Fall 1980

A Mathematics Course of Study for the Fifth Grade Under-Achiever

Constance J. Pearson

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FOR THE

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Lindenwood IV
Fall 1980
Culminating Project

TABLE OF CONTENTS

TABLE OF CONTENTS

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INTRODUCTION

Our schools have been faulted over the past fourteen years for declining Scholastic Achievement Test scores in the basic skills, that is, math, reading and language arts.[1] This criticism is based upon "de-emphasis" on basics and the inclusion of too many "frills" in the curriculum. Proponents of the back-to-basics movement desire a return to the more traditional ways of teaching.

It is important to establish a factually defensible theory of what education is, to take the place of forever running a race of opinion as to what education ought to be.[2] Education should prepare a student for adaptability; that is, the capacity to meet a very wide range of adjustments as the need arises. The individual learns out of his experiences of life and is always becoming something, in some way different from what he was before learning took place.

The influences that guide educational planning range from the school districts' policies and philosophies to the policies and philosophies of the classroom teacher. Revisions require a vast amount of input, and an evaluation of this input would be very difficult when confronted with the various individual differences in the educational hierarchy. When these obstacles exist, it is very difficult to create ongoing curricula revision within a system designed for consistency and interdependence.[3]

Changing societal attitudes, needs and interests have brought about many of the revisions of educational goals, content and methods. Curricula must serve the needs of the community, but the history of education indicates that mistakes have been made in educational practices, and without effective family upbringing and instruction, education is as likely to go wrong as to go right.[4]

Content and curricula are basically the same in all districts and systems, but the pedagogical problems arise in programming, strategies and methods.[5] Though content and curricula are basically the same throughout our American school systems, there must be some differentiation in strategies and methods. The content selection for the underprivileged low-achieving student must also be based upon the student's needs, interests and previous learning experiences.

If a student is failing or is bored, it is the responsibility of the teacher to modify the curriculum, the classroom structure and/or their own behavior in order to build a program that makes sense to the students. This skill and ingenuity in modification will provide the students with the experiences, resources and support they need to develop their sensitivity, compassion and intelligence.[6] The ability to determine the students' skills and needs and to build a learning environment based upon them is crucial to the learning atmosphere. Nurturing the growth of learning will stimulate the learning process.

It is, therefore, the intent of this paper to analyze the processes of mathematics curriculum development and to propose a course of study for the elementary middle grades, primarily the fifth grade. The proposed model will be for the underachiever but will be adaptable to a fourth grade enrichment program or a sixth grade remediation program.

CURRICULUM AWARENESS: AN ESSENTIAL NEED

We live in a technical age, in which science and mathematics occupy a leading position in the educational scheme. Arithmetic is becoming more and more important to people in their daily lives. It, therefore, is one of the major responsibilities of the elementary school to provide children with a proper

foundation in arithmetic. To do this, it is essential that teachers acquire a background of understanding and skill in facts, processes and application of arithmetic.[7]

There are other reasons for demanding increased competency in arithmetic. New developments in human growth, theories of learning and content within the field of mathematics necessitate changes in teaching and curricula design. These changes should retain the best of our present program and incorporate the desireable features from the expanding knowledge in the new areas before - mentioned.

Historically, the teaching of arithmetic has proceeded through three stages:

1. Drill Theory
2. Incidental (Activity) Theory
3. Meaning (Discovery) Theory

During the first part of the twentieth century, the drill theory of teaching arithmetic prevailed. Problems were difficult and processes were complex. The rationale for this theory was to "train pupils to think." Generally the arithmetic class was a period of almost pure drill. Little attention was given to meanings of facts and processes because adult performance in arithmetic required automatic responses and this same competence was expected of children.[8] The Child-Study Movement challenged this procedure of drill and some modern schools were set up based upon the movement.

The social aspect of arithmetic became evident during the mid-twenties. A group of private schools organized and was called the Progressive Education Association. This group introduced unit teaching activity and child-centered learning. These theories were not accepted in most public schools because teaching was incidental and there was no organization of arithmetic experiences,

specifically for the primary grades. By 1935, these theories, too, were challenged and considerable evidence was available to indicate the need for meaningful and planned teaching.[9]

Since 1935, research findings have increasingly indicated that meaningful teaching leads to greater retention over a longer period of time, greater transfer potential and greater ability to solve new processes independently.[10] However, with society becoming increasingly more technological, by 1950 much of what was taught in elementary and secondary schools was out of date. So many minor revisions had been made that school subjects had lost the identity they once possessed.[11]

Societal and technological changes during the late fifties created a fervor that initiated curriculum assessment and designing. A curriculum reform was begun, and along with the national interest in upgrading content, there was an increase in SAT scores until 1964.[12] It was during this period that the concept of modern math was introduced into the public schools' curricula. The increasing need on the part of scientists and social scientists for competence in the "new" mathematics as well as increased recognition of the subject's intrinsic importance in a technological society gave double impetus to curriculum studies. During the late sixties and early seventies, teachers, administrators and curriculum specialists set about revising goals, objectives, content and methods. The programs that evolved seemed to lack continuity, cohesiveness and success which was indicated by a decline in SAT scores.

Consequently, the "back-to-basics" movement became the cry of those concerned with quality public education. We are presently experiencing an innovation in curricula planning which may lead us to uniformity and consistency in the

"back-to-basics" movement. The current return to basics is a theory based upon a combination of the three stages of teaching strategy: drill theory, incidental theory and meaning theory.

Some members of our society may feel that education is returning to the traditional method of instruction, but, in effect, the combination of theories provides teachers with the flexibility to reach the individual student's needs and interests. The movement, therefore, will enhance the possibility of developing a curriculum which will suggest methods of instruction necessary to provide for individual differences.

A return to the basics could very well determine the educational progress of our students and create an upswing in SAT scores that have been showing a steady decline.

STATEMENT OF PROBLEM

Before major changes are made within the curricula, it is important to explore where we are presently positioned in our efforts to provide quality education. If the innovations in curricula are not carefully planned, they cannot be effectively implemented. Without effective planning and implementation, there will be no realistic improvement in the quality of education.

Ralph W. Tyler (1949) proposed four questions that are important in the development of curricula:

1. What educational purposes should the school seek to attain?
2. What educational experiences can be provided that are likely to attain these purposes?
3. How can these educational experiences be effectively organized?
4. How can we determine whether these purposes are being attained?[13]

The questions serve as guidelines to a total school district curriculum, an individual school curriculum or a curriculum developed by a classroom teacher. Using Tyler's questions as determinants, objectives, content, methods and evaluation are selected. The rationale for the selections must be within the framework of the educational philosophy of the district and the school.

Curriculum and teaching processes must translate "knowledge" into thought forms and experiences characteristic of the learners. Both the meanings on which generalizations are built and the situations to which they are to transfer must be real to the students.[14] Teachers must create reality experiences at both ends of the process: generalizations and principles and point of application.

The traditional classroom places the teacher in a position of managing a large number of students who are expected to master a preset and inflexible curriculum. The mastery of the curriculum is presumably achieved by the movement through textbooks and workbooks. This method of instruction creates an almost insurmountable problem; the slower students and the faster students are paced at the same rate as the average student who is usually in the majority is a heterogeneous class. Usually no provisions are made for individual differences because everyone is doing the same thing. The model curriculum that I've designed does provide for individual differences.

Innovative teachers try to modify the curriculum in order to improve their effectiveness with their students. This curriculum provides an opportunity for innovations and flexibility. However, many administrators frown upon these modifications and consider the teacher who implements them a "poor" teacher. We hope this curriculum will be effective enough to cause

administrators to be more receptive to innovations.

A teacher should be allowed to reconstruct the curriculum, redesign the environment and change his or her own behavior so that students will have the opportunity to develop to full potential in all areas of educational growth.[15] This is considered a child-centered teaching strategy. It gives the teacher an opportunity to observe and discover students' skills and needs and build a learning environment that grows from them. Teacher growth is also important. Teachers should engage in a constant process of experimentation with different strategies and methods. These are aspects of curriculum development that curriculum designers must keep in mind and they have been considered by this author.

There are basic principles which precede all methods, and they are modified only in degree by the characteristics of the learner, the content and the knowledge and skill of the teacher. These principles must be incorporated into the teaching process. Without an understanding of the teaching-learning process, the strategy of teaching does not necessarily culminate in students' learning because the selected methods may not be appropriate. The quest for higher levels of achievement involves the selection of the right learning experiences for students and setting the learners' minds in motion so that they may actively participate in the learning process.

There are no proven right or best methods of instruction.[16] It is for this reason that this curriculum has used many different approaches in implementing the objectives. Probably certain kinds of objectives, such as those concerned with the development of values, attitudes, appreciations and sensitiveness, are more dependent upon the methods used than on the content. A statement of objectives which includes different types of objectives is likely to require

a variety of methods for its achievement. This increases the possibilities of learning for the pupils, since all pupils do not learn best by the same methods.

The current methods utilized in the implementation of curricula should be analyzed:

1. Receptive Method - This is a method that places the teacher in the role of central position, leading, directing and controlling all that goes on within the classroom.[17]
2. Active Method - In the early grades, this method usually involves physical activity. However, in the later grades, the active method could be a personal rediscovery of truth-interior and abstract reflections.[18]
3. Intuitive Method - This method of instruction provides students with speaking-visual representation, either of objects or events themselves, or of the result of possible operations. These audio-visual aids are good only if used as accessories.[19] Learning operations are not reduced to perceptual or visual "forms".
4. Programmed Method - This method is based upon the stimulus - response view. Variable inputs (stimuli) produce observable outputs (response), and then determine the direct relationships between them. If teaching machines are sufficiently well-programmed, they will produce better results than an oral method of teaching.[20]

All of the above methods are incorporated into this curriculum model.

The phases of curriculum development span many concerns:

1. Curricula designs are too static for a dynamic society.
2. There is little interrelationship or integration within the designs.
3. Objectives are usually merely statements without provisions for implementation.
4. The curriculum designers do not provide for an efficient flow from objectives to daily practice.

The forms of this curriculum model addresses all of the above problem areas.

RATIONALE

My awareness of the limitations in the area of curriculum design inspired me to create a curriculum model for the fifth grade under-achiever. The model is a flexible design based upon the objectives required for mastery in the Missouri public school districts. The sequence of objectives was based upon the Basic Math Skill for Missouri Students, Missouri Department of Elementary and Secondary Education, 1977.

