70	71	12-9	7.6
I	F	12	2	75	70	73	12-9	7.6
J	M	12	2	76	72	72	12-9	7.6
K	M	12	3	84	79	81	15-0	9.9
L	M	12	2	84	59	67	11-10	6.7
M	M	13	11	50	40	45	9-6	4.4
N	F	12	2	76	70	73	12-9	7.6
O	F	12	8	52	51	52	10-0	4.8
P	F	12	5	76	72	73	12-9	7.6
Q	F	12	5	67	66	66	11-10	6.7
R	M	12	7	58	68	63	11-1	5.9
S	F	12	6	81	72	76	13-10	8.6
T	M	12	7	71	56	68	11-10	6.7
U	M	12	9	85	58	67	11-10	6.7
V	M	12	4	73	65	69	11-10	6.7
W	M	12	5	81	72	71	12-9	7.6
X	M	12	3	78	74	71	12-9	7.6
Y	F	12	3	58	59	59	10-6	5.3

remember to borrow when a figure at the bottom is larger than the figure above it.

To correct these deficiencies, the teacher gave many drills in addition and subtraction as well as holding discussions on numbers and their place value, the use of large numbers, round numbers, and exercises on how to use addition, subtraction, multiplication, and division.[1]

The following problems are sample lessons of practice with whole numbers:

1. Write each of the following numbers in figures:
   (a) Two hundred twenty-five
   (b) Six hundred forty
   (c) Eight hundred six
   (d) One thousand, four hundred thirty-nine
   (e) Forty thousand, five hundred three
   (f) Three hundred sixty thousand, seven hundred twenty

2. Read each of the following:
   (a) 250,000
   (b) 900,000
   (c) 1,750,000
   (d) 2,225,400
   (e) 68,092,623
   (f) 135,560,388
   (g) 482,073,295

3. Find the total value of the following:
   (a) 500 automobiles at $1000 each.
   (b) 200 radios at $150 each.
   (c) 2000 washing machines at $100 each.
   (d) 50 refrigerators at $200 each.

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[1]Herbert F. Spitzer, The Teaching of Arithmetic (New York: Appleton-Century-Crofts, Inc., 1951), pp. 55-142. These procedures are suggested by Spitzer.

4. Copy these sentences and fill in the blanks.
   (a) Five thousand = ____?____ hundreds.
   (b) Sixty-Four thousand = __________ hundreds.

The students recognized early that in order to progress in the seventh grade arithmetic they must be able to add rapidly and accurately, and readily recognize the sum of any two one place numbers and the sum of any two place number and any one place number, such as 7 + 6 and 15 +8.

The pupils were urged to make a habit of copying figures accurately and neatly, to keep columns straight, carry mentally, carry right away, and check by adding in the opposite direction.

Example:

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 68
 16
 24
 57
 49
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214
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Procedure. To add the above column, add down. Think 14, 18, 25, 34; write 4 and carry 3. Think 9, 10, 12, 17, 21. Check by adding up. Think 16,20, 26, 34; write 4, carry 3. Think 7, 12, 14, 15, 21. A drill exercise was then given the class with examples of the following type:

1. (a)	(b)	(c)	(d)
87	28	448	878
97	94	837	192
58	50	774	300
65	48	309	596
46	30	117	298
25	56	365	976
81	22	559	338

After the drill exercise of addition, word problems of addition in every day life were given.

Examples:

1. A salesman keeps a record of the amount of his sales. In one week his sales were $326.05, $294.75, $368.24, $493.75, $375.98, $578.90. Find the amount of his sales for that week.

2. Joan's father kept a careful record of the expenses of running his automobile for one year. The expenses included $88.72 for gasoline, $11.50 for oil and grease, $29.50 for garage rent, $54.00 for insurance, license fee, $16.50, and $62.50 for repairs. How much did it cost to run the car for that year?

A review of subtraction was given and the students were reminded that"we subtract a smaller number from a larger number, the larger number being called the minuend while the smaller number is called the subtrahend. The result is called the remainder or difference. The sign (—) used in subtraction is called a minus sign. It is placed before the number that is to be subtracted from the other number. Thus 525 - 125 means to subtract 125 from 525. We subtract in order to find

(1) How many are left.

(2) How much more is needed.

(3) What the difference is."

The pupils were given many drills in subtraction. Problems involving borrowing more than once and the checking of subtraction problems were stressed.

Below are given some sample lessons on subtraction.

1. Find the differences and check:

(a)	(b)	(c)	(d)
9428	8532	1211	8636
3659	2748	937	1064

(e)	(f)
809	9000
273	3275

Word problems in subtraction:

2. In a school election, Harry received 325 votes and Ann received 687 votes. How many more votes did Ann receive?

3. Sam has 1645 stamps in his collection. A year ago he had 988 stamps. How many new stamps did Sam add this year?

4. In June the speedometer of Mr. Jones' car registered 58639 miles. At the end of summer it registered 75,056. How many miles did Mr. Jones drive during the summer?