The importance of this curriculum is to show various methods of implementing the objectives. The curriculum design provides the option of using large group processes, small group processes and individual instruction processes. In designing this curriculum, the author is implementing procedures that Tyler (1949) proposed in Basic Principles of Curriculum and Instruction. Tyler's four questions which were explored in the introduction were used as guidelines for the selection of objectives, educational experiences to be provided, organization of these experiences and evaluation methods. All of these selections were made within the framework of the educational philosophy

of the district and the school.

Value activities were suggested throughout the curriculum in order to provide the teacher with an opportunity to reach the affective domain of the students (Bloom, 1956). Behavioral objectives are evident in both the cognitive and affective domains of this course of study. Four educational ideas strongly influenced the creation of this curriculum model:

1. Learning involves progressive changes in an individual's behavior directed toward acceptable goals and influenced by experience.
2. Learning takes place when there is a problem and the individual seeks a satisfying solution.
3. Learning is a function of "readiness" to learn. It is a function of the mental, physical emotional, educational and social maturity of the learner.

With all of the above points considered, the evaluation process for each objective was carefully designed to evaluate only those areas in which students had received instruction. Anecdotal records may be kept for the purpose of evaluating attitudes, interests, sensitivity, etc.

The entire curriculum is based upon the educational philosophy of the author who believes all children should be provided the opportunities, experiences and activities that will develop their potential in the educational processes. In the area of mathematics, it is the purpose of teachers to develop mathematical abilities necessary to solve problems of daily living, now and in the future. This development will enable students to appreciate and/or understand the discoveries of a technological society. This curriculum will meet the needs of students, provide them with a variety

of learning experiences and help them to reach full potential.

Mathematical Objectives: Processes, Skills and Concepts

The student can:

1. Use and understand mathematical terminology, i.e., addends, minuend, subtrahend, etc.
2. Demonstrate his knowledge of place value by writing numerals in expanded notation.
3. Read and write nine - place numerals.
4. Add whole numbers with re-naming. Average a given list of addends.
5. Subtract whole numbers with re-naming.
6. Multiply whole numbers to include two-digit multipliers.
7. Divide whole numbers to include two-digit divisors.
8. Continue, in writing, a given number sequence.
9. Use and interpret mathematical symbols, i.e., $=$, $\neq$, $>$, $<$, etc. Read and write Roman numerals through 100.
10. Indentify numerators and denominators when given a series of fractions. Knows and determines numerators and denominators.
11. Write and illustrate equivalent fractions and write and compute simplest forms of fractions.
12. Add and subtract like fractions.
13. Write measurement equivalents in linear, dry, liquid, time and temperature measurements.
14. Construct and recognize simple geometric figures. Knows fundamental geometric terminology.
15. Read and construct charts, graphs and tables.
16. Use all of the above skills to solve and construct word problems related to everyday situations.

UNIT I

UNIT I

Objective 1: The student will demonstrate, through use and comprehension, the knowledge of mathematical terminology appropriate for fifth grade. Suggested time - 1 week.

Rationale: The use of math terms is a part of all textbooks and the knowledge of them enhances the understanding of concepts.

Content: Mathematical names for the terms of the four fundamental processes.

Introduction of the mathematical terms in the fundamental processes is made by the teacher. These terms will include addend, sum, minuend, subtrahend, difference or remainder, multiplicand, multiplier, factor, product, divisor, dividend and quotient. As new concepts are introduced, new terms will augment the list. This introductory process is the same for all group processes. Suggested time - 30 minutes.

Activities

Large Group Process

The entire class will be taught the above listed terms. The teacher will write the terms and definitions on the chalkboard. Problems will be written by the teacher to illustrate each fundamental process. Each numeral in each problem will be labeled with the appropriate term:

Example:

2	addend	4	minuend
+ 2	addend	- 2	subtrahend
4	sum or total	2	difference or remainder

2 quotient

2 multiplicand divisor 2) 4 dividend

factors

x 2 multiplier 4

4 product

The above illustrations should be copied from the chalkboard into math composition books that have been provided by the teacher. After notes are copied, all labels on the chalkboard should be erased. The teacher will conduct an oral discussion and ask for volunteers to assist in re-labeling the numerals that have remained on the chalkboard. Definitions will be re-inforced during this activity. Suggested time - 20 minutes.

Small Group Process

After the introductory presentation, the teacher will divide the class into groups of two's. Cards that have been prepared, using index cards, will have a term or numerical illustration on each card. It will be necessary to make several sets of cards for an entire class.

Each student will be dealt four cards by his partner and the partner will have four cards. The remaining cards are placed face down in a stock pile. Each student, in turn, draws a card and discards one. The partner may draw a card or pick up the card last discarded. The object of the game is to match the appropriate terms of a process. The game is played like Rummy.

Example:

Paired Label Game (2 players)

Cards for the addition process -

(2) + 2 4	2 +(2) 4	2 + 2 (4)	addend	addend	total or sum
addend	addend	sum			

Any combination of two addends and a sum, either numerals and/or terms constitutes a three - card spread and the fourth card would be discarded. The bonus for making a three - card spread could be set at 25 points plus 5 points for each card in the opponent's hand. Six cards for each process would be made, as in the example for addition. Suggested time - 20 minutes.

Math Match Game (2 - 6 players)

The same set of cards used for the Paired Label Game may be used for this game. As new terms are introduced, more cards are added to the deck. A playing board is necessary for this game. (See Appendix A)

Cards are shuffled and turned face down on each space on the gameboard. The remaining cards are placed face down in the center of the board marked cards. The students take turns turning a card up on the board spaces. If a student matches an up-turned card on his turn of play, he scores the sum of the numbers in those spaces. The matched cards are turned face down in the section marked used cards. Two cards are taken from the card stock pile (cards in center) and placed face down to replace those cards that were matched and removed from the spaces on the board. Play continues until a pre-determined score is reached. Cards in the used card pile may be re-shuffled and used again during the course of the game. Suggested time - 30 minutes. The teacher will monitor all small group activities.

Individual Instruction Process

Individual students will make up their own problems, work them and label the numerals with the correct terms. Suggested time - 20 minutes.

The teacher will use large flash cards with a fundamental process on each card.

A numeral will be circled on each card, and the individual student will respond with the correct term that corresponds with the circled numeral. Suggested time - 20 minutes.

Values Activities

The teacher will equate mathematical processes with families. Emphasis is placed upon the fact that the names of mathematical family names do not change, but family names may vary according to emotions, family rank, rapport, etc. We have mathematical families and each member has a name but it remains the same, e.g., the Addition Family has members whose names are addends and sums or totals. There may be several members of the Addition Family because there may be several addends. The teacher may ask students, "How many members are in your family?" After responses from several students, the teacher could explain the relationship between addends and members of a family. The family name would represent the sum or total.

To explain how the names in a family change according to rank, order, relationship, etc., the teacher will construct a chart for students to fill in to show how names may vary within families but remain constant in math.

Example:

	First Name	Family Name	Nickname	Name you call them when angry	Name you call them to show love
Father					
Mother					
Sister					
Brother					

Suggested questions:

1. Do your father's friends call him the same name as you do?
2. What is the name that someone calls you that makes you feel good? feel bad?
3. What is the name of the subject you like best? Why?
4. What is the name of the activity you like best?
5. Do you like family, friend or individual activities? What is the name of this activity? Why do you like this activity?

This exercise is optional and may be used as a motivational tool or a follow-up exercise to the introductory lesson. It should, however, be used before evaluation.

Evaluation

The teacher will prepare a test constructed on the same general format used in the introductory lesson. Problems will be written on ditto sheets and passed to students. The students will work the problems and label all numerals with the correct terms. Students who do not master 80% of the terms will have individualized programs and activities developed for them by the teacher.

UNIT II

UNIT II

Objective 2: The student can demonstrate his knowledge of place value by writing numerals in expanded notation. Suggested time - 2 weeks.

Rationale: This is one of the skills required by the state of Missouri before the fundamental processes can be adequately taught.

Content: Place value and reading and writing multi-digit numerals.

The introductory lesson to the entire class will consist of an explanation of the base ten number system. A teacher directed discussion will emphasize the meaning of each digit in a two-digit numeral and show expanded notation. This discussion in successive lessons will progress through nine digits. Suggested time - 20 minutes.

Large Group Progress

Have students count off by one's until ten is reached. This counting will progress from child to child. Have the first group of ten children go to a designated area in the room. Continue having the students count through another group of ten, send them to another area in the room. Proceed until each child is in a group. Suggested time - 20 minutes

Suggested questions:

1. How many groups of tens do we have?
2. How many students are left who are not in a group of ten?
3. What place value does the group, which is not in a group of ten, represent? They will represent ones or units.

The teacher will demonstrate the use of an abacus to the entire group. Only the place values for ones through hundreds will be illustrated at this time. Learning place value seems to develop more readily when taught in periods. Periods are the groups of three digits separated by commas in a multi-digit numeral.

Example:

periods	billons	millions	thousands	hundreds
	1,	2 3 4,	5 6 7,	8 9 0

Suggested time - 20 minutes

Small Group Process

A large chart will be prepared by the teacher that illustrates the position of rings on an abacus to show different numerals. The illustrations on the chart will correspond with the numerals that have been prepared by the teacher on cards. The numerals on the cards will be passed to each child. Each card will be numbered and illustrations on the chart will be numbered to match each card. This will be a self-checking device.

Children will be assigned to groups of three or four. Each group will have an abacus. Each child within the group will show, through the use of the abacus, the number on his assigned card. Each child in each group will record the numerals of all the members in his group and write the expanded notation of each numeral. Suggested time - 30 minutes.

Individual Instruction Process

Popsicle sticks, straws or tongue depressors may be used to illustrate units or ones, tens and hundreds. When ten units or ones are counted, explain to

student that these are combined to form a group of ten. Several groups of tens will lead the teacher into subsequent lessons of multi-digit numerals. Suggested time - 30 minutes.

Discussion will evolve through these activities that will explain the changing of the meaning of a digit according to its position in the numeral. There are values placed upon people in different positions also. The position that a person may hold in another's life determines the value placed upon that person.

Value Activities

Suggested questions:

1. What place value would you like to share with a friend? (Ones' place - very special; tens' place - somewhat special; hundreds' place - not too special)
2. List five of your friends and put their names in the ones, tens or hundreds column.
3. If you were to take a trip, what places would you value most as places to visit? the least? Why? Label places 1, 10 and 100 with 1 being the most desired places and 100 being the least desired places.
4. Create a budget for your trip.