5. When empty, a coal truck weighed 3390 pounds. As it left the coal yard its weight was 12,400 pounds. How many pounds of coal were on the truck?

These four statements were given the students to remember when subtracting:

1. Remember to borrow when a figure in the bottom number is larger than the figure in above it.

2. Remember that you borrowed (if you did).

3. When you borrow, remember that there is one less in the place from which you borrowed.

4. Remember that a zero in the top number is made ten by borrowing from the figure directly to the left of it.

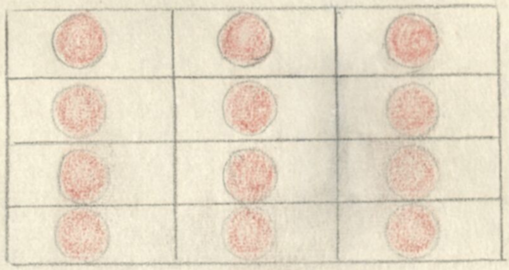
In introducing multiplication, the class was reminded that this was a review. However, the process was presented as though they knew very little about multiplication. The pupils were told that multiplication is a short way to add by means of the following drawing:

Row 1

Row 2

Row 3

Row 4



The students can see that there are four rows with exactly the same number of balls in each row. They can find the number of balls in the box by adding 3 ≠ 3 ≠ 3 ≠ 3 ≠ = 12. At the same time the student can readily see that the number of balls in the box is the number of rows times the number of balls in each row or 4 x 3. Terminology was stressed. Checking was done by interchanging the multiplicand and the multiplier, since, theoretically, the pupils had not been exposed to division.

The sample lesson included both numerical problems and word problems.

(a)	(b)	(c)	(d)	(e)
49	74	403	346	519
x 3	x 9	x 3	x 42	x 39

(f) 563
x206

Word problems in multiplication:

1. Last winter Mr. Smith burned 2250 gallons of oil in his furnace. The oil cost 6 cents a gallon. How much did Mr. Smith spend for fuel?

2. A storekeeper pays $1.49 each for baseball bats. How much does he pay for a dozen bats?

3. The price of admission to the school play was $.35. The pupils sold 248 tickets. How did the pupils collect?

Practice drill in multiplying with 12's and 15's was also provided.

The pupils brought to class pictures of an adding machine and a calculating machine, and discussed the advantages of such machines in this age of science. A report was given on the story of the abacus.

Adequate reviews were given the group on division with problems using one, two, three, and four figure divisors, problems showing the proper placing of the quotient figure, and the use of the trial divisor. The class recalled that"when we divide whole numbers, we break up a larger group into smaller groups, all of which are equal."

Terminology again was stressed; checking was done by multiplying. The following problems are typical of those used in the lessons in division.

1. Helen and Jane have 147 snapshots for their photograph album. They plan to put six pictures on each page. How many pages do they need?

2. A farmer paid Fred $3.60 for digging potatoes. If Fred dug 20 bushels of potatoes, how much was he paid for each bushel?

3. A monthly railroad ticket costs $12.48. If Mr. Smith rides twice a day on each of 26 working days a month, how much does each ride cost him?

4. There are 37 boys in a club. The cost of a two week camping trip for the entire club amounts to $592. What is each boy's share of the cost?

During the middle of this six-weeks period a Jiffy Quiz was given. Fig. 1 shows the results.

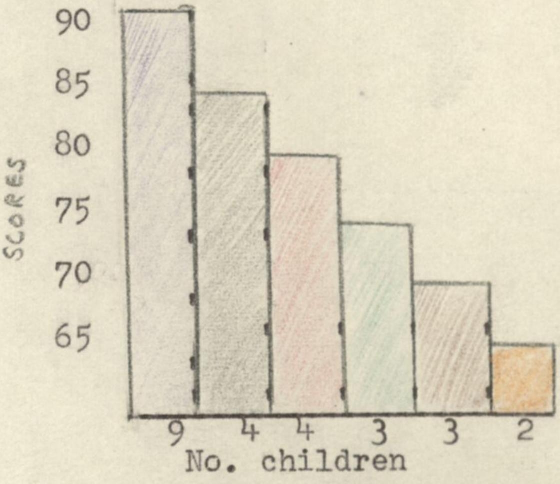


Fig. 1. Graph Showing Distribution of Scores of Jiffy Quiz I.

Fig. 1 indicates that nine children made a score of 90; four made 85; four made 80; three had a score of 75; three made 70; two made 65. The median score is 85, with seventeen pupils making a score above 80. The mean score is 81.4, with a standard deviation of 2.2.