Evaluation

The teacher will design a test having a chart that has a list of three-digit numerals; the students will record the numerals in expanded notation. Numerals will be written in expanded notation and students will record them in standard form. (See Appendix B) Those students who do not master 80% of the item on the test will have an individualized program developed for them by the teachers.

UNIT III

Objective 3: The student can read and write nine-place numbers.

Suggested time - 2 weeks.

Rationale: This is a necessary skill for everyday living.

Content: Reading and writing nine-place numerals.

Introduction of the next period of the number system (thousands) will be presented to the entire class. Thousands, ten-thousands and hundred-thousands will be taught and illustrated at the chaldboard. Suggested time - 20 minutes.

Large Group Process

Call upon students to come to the chalkboard, one at a time, to write a numeral that is dictated by the teacher. Another student will be asked to come to the chalkboard to label each numeral with its correct place value. Suggested time - 20 minutes.

Small Group Process

Use the same Small Group Process as in Objective 2 (use of the abacus). Suggested time - 20 minutes.

Individual Instruction Process

Use the same process as in Objective 2. Suggested time - 30 minutes.

Value Activities

We all put values on things. All of our personal possessions have values assigned to them. Make a list of your personal possessions; include anything that you wish. Pretend that you have $250.00 with which to buy insurance for your possessions. Check your list and place a monetary value on each item

listed. You need not insure an item for its full value. Have students share and compare lists.

Evaluation

Teacher will construct a test. (See Appendix C) The students who have not mastered 80% of the items on the teacher-made test will have individualized programs and activities developed by the teacher.

UNIT III

Objective 4: The student can add whole numbers with re-naming through hundreds. Suggested time - 2 weeks.

Rationale: The fundamental processes are skills included in the BEST which is a state required test.

Content: Addition of whole numbers with re-naming. Averaging will be included.

Introduction of the lesson will be presented to the entire class. A brief discussion will be held on previous lessons which involved place values. The teacher will write two-and three-digit addends on the chalkboard. Groupings of ones to make tens and groupings of tens to make hundreds will be explained. Suggested time - 30 minutes.

Example:

Tens	Ones
3	7
2	4
5	11

Tens	Ones
5	1

Tens	Ones
5 + 1	+1
6	1 = 61

Follow the same procedure for three digit numerals.

Large Group Process

Several problems will be illustrated at the chalkboard by the teacher. After several problems have been worked with two-and three-digit addends, the teacher will call upon a few students to come to the chalkboard to work some problems. Students who have not worked problems at the chalkboard will be called upon to correct errors or agree with written answers on the chalkboard. Place value and expanded notation will be an integrate part of this exercise in

order to re-inforce previous lessons. Suggested time - 30 minutes.

Small Group Process

Divide students into small groups of two to six. Play the following game.

Roll A Sum (2 - 6 players)

Game equipment:

a) Two cubes with the numerals 13, 14, 16, 16, 17 and 18 on the faces of the cubes.

b) Two cubes with the numerals 17, 18, 27, 28, 29 and 37 on the faces of the cubes. (Any numerals may be put on the faces of each set of cubes. The object is that the sums involve re-grouping or re-naming.)

c) Two or more Roll-a-Sum gameboards. (See Appendix D)

d) Markers - beans, corn buttons or disks.

Directions:

1. To start the game each player rolls one of the dice. The player with the largest number appearing on the top face of his thrown dice plays first.
2. On his turn, a player selects two of the four dice and rolls them on the playing area. The sum of the two numbers appearing on the top faces of the thrown dice is covered on the player's gameboard. If the sum is already covered, the player loses a chance to cover a square.
3. Players take turns rolling the dice.
4. Play continues in this manner until one player has either four markers in a vertical row or five markers in a horizontal row.
5. Variations:

   a. Cover entire board.

c. Cover a "T" (top horizontal row and middle vertical row).

Suggested time - 30 minutes.

Individual Instruction Process

The teacher will prepare worksheets for students to work independently. This worksheet will be based upon the introductory lesson which explained changing a numeral over nine into one more of the next higher place value and leaving the extras. (See example in the introductory lesson.) Expand the lesson to three-digit addends with re-naming of ones and tens. Suggested time - 20 minutes.

Value Activities

The addition process means more and, in many cases, it is believed that more of anything is better than less of it. Teacher leads discussion on this belief. Is more always better?

Exercise 1: Indicate by a check in the appropriate colum whether more is better or worse. Suggested time - 20 minutes.

	BETTER	WORSE
1. Rest		
2. Weight		
3. Crime		
4. Population		
5. Family		
6. Cigarettes		
7. Love		
8. Television		
9. Money		
10. Reading		

Exercise 2:

a) Which people, when they are "added to" you (in your company), increase your self-value or self-esteem? List their names and tell why.

b) Do you arrange your time so that you spend more time with the people who add value to you? What do you do together? Suggested time - 20 minutes.

Averaging

Large Group Process

Averaging will be taught using the large group process. The teacher will teach the entire class after the lessons and activities on re-naming have been completed. The teacher must be reasonably sure that most of the class has grasped the concept of re-naming.

The teacher will write several problems on the chalkboard. These problems will consist of one-digit addends written in columns with no sum exceeding three digits. Volunteers will be solicited to come to the chalkboard to work the problems.

Students at the desks will be asked to give the place values of different digits in the various problems (re-inforcement). Other students will be asked to count the number of addends in each problem. Addends should not exceed nine in number.

In the process of designing the problems, make sure that all sums are evenly divided by the number of addends. Illustrate the addition process and then the division process. Begin with two addends and gradually increase the number of addends until the process is understood. Have worksheets for

practice after instruction. Suggested time - 40 minutes.

Evaluation

A teacher prepared test based upon the introductory lesson and activities will be administered. Re-naming ones and tens and averaging will be included in the test items. Students who do not master 80% of the test items will have individualized programs and activities developed for them by the teacher.

UNIT III

Objective 5: The student can subtract whole numbers with re-naming through hundreds. Suggested time - 2 weeks.

Rationale: This is one of the skills tested on the BEST. It is one of the fundamental processes necessary for sequential learning.

Content: Subtraction of whole numbers with re-naming.

Introduction of the lesson will be presented to the entire class. Place values will be reviewed. The teacher will write two-digit minuend and two-digit subtrahend problems on the chalkboard. This lesson will be expanded to three digits in the minuends and subtrahends.

Groupings will be illustrated to show the concept of borrowing. Explain the correlation between borrowing and carrying when numerals are re-grouped.

Example:

$$\begin{array}{rcll} 51 & = & 50 + 1 & = 5 \text{ tens} + 1 \text{ one} \\ \underline{-\ 32} & = & \underline{30 + 2} & = \underline{-3 \text{ tens} + 2 \text{ ones}} \end{array}$$

Explain that the minuend does not have enough ones so we must borrow one ten in order to subtract the numeral 2.

$$\begin{array}{rcl} 4 \text{ tens} + 1 \text{ one} & = & 4 \text{ tens} + 11 \text{ ones} \\ -3 \text{ tens} + 2 \text{ ones} & = & \underline{-3 \text{ tens} + 2 \text{ ones}} \\ & & 1 \text{ ten} + 9 \text{ ones} = 19 \end{array}$$

Demonstrate the concept of the numeral 51 being the same as 4 tens and 11 ones. (Use cuisenaire rods, popsicle sticks, pegs, etc.) Expand the lesson to include more digits in both the minuend and subtrahend. Suggested time - 40 minutes.

Large Group Process

Students will work several problems at the chalkboard. Students at the desks will check the problems on the chalkboard. This checking will be done on paper at the desks. This will also re-inforce the addition skills previously learned. Put a teaching emphasis upon zeros in the minuend.

Example:

A. 600
- 352

Instruct students that it is impossible to borrow from the zeros, so they must move to the left until they reach a numeral that is not zero. In Example A the student would be instructed to move left until the 6 is reached. He then borrows one ten from 60 tens leaving 59 tens. After re-naming the problem would look like this:

Example A

59 tens + 10 ones = 59, ~~60~~0
-35 tens + 2 ones = -352
24 tens + 8 ones 248

or

5 hundreds + 9 tens + 10 ones
- 3 hundreds + 5 tens + 2 ones
2 hundreds + 4 tens + 8 ones

Example B

607
-389

59 tens + 17 ones = 59, ~~60~~7
-38 tens + 9 ones = 389

or

5 hundreds + 9 tens + 17 ones

-3 hundreds + 8 tens + 9 ones

2 hundreds + 1 ten + 8 ones = 218

(this is a very important concept because students have a tendency to subtract a zero in the minuend from the digit in the subtrahend.)

Students at their desks will continue to work problems along with those who are at the board. The teacher will monitor students at desk and spot check to see if the concept is being internalized.

Small Group Process

After the introductory lesson, the class will be divided into small groups. Several gameboards and problem cards will be prepared prior to this activity. (See Appendix E) Provide each student with scratch paper.

Lotto Game

Game equipment: Gameboards, problem cards and markers.

Directions:

1. Divide the class into groups of six students. In each group there is one "caller-checker" and five players.
2. The caller holds up a problem card. (this card will have an answer to a subtraction problem on the gameboards). The five players will look over their Lotto cards to see if the answer to any of their problems have a corresponding answer with the numeral card held up.
3. If a player has such an answer, he places a marker on the problem.
4. The winner is the first player to cover "three in a row" or the first player to cover his whole card. The caller-checker must check all problems on the winning card before he declares a winner. Suggested time - 30 minutes.

Individual Instruction Process

Worksheets will be passed to students to work exercises individually as practice sheets. The outcome of this exercise will determine whether or not the lesson needs to be re-taught. Suggested time - 20 minutes.

Value Activities

The subtraction process means less than. The belief that less than means worse is a misconception. There are cases where less is better. Teacher asks, "Can you think of any instances where less or fewer is better?" After several responses, there will be discussion among students. The teacher will not evaluate responses or discussion. Prepare worksheets for Exercises 1 and 2.

Exercise 1: Indicate by a check in the appropriate column whether less or fewer is better or worse. Suggested time - 15 minutes.