At the end of the first six-weeks period, the class was given Progress Test A. Table II shows the scores made by the twenty-five pupils on the test. This table also shows a comparison of the Progress Test and the Jiffy Quiz for each of the periods of study. The median score on Progress Test A was 80, with four scores above 95 and ten scores below the median measure. Although only eight pupils fell below the 80 mark on the Jiffy Quiz 1, ten fell below this score on Progress Test A. The mean score for the test was 80.4.

The second six weeks of the school term, the twenty-five pupils of the seventh grade of Fisher High School studied the use of fractions. Before the class started solving problems containing fractions one class period was spent discussing why it is necessary to study fractions and the usefulness of them. The group decided that in everyday life whether buying at the store, cooking in the kitchen, or making things with tools, whole numbers alone are insufficient. The class discussion also explained and emphasized the use of whole numbers and fractions, such as

$2\frac{1}{2}$ feet equals 2 feet and 6 inches, or 30 inches. Definitions of terms commonly used in fractions were reviewed and explained. Other pertinent facts about fractions were discussed and illustrated.

After the discussion of fractions in general and since the class had studied fractions prior to the seventh grade, a Jiffy Quiz (2) was administered the second day after beginning the subject of fractions. The purpose of the Jiffy Quiz at this point was to gear the class for work that was to follow. Sample quiz items are herewith given:

1. Can the numerator of a fraction be equal to the denominator?

2. Dividing a number by 8 is the same as multiplying it by what?

3. Taking $\frac{1}{4}$ of a number is the same as dividing it by what number?

4. Is 2/3 larger than 3/4?

5. How many 6's in 30? What is 1/6 of 30?

6. Which of these fractions are equivalent in value 6/9; 3/9; 8/12; 4/6; 2/6; 2/3?

7. How much is a pound and a half less a quarter of a pound?

8. John lives 3/4 of a mile from school; Fred lives 2/5 of a mile from school. Which of the boys lives nearer the school?

Following the Jiffy Quiz the balance of the second six weeks the class studied the following topics: comparison of fractions, equivalent fractions, reduction of fractions, improper fractions and mixed numbers, changing an improper fraction to a mixed number, changing a mixed number to an improper fraction, adding and subtracting similar fractions, adding and subtracting unlike fractions, multiplying a whole number by a fraction, multiplying a fraction by a whole number, multiplying a whole number by a mixed number, dividing a fraction by a whole number, dividing a whole number by a fraction. The class was also given drill exercises in multiplication of fractions using cancellation as a short cut. As soon as the students understood the processes of working with fractions they were given word problems that involved fractions to solve. At the end of the second six weeks, the students were given Progress Test B, a questionnaire, and a check list to evaluate their progress.

A few items taken from the questionnaire are listed below:

1. In the fraction 3/8, the numerator is _________ and the denominator is ________.

The fraction 8/24 reduced to its lowest terms is _________.

An improper fraction can always be changed to a ________ number or to a ________number.

Of these three fractions, 1/4. 1/6. 2/3. the smallest is________ and the largest is ________.

A proper fraction is a fraction whose numerator is ________ than its denominator.

To reduce an improper fraction to a mixed number, we ________the numerator by the ________.

If a whole number is divided by a proper fraction, the quotient will always be ________than the number.

If a whole number is multiplied by a proper fraction, the product will always be ________ than the number.

The following statements are taken from the checklist administered to the class at the end of the unit on fractions:

Check the false statements:

1. If two different fractions have the same numerators, the fraction having the smaller denominator is the smaller fraction.

2. If two fractions have the same denominator the larger numerator is the larger fraction.

3. If you add the same number to the numerator and to the denominator of a fraction, the value of the fraction remains the same.

4. If you multiply only the denominator of a fraction by a number, you multiply the value of the fraction by that number.

5. When a whole number is divided by a proper fraction the quotient is greater than the whole number.

As an extra motivational activity, a film on fractions was shown during the second week of this period.

The purpose of the checklist and the questionnaire was to determine the extent of the pupils' understanding of mathematical terminology as applied to fractions, and their functional competence with fractions. This purpose is supported by Sueltz.[1] The ability to (a) sense a use of fractions; (b) to recognize and understand the essential principles involved; (c) to know what to do; to think through the situation; (d) to perform the necessary steps of computation; and (e) verify and feel confident of a conclusion are all phases of a genuine functional competence with fractions. In order to develop these abilities, the class work was directed to this end.

TABLE II. A COMPARISON OF SCORES MADE BY TWENTY-FIVE SEVENTH GRADE PUPILS ON PROGRESS TESTS AND JIFFY QUIZZES.