PROBLEM	BETTER	WORSE
1. Family activities		
2. Homework		
3. Children in family		
4. Money		
5. Time for play		
6. Activities with friends		
7. Rooms in your house		
8. Time to be alone		
9. Conversation with parents		
10. Time with younger brothers or sisters		

Exercise 2:

a) Which friends do you have who make you feel less important than you like to feel? What do they do to cause you to feel less valued as a person?

b) On a scale from 1 - 10, list the names of the friends, one beside each number. Write the name of the friend who makes you feel most important beside number 1 and the name of the friend who makes you feel least important beside number 10. Suggested time - 30 minutes.

Evaluation

A teacher prepared test will be administered to determine mastery of the subtraction process. Students who do not master 80% of the test items will have individualized programs and activities prepared for them by the teacher.

UNIT IV

UNIT IV

Objective 6: The student can multiply whole numbers to include two-digit multipliers and multiplicands. Suggested time - 3 weeks.

Rationale: This skill is one of the fundamental processes necessary for sequential learning.

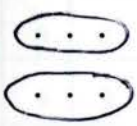
Content: Multiplication of whole numbers.

Multiplication of whole numbers with one- and two-digit multipliers and multiplicands.

Introduction of the lesson will demonstrate the relationship between addition and multiplication. Demonstrations will be shown at the chalkboard by the teacher. After several teacher demonstrations, several students will be asked to come to the board to write single digit multiplication problems and their related addition problems.

Students at the desks will work similar problems and the teacher will "spot check" to determine their comprehension. Arrays will be drawn on the chalkboard to show the difference between groupings. Suggested time - 30 minutes.

Example:



Two groups of three or two times three (2 x 3)

Three groups of two or three times two (3 x 2)

The multiplier tells the number of groups and the multiplicand tells how many there are in a group. The teacher will explain the commutative property of multiplication which also applies to addition. The commutative property of

each operation shows that the order of any two numerals in either operation does not alter the answer.

Example:

$2 + 3 = 5$ and $3 + 2 = 5$

$2 \times 3 = 6$ and $3 \times 2 = 6$

Large Group Process

The teacher will draw a ten-by-ten multiplication grid on the chalkboard. Certain numerals will be filled in; the choice is the teacher. The students are asked to volunteer to complete the chart.

Example:

MULTIPLIERS

MULTIPLICANDS										
X	1	2	3	4	5	6	7	8	9	10
1	1	2	3	4	5	6	7	8	9	10
2	2	4	6	8	10	12	14	16	18	20
3	3	6	9	12	15	18	21	24	27	30
4	4	8	12	16	20	24	28	32	36	40
5	5	10	15	20	25	30	35	40	45	50
6	6	12	18	24	30	36	42	48	54	60
7	7	14	21	28	35	42	49	56	63	70
8	8	16	24	32	40	48	56	64	72	80
9	9	18	27	36	45	54	63	72	81	90
10	10	20	30	40	50	60	70	80	90	100

After completing the chart, students will be asked to discover patterns in the array. Suggested time - 40 minutes.

Small Group Process

Divide the class into small groups of two to four preferably, but as many as six will be acceptable.

Game equipment:

Gameboards and playing cards with answers for each of the spaces on the gameboards. (See Appendix F)

Directions:

Each player gets ten cards (2 - 4 players) or seven cards (5 - 6 players). One card is placed by the player to the left of the dealer anywhere on the board. Each player then has a turn in playing one of his cards, but his card must in some way touch another card on the board. If he cannot play with the cards in his hand, he must draw from the cards in the stock pile. If there are no cards in the stock pile the player must pass his turn. The first player with no cards left in his hand is the winner. Suggested time - 30 minutes.

Finger Computations

The two following exercises apply to multiplication by 9 only.

Exercise 1: Assign numbers to the fingers of each hand, as shown.

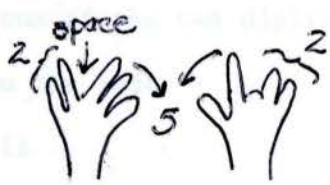
left right

To multiply 9 x 6 - turn down the finger assigned number 6. The answer 54 is now shown on the hands. Five fingers to the left of the down finger and four fingers to the right of the down finger give the answer 54. Suggested time - 30 minutes.

Exercise 2: Use the same finger assignment as in Exercise 1. This exercise shows how to multiply a two-digit numeral by 9.

The ten's digit in the two-digit numeral must be less than the one's digit. For example, to multiply 9 x 28, create a space after the finger assigned the numeral in the tens place of the two-digit numeral, in this case it would be two. Put the finger down that is assigned the numeral in the one's place, in this case it would be 8. Record the product in terms of groups of fingers.

Example:



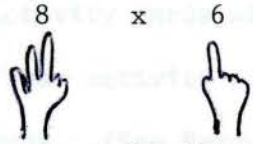
Suggested time - 40 minutes

Exercise 3: To multiply any two numbers between 5 and 10, such as 8 x 6. The closed fist represents 5, one finger raised is 6, two raised is 7, etc. - - - - 5 raised is 10.

To multiply 8 x 6, show 8 on one hand and 6 on the other. To find the number of tens in the product, add the extended fingers. To find the number of ones in the product, multiply the number of down fingers on one hand by the number of down fingers on the other hand.

Example:

8 x 6



3 + 1 (extended fingers) = 4 tens

2 x 4 (down fingers) = 8 ones

Answer: 48

Suggested time - 30 minutes

Fun Activities in Multiplication

1. To multiply a number by 5, add one zero and divide by 2; to multiply by 25, add two zeros and divide by 4; to multiply by 125 add three zeros and divide by 8.

2. To multiply a two-digit number by 11, add the two digits and place the sum between the two digits.

   Example: 63 x 11

   6 + 3 = 9 6 9 3

   63 x 11 = 693

   If the sum of the two digits is greater than 9, add one to the digit on the left.

   Example: 75 x 11

   7 + 5 = 12

   Place the numeral 2 between the 7 and 5 and add 1 to the 7.

   Answer: 825

3. To multiply numerals of more than two digits by 11, multiply the numeral by 10 and add the multiplicand to the product.

   Example:

   362 x 11 = 3620 + 362 = 3,982

4. To multiply a numeral by 9, 99, 999, etc., multiply the numeral by 10, 100, 1000, etc. and subtract the multiplicand from the product.

Individual Instruction Process

Exercise 1: Activity cards will be assigned as practice exercises. These activity cards will be teacher - made or commerically made. (See Resources) Suggested time - 30 minutes.

Exercise 2: Have students make up word problems and write them on

problem cards. Each student will construct these word problems. The teacher should instruct them to use the math word chart or dictionary for words that they do not know how to spell.

Have students work their problems on scratch paper and put the answer on the backs of the activity cards. These cards will be added to the collection of class-made activity cards. The teacher will check each card before storage. Shoe boxes could be used for storing the cards and a different box could be used to store problems using like processes, i.e., one box for addition problems, one box for subtraction problems, etc. The teacher will check all answers on the activity cards before they are stored. Suggested time - 20 minutes.

Value Activities

The concept of multiplication is the same as addition. In fact, as explained before, multiplication is a short method of addition. Both processes mean more of something. Is more always better? When is more not better? Place a check in the appropriate column to indicate your feelings about things that are multiplied.

	BETTER	WORSE
1. Population		
2. Cancerous cells		
3. Automobiles		
4. Rodents		
5. Athlete's salaries		

Select two of the items and explain why you feel the way that you do about each one. Suggested time - 30 minutes.

Evaluation

The teacher will design a test with an expectancy of 80% mastery in computation and problem solving skills of multiplication. For those students who have not mastered the skills, an individualized program will be developed.

UNIT IV

Objective 7: The student can divide whole numbers which include two-digit divisors. Suggested time - 3 weeks.

Rationale: This is one of the fundamental processes necessary for coping with present and future problems that require arithmetic for their solution.

Content: Division of whole numbers.

Introduction of the lesson will begin by the teacher asking the entire class to divide themselves into groups of two's, then three's, then four's, etc. This can be accomplished by having the class count off 1, 2, 1, 2 or 1, 2, 3, 1, 2, 3, etc. All ones will go to a designated area in the room, all two's will go to another area, etc. The teacher will ask, "How many are left?" In some cases, there may be none left, but when there are extras, the teacher will reinforce the term remainder or difference. The teacher will write one-digit divisor problems on the chalkboard. Students will be asked to respond to questions asked by the teacher.

Suggested questions:

1. Which numeral is the divisor? the dividend?
2. After problems are solved: Which numeral is the quotient? the remainder?

The teacher should demonstrate problems having remainders and those without. Suggested time - 40 minutes.

Large Group Process

The teacher will give the class the Rules of Divisibility:

A number is divisible by:

2 if the last digit is an even digit

3 if the sum of the digits is a multiple of 3

4 if the last two digits are divisible by 4

5 if the last digit is 0 or 5

6 if the number is divisible by 2 and 3

7 if the last digit of the number is doubled and subtracted from the remaining digits, this process continues until a discernible multiple of 7 is reached. If a multiple is reached, the number is not divisible by 7.

Example:

20, 692 ÷ 7

20,692
- 4
2065
- 10
196
- 12
7

therefore, 20,692 is divisible by 7 because 7 is a multiple of 7

Remember: Zero is a multiple of all numerals.

68,932 ÷ 7

68,932
- 4
6893
- 18
670
- 0
67

67 is not a multiple of seven, therefore, 68,932 is not divisible by 7.

8 if the last two digits are divisible by 8.

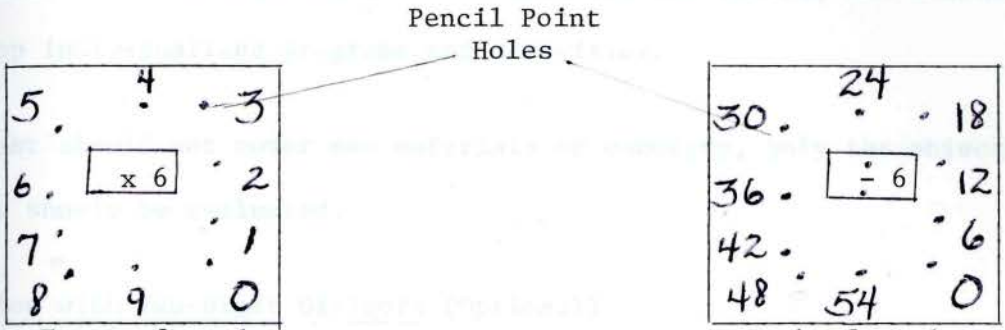
9 if the sum of the digits is a multiple of 9.