SCORES	P. Test A	JIFFY TEST 1	Prog TEST B	Jiffy TEST 2	Prog. TEST C	Jiffy Test 3	Prog T. D	Jiffy TEST 4	Prog. TEST E	Jiffy TEST 5	Prog TEST F	Jiffy TEST 6
95 +	4		5		3	5	5	9	6		7	5
90 90	5	9	5	5	6	5	5		4	11	3	4
85	2	4	1	4	3	6	2	5	1	3	2	6
80	4	4	4	4	5	4	4	6	8	4	6	6
75	5	3	4	3	4	3	6	3	3	3	3	3
70	1	3	3	5	1	2		2	1	2	2	1
65	1		1		2		2		1		1	
60	3	2	2	4	1		1		1	2	1	

[1] Sueltz, op. cit., p. 210.

The pupils' performance on Jiffy Quiz 2 was not quite so good as on the first Quiz. This is probably accounted for in that it was administered nearer the beginning of the six-weeks period than was Jiffy Quiz 1. The median score on Quiz 2 was 80, with twelve pupils scoring below this point. On Progress Test B, administered at the end of the period, five pupils scored 95 or above. The median score on this test was 80 also, with only ten pupils falling below this score. Two pupils made 60 on the Progress Test, but four made 60 on the Jiffy Quiz. These facts are shown in Table II.

For the third six weeks, the seventh grade students of Fisher High School studied decimals since decimals are closely allied to fractions. In introducing the subject of decimals to the class, the writer explained that the subject is interesting and demands some brain work, but that it is nothing to be afraid of because they have been using decimals without even knowing that they were. For example, a dime is ten cents, but since there are one hundred cents in a dollar, a dime is 10/100 of a dollar or $.10.

After the discussion of money and fractions, it was easier for pupils to see how fractions with denominators of tens, or hundreds, or thousands, are converted into decimals.

Jiffy Quiz 3 was given at the end of the first three weeks which was about mid-point of the total period. Fig. 2 shows the distribution of scores on Jiffy Quiz 3.

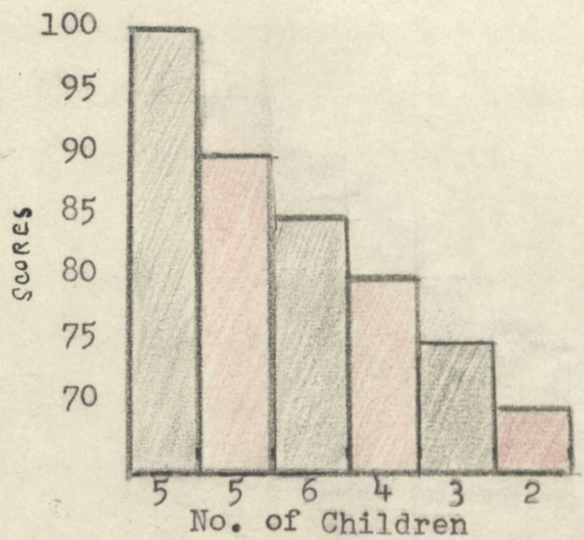


Fig. 2. Scores Made by Twenty-five Pupils on Jiffy Quiz No.3.

Fig.2. indicates that five pupils made a perfect score, five made 90 on this Quiz. No one made less than 70 on this test, which brought the average score above 80. The median score for this Quiz was 85; eleven pupils fell below the median score.

The remainder of the third six-weeks period was spent by the class reading, writing, adding, subtracting, multiplying, dividing decimals, changing fractions to decimals and decimals to fractions. Problems of real life involving decimals were given the pupils to solve. The class brought in newspaper clippings containing decimals.

At the end of the third six-weeks, a Progress Test (C) was given. Table II shows a comparison of Progress Test C and Jiffy Quiz 3 (scores). As in previous Progress tests, the median score was 80, whereas on the Jiffy Quiz 3, the median score was 85. Three pupils scored 95 or above on Progress Test C; six made a score of 90. On Jiffy Quiz 3, ten pupils scored 90 or above, five of whom were above 95. At the lower end, on Progress Test C, one pupil made 60, and two made 65; on the Jiffy Quiz 3, no pupil made a score of less than 70.

The seventh grade class spent the fourth six-week period studying percentage because this area of mathematics is closely related to decimals and fractions. Since per cent means by the hundredths, the students were taught to write 37 hundredths three ways:

1. As a common fraction, 37/100
2. As a decimal, .37
3. As per cent, 37%.

The pupils found per cent was used in many ways such as grades received in a spelling test, sales reduction on automobile tires, the rise in the cost of living, saving bank interest, and a statement in a geography book about 70% of the earth's surface.

The pupils' first lessons were to change common fractions to hundredths, find per cents of numbers followed by drills of writing decimals as per cent, changing per cent to decimals, solving word problems of finding a per cent of something, and using fractions to find a per cent of something. Some per cents were used so often in every day life affairs that the seventh grade group found it worthwhile to memorize their decimal equivalents. Included in these were such fractions as 1/5, 1/3, 1/2, 3/4, 3/8, 1/6, 5/8 and others.

The class's attention was called to the fact that all of anything is equal to 100 %. Everyday problems are solved in finding per cent-especially increase and decrease.

During the six-weeks period, one Jiffy Quiz (4) was given and at the end of this fourth six-weeks period Progress Test D was given.

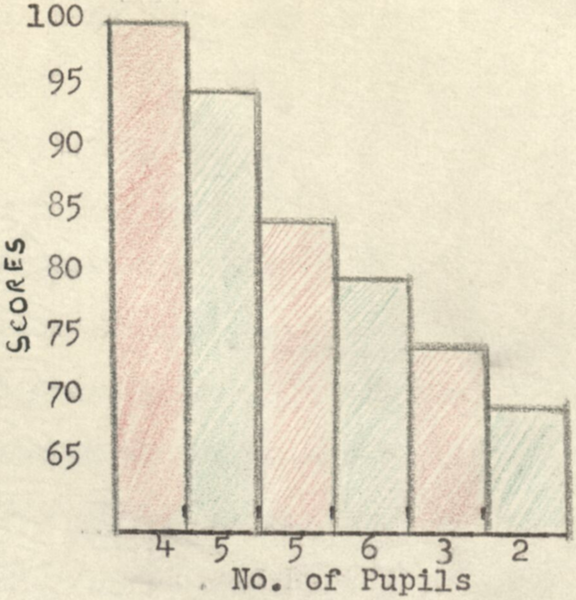


Fig. 3. Distribution of Pupils' Scores on Jiffy Quiz 4.

Fig. 3, which shows the distribution of pupils' scores on Jiffy Quiz 4, and Table II, (p.39) which is a comparison of scores made on the Progress Tests and the Jiffy Quizzes, both indicate that the pupils were making higher scores consistently. On Progress Test D, ten pupils made a score of 90 or above; on the Jiffy Quiz 4, nine pupils made a similar score. Here again, the median scores were 80 and 85, respectively. Only three pupils made below 75 on the Progress Test; no one scored below 70 on the Jiffy quiz.

The fifth six-weeks period was spent studying common measures. A Jiffy Quiz was given about the fourth week of this period and a Progress Test (E) was given at the end. Table II shows the scores made by the twenty-five seventh grade pupils on Progress Test E and Jiffy Quiz 5. Six pupils made a score of 95 or above on the Progress Test; four made a score of 90. On the Jiffy Quiz, 11 made a score of 90. Although no one made a score less than 60, there were two people making a score of 60. On the Progress Test, one person made 60, one 65, and one, 70. The median scores on the two tests were 80 for the Progress Test and 85 for the Jiffy Quiz.

The sixth period was spent in studying graphs (one week) and family budgets. Under the topic, graphs, such items were included as picture graphs, horizontal graphs, bar, vertical bar, line, and divided bar graphs. The class decided many numerical facts could be better understood by means of graphs. As a result, each member of the class brought to school a graph from a newspaper or magazine which explained an idea that could not be understood as well by words as by the graph. A Jiffy Quiz was administered at the end of the graph discussions.

The class spent the remaining weeks studying problems of every day life. After much discussion on the first day of this unit, the seventh grade group decided that nearly every member of the class was experiencing some economical difficulties because of the high cost of living. Consequently, they decided along with the teacher to work out a project on family budgeting on the basis of present day salaries for a family of five members. They decided that the salary of the head of the family should be $60 a week or $240 monthly. This budget was made for a family of five and was to cover expenses for a period of one year.

Each student of the class was to visit a family of five members, several times, carrying note book and pencil. They were to have extensive conversations with the household heads about such topics as family income and its distribution as to food, shelter, clothing, operating expenses, advancement, and savings. When they returned to class, they reported their findings. Each day, there were questions added to this unit such as "Do you think Mother should keep an account book?" This would be followed by class discussion.

Each member of the class made a chart showing how the family that they contacted divided its income on the percentage basis. The fifth week of this project the class was divided into committees of five each. There were five groups: one group worked on booklets, another on reports, another on Quizzes, the group on a typical chart for a family of five with an income of $240 per month or $2880 per year. The fifth committee evaluated the work of the class as a whole by writing a summary of all group activities that had taken place during the unit period. The sixth week of the period was used for reports by various committees. These activities were followed by Progress Test F.

Table II shows a comparison of the scores made by the pupils on Progress Test F and Jiffy Quizz 6. It will be noted that ten pupils made scores of 90 or above, seven of whom made 95 or above. No pupils made a score below 70 on the Jiffy Quiz; on the Progress Test, two made 70; 1 made 65; one made 60. The two median scores were 80 for the Progress Test and 85 for the Jiffy Quiz.