10 if the last digit is 0.

The teacher should demonstrate each process. Suggested time - 40 minutes.

Small Group Process

The teacher will construct practice cards for the related facts that are to be reinforced. For example, a multiplication/division practice card would appear as follows:



Front of card for Mult.

Back of card for Mult.

Students will work in pairs to practice their facts. The holder of the card inserts his pencil point from the back of the card through the hole for a number, e.g., 8. The other student must give the product for 6 x 8. The holder of the card can check the answer on the back of the card beside the hole through which he inserted his pencil point. For division, the card is reversed so that - 6 shows for the student computing the answers. This exercise is also adaptable to addition and subtraction. Suggested time - 40 minutes.

Individual Instruction Process

Worksheets will be passed to the students to work individually.

Example: Answer the questions about the following problem:

$3\overline{)5836}$

1. Name the place value of each digit in the dividend.
2. Where will the first quotient figure be placed? What is its value?

3. How many places will the quotient have?

4. After the first step (5 - 3) the remainder is 2. What does this 2 represent? Suggested time - 30 minutes.

Evaluation

The teacher will design a test and 80% mastery of division skills will be expected. If some students have not mastered the skills, the teacher will develop individualized programs and activities.

The test should not cover new materials or concepts, only the objectives taught should be evaluated.

Division with Two-Digit Divisors (Optional)

Introductory lesson will review the lesson on remainders being numerals left over. A new use of the remainder will be demonstrated through a two-digit divisor problem. Two-digit divisor problems should first be introduced with zeros in the one's digit of the divisor.

Large Group Process

The teacher will write a problem on the chalkboard.

Example: A farmer raised 3170 bushels of corn on 50 acres of land. How many bushels of corn was this per acre?

Ask students which process should be used to solve the problem. After determining that division will be used, ask students: What is the first quotient figure? How did you determine this? Some of the students may say the figure is 6 because 6 x 50 is 300. Accept this answer, but explain that some problems may not be so obvious. Teach the students to look at the first digit on the

left in the divisor and the first digit in the dividend. If the first digit in the dividend is less than the first digit in the divisor, look at the first two digits in the dividend. Determine how many of the first digit in the divisor are contained in the first two digits of the dividend. This will be your trial quotient.

Example:

$$50\overline{)3170}$$

Look at 5 in the divisor and 3 in the dividend. It's not possible to take any fives out of three so we look at 31. How many fives are contained in 31? The answer is 6. Have students multiply 6 x 50 to see if this quotient will be correct.

$$\begin{array}{r} 6 \\ 50\overline{)3170} \\ -300 \\ \hline 170 \end{array}$$

No fifties are in 3 or 31 so the quotient is placed over the 7. Subtract and bring down the 0. Look at 5 and 17. How many fives are contained in 17. The answer is 3. Have students multiply 3 x 50. Put the 3 over the 0. After subtracting 150 from 170, explain and discuss remainders.

Pass practice sheets to students with problems having two-digit divisors with zeros in the one's place. The teacher should leave a sample problem on the board for students to use as a source of reference. These worksheets should be prepared such as those used in the S.L.A.M. Division resource.

Example:

Without remainder

$$\begin{array}{r} \\ 30\overline{)2760} \\ - \\ \hline \\ - \\ \hline \end{array}$$

With remainder

$$\begin{array}{r} \\ 30\overline{)2763} \\ - \\ \hline \\ - \\ \hline \end{array}$$

R

It is at this time, after students begin to understand the procedure, that the teacher explains the use of the remainder as part of the quotient. The remainder is placed over the divisor to form a fraction that is placed in the quotient after the last digit in the quotient. Suggested time - 40 minutes.

The teacher should continue drill and practice exercises, including word problems, until reasonably sure of mastery by the students. After much practice, computation with two-digit divisors (other than zero) will be easily handled.

During this period of drill and practice, several interim tests should be administered. For those students who are not grasping the concept, assign peer tutors and the teacher will conduct individualized instruction sessions with others before final evaluation.

Evaluation

The teacher will design a test using one- and two-digit divisors and word problems. A score of 80% will indicate mastery achievement. For the students who do not attain this level mastery, the teacher will develop an individualized program.

UNIT V

UNIT V

Objective 8: The student can continue, in writing, a given number sequence. Suggested time - 1 week.

Rationale: This skill reinforces the fundamental processes and logical thinking.

Content: Number sequences, patterns and progressions.

The introductory lesson for this skill will be a series of exercises written on the chalkboard by the teacher before the lesson begins. Oral response will be solicited from the students.

Example:

1.) 2, 4, __, 8, 10

2.) 1, 5, 9, __, 17

3.) 2, 6, __, 54, 162

4.) 13, 10, 7, ___, 1

Ask students to look for patterns. In Exercise 1, it may be easy to see the plus 2 is the pattern. In Exercise 2, it may be more difficult and each succeeding exercise may be more difficult. Before asking students to fill in the missing numerals, have them to look at any two adjacent numbers and try to find a relationship between them. Allow students ample time to work at their desks in an attempt to discover relationships. The teacher, at this time, is only looking for relationships, not numerals.

Eventually the pattern will evolve.

Exercise 1 = +2

Exercise 2 = +4

Exercise 3 = x3

Exercise 4 = -3

Once the relationships are established, the class may volunteer to fill in the missing numerals. Emphasize the increased or decrease in numbers of the sequence. If an increase is shown, the function of the process will be addition or multiplication. If a decrease is shown, the process will be subtraction or division. Suggested time - 40 minutes.

Large Group Process

Have students take turns going to the chalkboard and writing sequences for other students to fill in. The student who fills in the missing numerals must explain whether there is an increase or decrease in the sequence and the process used for determining the missing numerals.

The teacher will show how a combination of processes may be used.

Example:

10, 9, 11, 10, __, 11, 13 (ans. -1 + 2 - 1 + 2 - 1 + 2)

Suggested time - 40 minutes.

Small Group Process

The teacher will make flash cards with number sequences written on the front side and answers written on the back. Arrange students in groups of fives. One student in each group will flash the cards to the other four and check answers. Set a time limit for this game to be played. (15 minutes)

The student who first correctly solves the sequence will receive one point. The checker will keep score. Students will select another checker after the allotted time and the game will begin again. Suggested time - 30 minutes.

Individual Instruction Process

The teacher will design worksheets that have several number sequences from

simple to complex as illustrated in the introductory lesson. This exercise will be an interim device of evaluation. Suggested time - 30 minutes.

Evaluation

A teacher constructed test will determine mastery of the skill. Combinations of processes will be included in the sequences and an 80% mastery will be expected. If this achievement is not attained, individualized programs will be developed.

UNIT V

Objective 9: The student can use and interpret mathematical symbols, i.e., $=, \neq, >, <, \leq, \geq$, +, x, $\div$ and Roman numerals. Suggested time - 1 week.

Rationale: The ability to read and interpret symbols is a necessary part of daily living. The comprehension of mathematical symbols is an integral part of the mathematical sequential learning pattern.

Content: Mathematical symbols and Roman numerals.

The introductory lesson will review the symbols used for the fundamental processes, i.e., addition, subtraction, multiplication and division.

The teacher will write symbols on the chalkboard. The symbols will illustrate the symbols used in equalities and inequalities. The signs and definitions should be copied by the students into their math composition books.

Large Group Process

The teacher will explain the meanings of each symbol.

Equal: ($=$) means the terms on each side of this symbol are the same or equivalent to each other.

Is not equal to: ($\neq$) means that the terms on each side of the symbol are not the same or are not equivalent to each other.

Is less than: ($<$) means that one quantity (the first) is less than the other; the small end or the point will always point to the smaller numeral or quantity.

Is greater than: ($>$) means that one quantity is greater than another; the open end will always face the larger number or quantity.

Is less than or equal to: ($\leq$) means that a numeral or quantity on one side of the symbol may be less than or equal to the numeral or quantity on the other side of the symbol.

As the teacher defines each symbol, an example should be written for each. Examples for each symbol should include numeral comparisons as well as quantity comparisons.

Example:

$12 > 9$ = numeral comparison

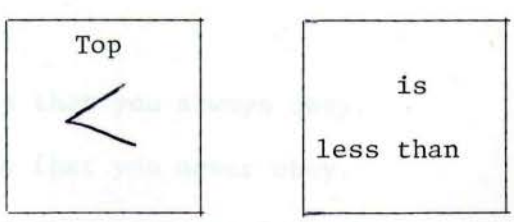
$12 - 3 > 9 - 4$ = quantity comparison

Reinforce numeral sequences. Ask whether the quantity on the left is less than or greater than the quantity on the right. Suggested time - 40 minutes.

Small Group Process

The teacher will add cards to the deck of cards used in the Math Match Game. (See Appendix A) A card will be made for each symbol and one for each definition.

Example:



When making cards for the symbols, be sure to indicate the top of the card by some method. This will eliminate complications in student's interpretations.

Allow students to play the Math Match Game in small groups. As cards are added to the deck, more students may be assigned to each group. Suggested time - 30 minutes.

Individual Instruction Process

The teacher will design several sets of numbered activity cards with symbols to be placed (by the students) into number sentences that show equalities and inequalities.

Example:

$9 \geq 6$

$9 \geq 9$

Place these sets of cards in an accessible location. Each student will be expected to work through an entire set. Some students could be working on this activity while others are working with the Math Match Game. The teacher will have an answer key coded by the number on the activity card. Suggested time - 30 minutes.

Values Activities

Teacher should explain the importance of symbols in our everyday living, e.g., road signs, sign language for the deaf, logos, etc.

Suggested questions:

1. List the symbols that you always obey.
2. List the symbols that you never obey.
3. List the symbols that you sometimes obey.

4. Rank the symbols or signs in the order of importance to you. List them in a one to ten order with one being the most important.

Evaluation

Write several equality and inequality number sentences. Ask students to insert the correct symbols, be sure to include the four basic symbols. If 80% mastery is not attained, the teacher will devise an individualized program for those students who need it.

UNIT V

Roman Numerals as Symbols Suggested time - 1 week

Rationale: Roman numerals are used on some clocks; they are sometimes used in numbering the chapters of a book and in the major subdivisions of an outline.

Content: Roman numerals.