A further analysis of Table II reveals that on none of the tests did the scores go below 60. On several tests, there were perfect scores and near perfect scores. On Jiffy Quiz 5, evidently the test was too easy, for eleven pupils made 90, which was 44 per cent of the class or nearly half. On Progress Test F, nearly half the class (40 per cent) made 90 or above. In every instance, the median score of the Progress Test was 80; on the Jiffy Quiz, the median score was 85 with the exception of Jiffy Quiz 2, on which the median score was 80.

TABLE III. SCORES MADE ON PROGRESS TESTS BY TWENTY-FIVE SEVENTH GRADE PUPILS.

Pupil	A	B	C	D	E	F	Av Score
A	90	90	92	93	94	97	93
B	92	90	92	93	94	94	92
C	90	90	90	94	92	94	92
D	85	88	86	86	88	88	86
E	95	95	90	95	95	95	94
F	90	95	100	100	95	100	97
G	80	80	80	85	80	85	81
H	80	90	90	90	90	90	88
I	95	95	95	95	95	95	95
J	95	95	100	95	100	95	96
K	75	80	80	75	80	80	78
L	70	75	70	75	75	75	73
M	80	75	80	80	80	80	79
N	80	80	80	80	80	80	80
O	75	75	80	75	80	80	77
P	65	70	85	80	80	80	76
Q	75	70	75	75	75	75	74
R	75	70	75	75	80	75	75
S	85	80	75	80	80	80	80
T	90	90	90	90	95	95	91
U	95	95	85	95	95	95	93
V	75	75	75	75	75	75	75
W	60	60	60	60	60	60	60
X	60	65	65	65	65	65	64
Y	60	60	65	65	70	70	65

An examination of Table III indicates that students were more or less consistent in their scores on the Progress Tests. For example, Pupils A, B, C, E, F, I, J, T, and U except for one test, made scores of 90 or above on all six tests. Likewise, pupils scoring in the 60's did so consistently, such as Pupils W and X. Pupils N and V apparently could not get beyond 80 and 75, respectively, in either direction.

With the obvious bunching toward the higher end of the curve, one must look for possible reasons. One has already been suggested: too easy tests. Another reason might be that by employing the principles of learning and by applying the laws of growth and development the pupils, being highly motivated, learned and worked nearer to their capacity.

Table IV shows the scores made by the seventh grade class at Fisher High School on the second achievement test[1] which was administered in April, about the third week of the last six-weeks period. One outstanding fact that is quickly discernible is that nine pupils achieved above high school. Their educational age, in this instance, was 18 plus. On the first achievement test, one student achieved the eleventh grade; the ninth grade was the next highest educational

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[1]The achievement test was administered in accordance with the schedule of the State Department of Education.

TABLE IV. SCORES, AGE, AND GRADE PLACEMENT MADE BY TWENTY-FIVE SEVENTH GRADE PUPILS ON THE GRAY-VOLAM-ROGERS GENERAL ACHIEVEMENT TEST, APRIL, 1958.

Pupil	Sex	Age Yrs	Age Mos	Arith Reas	Arith Comp	Av Score	Ed Age	Ed Grade
A	M	12	10	94	73	84	15-0	9.9
B	F	12	7	97	90	93	18 +	12 +
C	F	12	11	97	83	90	18 +	12 +
D	F	13	11	54	51	53	10-0	4.8
E	M	13	1	94	70	82	15-0	9.9
F	F	14	9	57	48	57	10-6	5.3
G	F	15	1	51	42	47	9-6	4.4
H	M	13	2	89	59	74	12-9	7.6
I	F	12	9	95	86	92	18 +	12 +
J	M	13	10	94	78	81	15-0	9.9
K	M	12	10	97	90	93	18 +	12 +
L	M	12	10	90	76	83	15-0	9.9
M	M	14	7	48	43	46	9-6	4.4
N	F	12	10	96	90	93	18 +	12 +
O	F	13	3	76	50	63	11-1	5.9
P	F	13	1	96	85	91	18 +	12 +
Q	F	13	1	96	88	92	18 +	12 +
R	M	13	2	88	70	76	13-10	8.6
S	F	13	1	96	88	94	18 +	12 +
T	M	13	2	97	90	93	18 +	12 +
U	M	13	4	70	54	62	11-1	5.9
V	M	13	0	84	72	78	13-0	8.6
W	M	13	1	88	65	71	12-9	7.6
X	M	12	10	80	80	80	15-0	9.9
Y	F	12	10	75	70	72	12-9	7.6

grade placement. One student placed in the lower half of the fourth grade; two others placed in the upper half of the fourth grade. Three pupils placed in the fifth grade. Of the twenty-five students in the seventh grade, six failed to achieve the presently assigned grade level. This represents

24 per cent of the class; by contrast, 36 per cent of the class achieved above the twelfth grade. Sixty-four per cent of the class achieved above the assigned grade level on the second achievement test.

Fig. 4 and Table V show a comparison of the scores made by the pupils on the September achievement test and the April test. In only one case was there a negative result. The amount of increase in scores ranges from 0 to 26. There were only two cases indicating either no improvement or negative improvement. The average increase in scores was 10.8. This figure is also reflected in the difference in mean scores on the two tests: in September, the mean score was 65.4; in April, the mean score was 78.

The question arises: why or what accounts for this almost phenomenal increase? This question probably requires an involved answer, involvements which cannot be ascertained from the present study. Factors, such as health, home activities prior to the test, amount of sleep the previous night, breakfast (or the absence of it), personal anxieties, rapport with the examiner (a consultant administered the tests), the amount of forgetting that took place over the summer months, and physical conditions of the classroom would have to be considered. Insofar as the present study is concerned

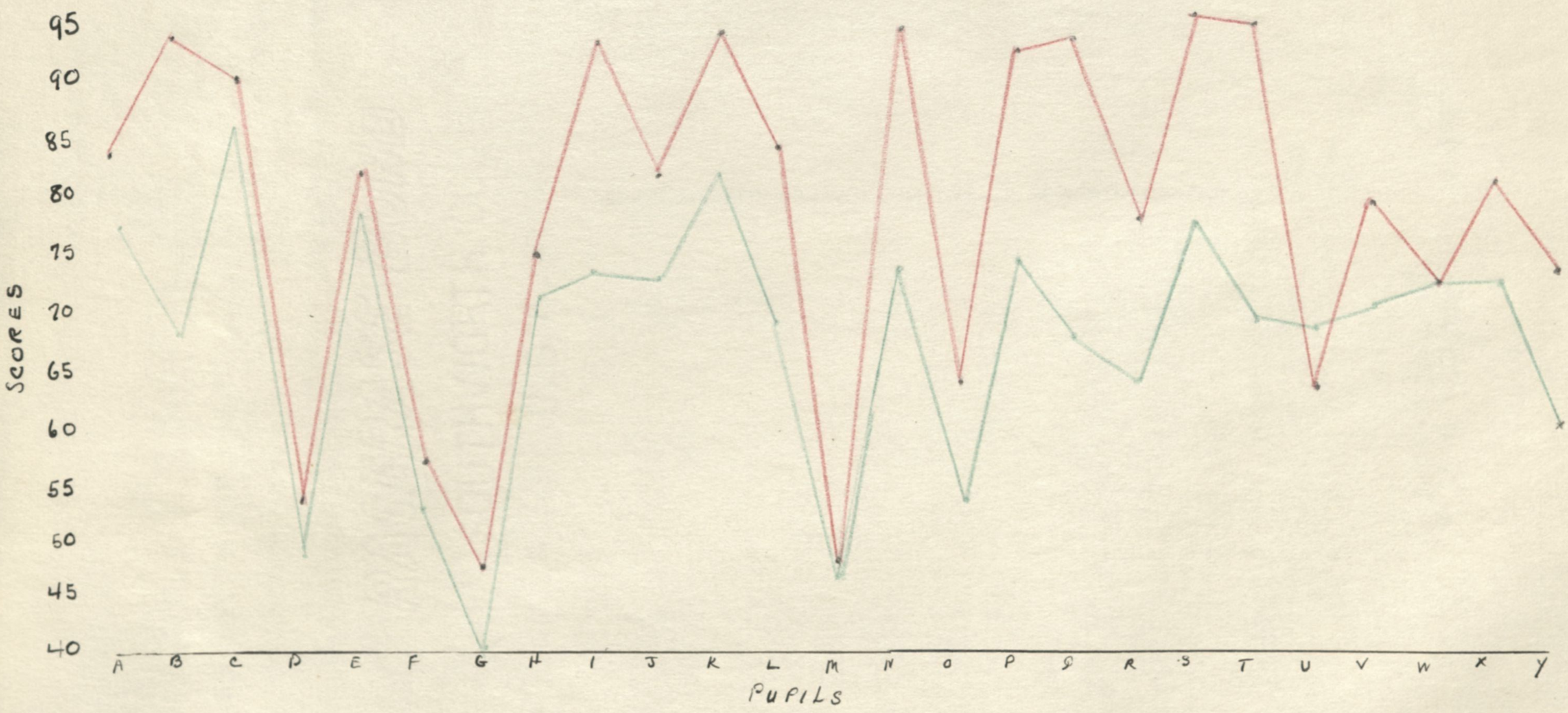

Fig. 4. GRAPH SHOWING COMPARATIVE SCORES ON TWO ACHIEVEMENT TESTS ADMINISTERED TO TWENTY-FIVE SEVENTH-GRADE PUPILS, 1957-1958.