The teacher will introduce the first five symbols of Roman numerals, i.e., I, V, X, L and C. This introductory lesson will give a definition of the value of each symbol.

Example:

I = 1

V = 5

X = 10

L = 50

C = 100

Explain to the students that the expression of number two is shown by two I's, and the express the number three, use three I's. Repeating a symbol repeats its value. Four could be written as four I's, but in the Roman numeral system as few symbols as possible are used to denote a number.

If a symbol is placed at the left of a symbol of greater value, then the combined value of the two symbols is the difference of their values. This, IV means to subtract one from five, so it represents four. Likewise, IX means to subtract one from ten, so IX represents nine.

If a symbol is placed at the right of a symbol of greater value, the combined value of the two symbols is the sum of their value. Thus, VI means

to add five and one, so it represents six. Similarly, XI means to add ten and one, so it represents eleven.

If a symbol is placed between two symbols of greater value, the combined value of the three symbols is the sum of the two greater minus the smallest. For example, in XIX, the one is placed between two tens, so the combined value is:

$$(10 + 10) - 1 = 19$$

Placing a horizontal line over a symbol multiplies its value by one thousand. Thus, $\overline{V}$ means five thousand. There is no place-value per se in the Roman numeral system.

Large Group Process

Give students drill sheets with a list of Arabic numerals to be changed to Roman numerals and some Roman numerals to be changed to Arabic numerals. Exercises may also be written on the chalkboard and volunteers asked to come forth and decipher. Suggested time - 40 minutes.

Small Group Process

The teacher will make at least three sets of cards with Roman numerals from 1 to 100. Divide the class into small groups. If all one hundred cards are used, there may be as many as ten students to a group. If fewer cards are used, e.g., 1 to 50, then smaller groups would play together.

A dealer would deal a certain number of cards to each student. If the cards 1 to 50 were used and five students were in a group, each student would be dealt ten cards. The student playing the highest card wins the hand.

Directions:

Cards dealt to students in a group would remain in a pile face down. In his turn, each student would turn a card face up from his pile. The highest up turned card on each round would win all upturned cards. When the last card from each pile is turned up and the winning card is determined, the game ends. The player having conquered the most cards wins the game. Shuffle cards and begin again.

The teacher will have an equivalence chart for students to use as a check. One student could be assigned as a judge, using the chart, to determine the high card. Suggested time - 40 minutes.

The teacher will design flash cards with Roman numerals on one side and Arabic numerals on the other. Pair students and have them flash cards to one another. The cards from 1 to 100 could be divided into sets of twenty card segments, for example, 1 - 20, 21 - 40, 41 - 60, etc. Once a sequence of cards is mastered, the pair could move to the next sequence. Suggested time - 30 minutes.

Individualized Instruction Process

The teacher will prepare worksheets for students that require them to change Arabic numerals to Roman numerals and Roman numerals to Arabic numerals. Suggested time - 30 minutes.

Evaluation

The teacher will design a test based on the same principle as in the Individual Instruction Process. If 80% mastery is not attained, an individualized program will be developed by the teacher.

UNIT VI

UNIT VI

Objective 10: The student can identify and define numerators and denominators when given a series of fractions.

Suggested time - 2 weeks.

Rationale: There is a widespread use of fractions in daily living. This objective is important as a foundation for measurement, finding parts of numbers and working with decimals.

Content: Beginning fractions.

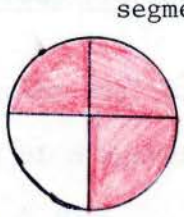
The introductory lesson will explain the meaning of a fraction. The word fraction is derived from the Latin word "fractio", which means "to break". Thus, the fraction 3/4 means that something has been broken into four equal parts, and three of them have been taken.

The teacher should present the concept with objects, then with pictures or representations of objects and finally with abstract symbols.

Example:

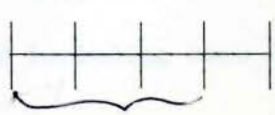
The meaning of 3/4 can be illustrated by cutting an an apple into four equal parts and taking three of them. Next, a cutout of a circle can be shown on a flannel board, showing three of four equal parts. Finally, the symbol 3/4 is presented.

Many diagrams should be used to illustrate the meaning of a fraction, such as, circles, rectangles and line segments.



3/4

3/4



3/4

A fraction may also be shown as one or more equal parts of a group of units. Thus, four apples can be shown, and three of them will convey the ideas of 3/4 of these apples.

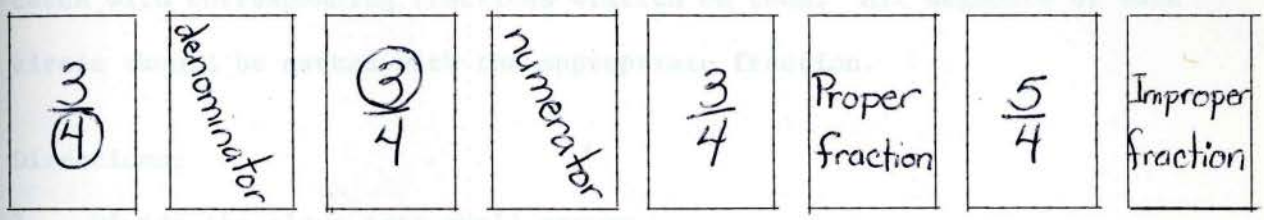
The teacher should have students add the definitions of fraction, numerator and denominator to the math vocabulary in the math composition books.

Example:

1. Fraction: an equal part of a whole.
2. Numerator: the top term of a fraction.
3. Denominator: the bottom term of a fraction.

The teacher will make cards to add to the Math Match deck.

Example:



Helpful hint: In order for the students to remember which numeral represents the numerator and which numeral represents the denominator, explain that the word numerator contains the letter "u" and it is the "up" numeral; the word denominator begins with the letter "d" and it is the "down" numeral. The denominator represents the total number of equal parts, and the numerator represents the number of parts taken from the total number. Suggested time - 40 minutes.

Large Group Process

The teacher will have each child prepare a "fraction kit." This kit will consist of a number of circles cut from construction paper, including some whole

circles, some half circles, some quarter circles and some eighth circles. Have students make all whole circles of one color, all half circles of a different color, etc. Comparison of unit fractions will be made through the use of the kits. Suggested time - 40 minutes.

Small Group Process

Place additional cards in the Math Match deck and allow small groups to play the game.

Make-a-Whole Game

Make several circles. Divide some of them into halves, some into fourths, some into eights, some into thirds and some into sixths. Make a set of cards with corresponding fractions written on them. All segments of each circle should be marked with the appropriate fraction.

Directions:

1. Divide the class into small groups.
2. Have a dealer shuffle the cards and place them face down on the table.
3. Place fractional parts face up on the table.
4. Each player in turn will draw a card and select the corresponding fractional part from the sections of a whole placed face up.
5. The players will piece the sections of circles together in an attempt to make a whole circle.
6. This process will continue until the card stock pile has been exhausted.
7. When all face down cards have been used, the player with the most completed circles is the winner. This is a self-checking exercise.

Individual Instruction Process

The teacher will construct a worksheet with figures (circles, rectangles, line segments, etc.) of which certain portions are shaded. The students will be expected to name the fraction illustrated by the figures. A second part of the worksheet will list common fractions that must be illustrated by figures drawn by the student.

Value Activities

The denominator of a fraction is the name of the "family." The numerator tells the given numbers represented by that family at a specific time.

Example: 1/2= a family of "2" of which one member is present;

3/4 = a family of "4" of which three members of the "family" are present.

Think of your family. What number would represent your whole family? Complete the chart below:

Activity	Participants (Numerator)	Number in Family Fraction (Denominator)
Eat breakfast together		
Eat lunch together		
Eat dinner together		
Watch TV at same time		
Go on vacation together		
Visit relatives together		
Read together		
Are attending school		
Play games together		
Go shopping together		

What does this chart tell you about your family?

Would you change any fractions if you could? Which fractions would you change? Why?

Evaluation

The teacher will construct a test based upon previous instruction. Students will be expected to have attained 80% mastery in skills taught. For those students who have not attained the level of mastery, devise a program of individualized instruction and activities.

UNIT VI

Objective 11: The student can write and illustrate equivalent fractions and write and compute fractions in simplest form.

Suggested time - 2 weeks.

Rationale: These skills are necessary functions of learning the fundamental processes of fractions.

Content: Fractional equivalents and simplification of fractions.

The introductory lesson will be directed by the teacher at the chalkboard. The lesson will use unit fractions to begin the equivalency lesson. Unit fractions are fractions with one as a numerator. The teacher will show how fractions are changed to higher denominators by multiplying the numerator and the denominator by the same numeral.

Example:

$$\frac{1}{2} = \frac{1 \times 2}{2 \times 2} = \frac{2}{4} \qquad \text{Thus, } \frac{1}{2} = \frac{2}{4}$$

$\frac{1}{2}$ and $\frac{2}{4}$ are equivalent fractions.

The teacher will demonstrate how fractions are simplied through the process of division of each term of the fraction by the same numeral.

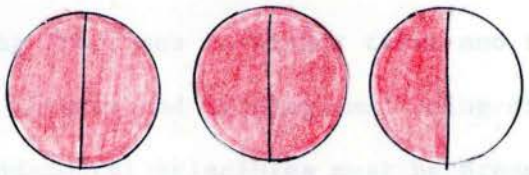
Example:

$$\frac{9}{12} = \frac{9 \div 3}{12 \div 3} = \frac{3}{4} \qquad \text{Thus, } \frac{9}{12} = \frac{3}{4}$$

A distinction between proper and improper fractions is important at this time. Define each. An improper fraction is a fraction whose numerator is greater than or equal to the denominator. A proper fraction is a fraction whose numerator is less than the denominator.

The teacher should show through illustrations (drawings at the chalkboard) how improper fractions are simplified.

Example:



$= 2 \text{ wholes} + \frac{1}{2} = 2\frac{1}{2}$

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

Thus, $\frac{5}{2} = 2\frac{1}{2}$

After several such illustrations, the teacher will instruct the students in the division process of simplification of improper fractions.

Example:

$\frac{5}{2}$ Divide denominator into numerator. The quotient is the whole number. If there is a remainder, use it as the numerator and the divisor as the denominator to form a fraction.

$$\frac{5}{2} = 2\,\frac{2}{5} = 2\frac{1}{2}$$
$$\frac{4}{1\ R}$$

Add proper fraction and improper fraction cards to Math Match cards.

Example:

$\frac{5}{3}$	Improper Fraction	$\frac{3}{4}$	Proper Fraction

Have students come to the chalkboard to demonstrate the changing of fractions to equivalent fractions. After unit fractions have been explored thoroughly, move into numerators other than one. Continue chalkboard exercises to follow-up

other instruction on fractions. Suggested time - 40 minutes.

Large Group Process

Changing fractions to higher terms and the equivalence of two fractions may be illustrated by diagrams, using circles, rectangles and line segments. Two fundamental principles must be presented by the teacher at the chalkboard.

1. If both numerator and denominator of a fraction are multiplied by the same numeral, except zero, the value of the fraction is unchanged.
2. If both numerator and denominator of a fraction are divided by the same numeral, except zero, the value of the fraction is unchanged.

Thus,

$$\frac{2}{3} = \frac{5 \times 2}{5 \times 3} = \frac{10}{15} \qquad \frac{2}{3} = \frac{10}{15}$$

and

$$\frac{6}{8} = \frac{6 - 2}{9 - 2} = \frac{3}{4} \qquad \frac{6}{8} = \frac{3}{4}$$

The teacher should write several fractions on the chalkboard for students to change to higher terms, lower terms and improper fractions to be simplified. Student volunteers should be called to the chalkboard to perform the functions. As many students as possible should be involved in this activity. Those students at their desks should perform the operations simultaneously with the students at the chalkboard. Suggested time - 40 minutes.

Small Group Process

The teacher will prepare several sets of puzzles with a set distributed to each small group. It is a good idea to construct each set in a different color of construction paper so that they may be stored together but easily separated. Divide the class into groups of five or six. This is a self-checking exercise

because each completed puzzle will fit together as jig-saw puzzles. (See Appendix G) Suggested time - 40 minutes.

Individual Instruction Process

The teacher will distribute worksheets that will require students to simplify fractions and change fractions to higher terms. These worksheets will require the students to supply missing numerators or denominators.

Example:

$\frac{1}{3} = \frac{?}{12}$ $\qquad$ $\frac{3}{4} = \frac{9}{?}$

Simplify:

$\frac{6}{8} = \_\_\_\_$ $\qquad$ $\frac{2}{4} = \_\_\_\_$

Value Activities

Common fractions can become "overweight" fractions (which are fractions in higher terms) that could be simplified. When fractions are "overweight," they keep their same value, just as people who become overweight keep their same personal value. People who lose weight or gain weight are the same (equivalent) persons.

We know how to reduce (simplify) fractions and we know how to make fractions gain weight (raise to higher terms), but what do we know about weight with human beings?

Suggested questions:

1. Is being "overweight" a problem in human life?
2. What are some of the causes of being "overweight"?
3. What can people do about being "overweight"?
4. Do additional weight affect personalities? How?

5. How can you determine whether a fraction is "overweight"?

Evaluation

The teacher will construct a test that requires the students to perform several operations that have been taught.

Example:

Simplify:

$\frac{2}{4} = \frac{\quad}{\quad}$ $\qquad \frac{6}{8} = \frac{\quad}{\quad}$ $\qquad \frac{9}{12} = \frac{\quad}{\quad}$

Change to higher terms:

$\frac{2}{3} = \frac{?}{9}$ $\qquad \frac{5}{8} = \frac{10}{?}$ $\qquad \frac{1}{2} = \frac{?}{10}$

Change to mixed numerals:

$\frac{5}{3} =$ $\qquad \frac{7}{4} =$ $\qquad \frac{6}{5} =$

The students will be expected to perform at 80% mastery, if not, the teacher will develop an individualized program for those students who need it.

Objective 12: The student can add and subtract like fractions.

Suggested time - 2 weeks.

Rationale: The fundamental processes of fractions are required by the state just as the knowledge of the fundamental processes of whole numbers.

Content: Addition and subtraction of like fractions.

In the introductory lesson the teacher must be sure to emphasize the difference in addition of fractions and the addition of integers. The natural tendency of students is to add all numerators and denominators. It is, therefore, important to teach very carefully how fractions are added.

To introduce the concept of the addition of fractions, the teacher may say:

1. two apples and three apples are five apples.
2. two dollars and three dollars are five dollars.
3. two-fifths and one-fifth are three fifths.
4. $\frac{2}{5} + \frac{1}{5} = \frac{3}{5}$

This method of introducing the idea emphasizes the unit fraction concept and leads to the idea of understanding that the sum of two fractions of the same kind (denominator) is obtained by adding the numerators. This introductory lesson will also present the concept of subtraction of like fractions.

Drawings on the chalkboard will be used as illustrations for the teaching of both skills. Initially, all chalkboard demonstrations and problems worked by the students at the chalkboard will have sums and differences less than one. Drill on many examples of addition and subtraction of this type will provide the students with a good foundation on which to build.

After these principles have been firmly established, examples in which the sums and differences are greater than one can be presented. These problems would give practice in simplifying fractions and changing improper fractions to mixed numerals. Suggested time - 40 minutes.

Large Group Process

The teacher will pass twelve inch rulers to the students and have the students use them as she reinforces the concept of fractions. The flannel board will be used with a fraction kit (pieces of flannel cut into several fractional segments) to demonstrate fractions also. There is a two-fold purpose in using rulers for teaching these fractional skills, this will lead into the unit on measurements.

The teacher should also use number lines marked off in fractional units.

Small Group Process

The Small Group Process game, Make-a-Whole, used in Objective 10 may be used for this objective.

Individual Instruction Process

Provide students with worksheets that cover all instruction on the addition and subtraction of fractions. These worksheets will include the reduction of fractions process.

Example:

$$\begin{array}{rrrrrrr} \frac{1}{4} & \frac{2}{5} & \frac{3}{8} & \frac{4}{5} & \frac{3}{5} & \frac{3}{4} & \frac{7}{8} \\ +\frac{2}{4} & +\frac{1}{5} & +\frac{1}{8} & +\frac{2}{5} & -\frac{1}{5} & -\frac{1}{4} & -\frac{3}{8} \\ \hline \end{array}$$

Construct about twenty problems that will use all the skills that have been

taught, that is, addition and subtraction problems with and without reduction of sums and differences.

Evaluation

The teacher will devise a test to determine the achievement of the students.

Example:

Can these fractions be reduced again?

1.) $\frac{9}{12} = \frac{3}{4}$ yes or no

2.) $\frac{4}{10} = \frac{2}{5}$ yes or no

3.) $\frac{4}{8} = \frac{2}{4}$ yes or no

4.) $\frac{4}{6} = \frac{2}{3}$ yes or no

Reduce to lowest terms:

5.) $\frac{12}{18} =$

6.) $\frac{10}{15} =$

7.) $\frac{6}{10} =$

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

Simplify:

9.) $\frac{9}{7} =$

10.) $\frac{11}{3} =$

11.) $\frac{9}{4} =$

12.) $\frac{13}{5} =$

If students do not successfully master 80% if the test items, the teacher will develop an individualized program.

UNIT VII

UNIT VII

Objective 13: The student can write measurement equivalents, i.e., linear, dry, weight, liquid, time and temperature measurements. Suggested time - 6 weeks.

Rationale: The knowledge of measurements at this level is a segment of the sequential learning skills that are necessary for for the fulfillment of state requirements.

Content: Measurements - linear, dry, weight, liquid, time and temperature.

The teacher will introduce the lesson by writing the common linear measurements on the chalkboard. Abbreviations should be emphasized. Make cards to be added to the Math Match deck.

Example:

12 inches (in.) = 1 foot (ft.)

3 feet = 1 yard (yd.)

36 inches = 1 mile (mi.)

5,280 feet = 1 mile

1,760 yards = 1 mile

16½ feet = 1 rod (rd.)

320 rods = 1 mile

This information will be written in the math composition books. The teacher will demonstrate, through the use of a twelve inch ruler and a yard stick, the comparative units of linear measures.

Ask the students:

1. Which unit of measure would you use to measure a pencil? a room? a door? a book?
2. Which unit of measure would you use to measure the distance from St. Louis to Kansas City?

Initiate other questions and discuss the responses.

The teacher will ask students to use notes to determine how to change measurements from one unit of measure to the other, i.e., feet to inches, inches to feet, yards to feet, etc. Have volunteers go to the chalkboard to change measurements that the teacher may write on the chalkboard. Suggested time - 40 minutes.

Give learning codes for students to memorize which process should be used to change units of measure.

One good example is:

L → S → M = LSM

To change a larger unit of measure to a smaller unit of measure - multiply

S → L → D = SLD

To change a smaller unit of measure to a larger unit of measure - divide.

The students needs to learn only one of the codes. If one is known, then he will know that the opposite operation will be the inverse process.

Make measurement equivalent cards to be placed into the Math Match deck. Include abbreviation cards for units of measure.

Large Group Process

The teacher will prepare problem cards which ask for a change in measurements.

Establish relay teams. The teacher will display problem cards and as quickly as a student completes a problem at the chalkboard, another problem card will be displayed. The first team to complete the series of problem cards ends the game. The team with the most correct answere is the winning team. The process may be repeated and points awarded to each winning team until a predetermined number of points is earned.

Example of problem card:

12 ft. = ____ in.

Suggested time - 40 minutes

Small Group Process

Divide the class into small groups for Math Match games. There should be enough cards in the deck, by this time, for eight to ten players to participate in each game. Suggested time - 40 minutes.

Individual Instruction Process

Distribute worksheets to students which will include computational changing of units of measure, i.e., as in the problem card activities; use work problem activities also. Suggested time - 40 minutes.

The processes for each measurement area of study will be the same except for the introductory lessons. The difference in the introductory lessons will be in the terms that are introduced.

Terms to be introduced in dry measure area of study:

16 onces (oz.) = 1 pound (lb.)

16 ounces = 1 pint (pt.)

2 pints = 1 quart (qt.)

8 quarts = 1 peck (pk.)

4 pecks = 1 bushel (bu.)

Terms to be introduced in weight area of study:

16 ounces = 1 pound

100 pounds = 1 hundredweight (cwt.)

2000 pounds = 1 ton (t.)

Terms to be introduced in liquid measure area of study:

2 cups (c.) = 1 pint

16 fluid ounces = 1 pint

2 pints = 1 quart

4 quarts = 1 gallon

Terms to be introduced in time measure area of study:

60 seconds (sec.) = 1 minute (min.)