TABLE V. COMPARISON OF SCORES ON TWO ACHIEVEMENT TESTS.

Pupil	Scores Sept	Scores April	Am't Progress
A	77	84	7
B	68	93	25
C	86	90	4
D	48	53	5
E	78	82	4
F	53	57	4
G	40	47	7
H	71	74	3
I	73	92	19
J	72	81	9
K	81	93	12
L	67	83	16
M	45	46	1
N	73	93	20
O	52	63	11
P	73	91	18
Q	66	92	26
R	63	76	13
S	76	94	18
T	68	93	25
U	67	62	-5
V	69	78	9
W	71	71	0
X	71	80	9
Y	59	72	13

the test scores reflect the methods and techniques used by the teacher in presenting the material to these pupils. She has applied the basic principles of learning,as set forth in Chapter I, to the teaching situation. By taking the pupils where they were and working with them more or less on an individual basis she was able to correct their faults and to strengthen their weaknesses; thereby, she helped them to build a stronger foundation in the basic mathematical operations and concepts.

CHAPTER IV

SUMMARY, CONCLUSION, ABD RECOMMENDATIONS

Summary

The purpose of this study has been to determine by means of various evaluative instruments the relative merits of certain motivational devices as applied to the teaching of selected topics in seventh grade mathematics. The teaching technique used was the unit method which embraced several approaches such as projects, group activities, individual reports, teacher and/or pupil-led discussions, and audio-visual aids. Twenty-five pupils, who comprised the seventh grade class at Fisher High School, Athens, Texas,were selected for this study.

Although the selected topics used in the present study were pre-determined by the local school administration and the State Department of Education through the selection of the textbook, Making Sure Arithmetic, it was possible within the prescribed limits to employ the designated teaching techniques.

The units covered included whole numbers, fractions, decimals, common measures, percentage, and graphs. The first unit, whole numbers, was a review which was found to be necessary because of the poor performance by these pupils on the first achievement test which was administered in September, 1957.

As a means of evaluating the progress made, the teacher gave a Jiffy Quiz once during each six-weeks period; at the end of this period, a teacher-made Progress Test was given. In April, a second achievement test was administered.

The results of the tests as shown in the accompanying tables and graphs indicate that the methods and techniques with the attending specific approaches used were effective. The pupils, with two exceptions, made definite progress: nine pupils jumped from the sixth and seventh grade levels to the twelfth grade and beyond within eight months, as determined by the scores on the achievement test given in April. Even though two children failed to indicate progress on this particular achievement test, other evaluative techniques might show different results. One hesitates to state that these children gained little or nothing during the thirty-six weeks that they were in class. Probably a better statement would be that the evaluation techniques used did not reach these pupils; therefore, other methods should have been explored.

Obviously, there are several factors operating in these results. First, the children were highly motivated. Second, the teacher took them where they were, corrected their deficiencies, thus giving them a very solid foundation upon which to build their new mathematical concepts and skills. Third, by varying an approach, the teacher was able to catch the interest of the class and to make the material life-related. Fourth, she was able, by means of the achievement test, which was used also as a diagnostic test, to adapt the material to the maturation level of the children, thereby providing for individual differences.

Conclusion

Teachers make the goals of education come to life for boys and girls in the classroom and other activities. Next to parents, the teacher exerts the most important influence on what kind of person the adolescent is now and what he will become later. Assumption of this responsibility means that the teacher must be competent as a director of learning, a counselor and guide, a mediator of the culture, and a cooperating member of the school, the wider community and the teaching profession. Thus, by recognizing the principles of learning and of growth and development of the individual child, a teacher can successfully motivate a class in mathematics. Also, by utilizing varied approaches, such topics as whole numbers, decimals, percentage, fractions, common measures, and graphs can be made interesting enough for children to like them and, in turn, like mathematics.

One may hope that as a result of this successful learning experience in mathematics that there have been uncovered some future mathematicians and scientists.

Recommendations

The teaching of mathematics has been undergoing a metamorphosis that seems to have a long way yet to go. One interesting study with seventh grade children would be to determine just how much new material a class could absorb when modern methods and techniques are used. There is a possibility that the children in this study, for example, could have handled much more advanced material than that which they were given.

A longitudinal study would be of much interest to determine the amount of carry-over from one grade to the next, when certain teaching methods have been employed. Does one method have a greater carry-over than another method?

A third area of interest would be to enlarge upon the methods used in this study and to employ more laboratory techniques. A study to determine the effectiveness of such teaching procedures would be of interest to teachers everywhere, for seventh graders very often are difficult to understand.

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