60 minutes = 1 hour (hr.)

24 hours = 1 day (da.)

7 days = 1 week (wk.)

4 weeks = 1 month (mo.)

12 months = 1 year (yr.)

365 days = 1 year

366 days = 1 leap year

52 weeks = 1 year

10 years = 1 decade

20 years = 1 score

100 years = 1 century

Terms to be introduced in temperature area of study:

32^{o} = freezing temperature on Fahrenheit (F) scale

212^{o} = boiling point temperature on Fahrenheit scale

0^{o} = freezing on Celsius scale

100^{o} = boiling point on Celsius scale (C)

Discuss the symbol used to indicate degrees.

Use the same processes as outlined in the linear measurement lessons for large group, small group and individual instruction. Interim tests should be given after each measurement area of study.

Value Activities

This is an important aspect in our lives. We must always budget our time. "How do you budget yours? the teacher asks.

Suggested questions:

1. How many hours do you sleep each day?
2. How much time do you spend watching television each day?
3. How much time do you spend studying each day?

The teacher will pass worksheets to study that they will fill in each day for a week.

Example:

Have students indicate the nunber of minutes spent doing each activity.

Activity	Sun.	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.
Studying							
Television							
Reading							
Sleeping							
Chores							
Playing							
Telephone							

1. How many minutes did you spend on each activity for the entire week?
2. How many hours was this?
3. Could you have spent or measured your time more wisely?
4. What time on which activity do you plan to change? Why?

Evaluation

The teacher will construct a test that includes all the areas of measurement that have been taught.

Example:

1.) Three feet = _____ in.

2.) _____ feet = 1 mi.

3.) _____ oz. = 1 pt.

4.) 1 bu. = _____ pk.

5.) _____ lb. = 1 T.

6.) 1 qt. = _____ pt.

7.) 12 weeks = _____ mo.

8.) 50 years = _____ decades

9.) 360 min. = _____ hours

10.) _____^{o} = boiling point on Fahrenheit scale

Change:

1.) 96 in. to feet

2.) 32 oz. to lb.

3.) 4 pk. to qt.

4.) 6 bu. to pk.

5.) 12 qt. to pt.

Each student will be expected to attain 80% mastery. If this mastery is not attained, the teacher will develop an individualized program.

UNIT VIII

UNIT VIII

Objective 14: The student can recognize and construct simple geometric figures and knows fundamental geometric terminology.
Suggested time - 4 weeks.

Rationale: The purpose of teaching this unit is to sharpen students' awareness of the variety of regular and irregular shapes that surround them. A basic knowledge of geometry is also a state requirement in the public schools.

Content: Basic geometric terms and recognition and construction of simple geometric figures.

The introductory lesson will be a presentation of terms, definitions and illustrations at the chalkboard. The terms to introduce at this time should include the following:

Point - a location symbolized by a dot.

Line - a set of points with no end points symbolized $\longleftrightarrow$

Line segment - a line with two end points symbolized $\overline{\quad\quad}$.

Ray - a line with one end point symbolized $\overrightarrow{\quad\quad}$.

Polygon - a closed plane figure with three or more sides.

Quadrilateral - a closed plane figure with four sides.

Square - a quadrilateral with all sides equal

Rectangle - a quadrilateral with opposite sides equal.

Triangle - a closed plan figure with three sides.

Circle - a closed plan curve all of whose points are the same distance from a given fixed inside point, called the center.

Radius - a line from the center of a circle to any point on the circumference of the circle.

Diameter - a straight line segment which passes through the center of a circle joining two opposite points on the circle.

Perimeter - the distance around a polygon.

Circumference - the distance around all points on the circle.

Perpendicular lines - lines that intersect and form.

Parallel lines - lines or curves that remain equidistance infinitely.

Horizontal lines - lines constructed from left to right or right to left.

Vertical lines - lines constructed from top to bottom or bottom to top.

Angle - a common point at which two rays meet.

The terms listed are those that the student at fifth - grade level should master to fulfill Missouri requirements. Several illustrations and chalkboard exercises must be demonstrated by the teacher. The more time that the teacher devotes to these basic concepts, the easier it will be for the students to grasp more complex concepts. The students should copy these terms, symbols and definitions into their math composition books. Suggested time - three 40 minute periods.

Large Group Process

The teacher should have students survey the room for objects that illustrate terms presented in the introductory lesson. Ask for volunteers for responses. List responses and the illustrative characteristics of the responses. Discuss.

Example:

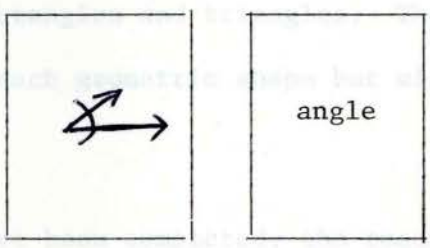
Teacher: Look around the room to see if there are any objects that illustrate terms we've discussed.

Student : The door represents a rectangle.

The teacher will write "door" on the chalkboard and the word rectangle beside it. After the list is complete. The teacher will ask volunteers to cite the characteristics of each object that makes it illustrative of the geometric term. Some responses listed may not have been correct; it is during this discussion that corrections are made. Suggested time - 40 minutes.

Add Math Match cards to the deck.

Example:



Small Group Process

Divide the class into small groups and allow them to play the Math Match game. Suggested time - 40 minutes.

Individual Instruction Process

The teacher will prepare worksheets will all or some of the terms taught. The students will be given the worksheets, rulers and compasses. This exercise will require construction of geometric figures. Suggested time - 40 minutes.

Value Activities

Suggested questions:

1. What are your feelings about the shapes we've discussed?
2. Which shapes are pleasing to you?
3. Which shapes seem to compliment one another?
4. Which shapes do not compliment one another?

5. Which shape would you like to be?

6. Which shape would you select to symbolize your goals? Why?

Share the responses in small groups and have the students justify their selections to other members of the group.

Application Activity

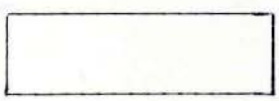
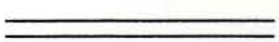
Have students draw pictures of themselves using geometric shapes, i.e., squares, circles, rectangles and triangles. The teacher will pre-assign numerical values to each geometric shape but will not divulge this to the students.

When the pictures have been completed, the teacher will disclose the value of each shape. Each student will be asked to assess his personal value on the basis of the shapes used and their values. Suggested time - 40 minutes.

Evaluation

The teacher will prepare worksheets with drawing of the geometric figures previously taught. The students will be required to correctly identify them.

Example:

	Answers
	rectangle
	parallel lines

The students are expected to show 80% mastery on this test. Those students who do not show this percentage of mastery will have an individualized program developed for them by the teacher. Suggested time - 30 minutes.

UNIT IX

UNIT IX

Objective 15: The student can read and construct simple charts, graphs and tables.

Rationale: The interpretation of data from charts, graphs and tables is a necessary facility in daily life situations.

Content: Charts, graphs and tables.

The teacher will introduce the lesson by differentiating between charts, graphs and tables. Following each definition, the teacher will demonstrate each at the chalkboard.

Example:

Chart - a sheet giving information in the form of a diagram.

The children in the class could be used as statistics for constructing a chart. Ask the students to determine the number of students in the class, e.g., twenty students.

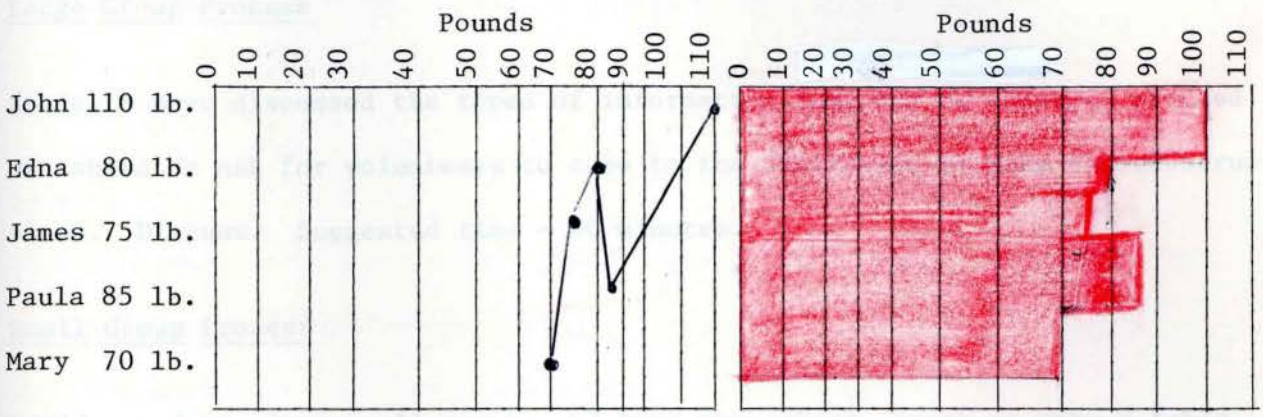
Assign numbers to students

		Boys	Girls	Brown Eyes	Blue Eyes	11 years old
1.		✓		✓		
2.		✓			✓	✓
3.			✓		✓	
4.			✓		✓	✓
5.			✓		✓	✓
6.		✓		✓		✓
7.			✓	✓		
8.		✓			✓	✓
9.			✓	✓		
10.		✓			✓	
11.			✓	✓		✓
12.		✓			✓	
13.		✓		✓		
14.		✓			✓	
15.			✓	✓		
16.		✓		✓		
17.			✓	✓		
18.		✓		✓		
19.		✓		✓		
20.		✓		✓		

Graph - a diagram representing the successive changes in the value of a variable quantity or quantities.

The class will again be used as the basis for constructing a graph. Select five pupils and ask them to tell you their weight. Use this information to construct a line graph and a bar graph.

Example:



Emphasize the fact that the intervals between numbers on a graph may vary and that it then becomes necessary to estimate, e.g., seventy-five would be midway between seventy and eighty as shown on both graphs.

Table - a compact orderly arrangement of facts, figures, etc., usually in rows and columns.

Example: Multiplication Table

X	1	2	3	4	5	6	7	8	9
1	1	2	3	4	5	6	7	8	9
2	2	4	6	8	10	12	14	16	18
3	3	6	9	12	15	18	21	24	27
4	4	8	12	16	20	24	28	32	36
5	5	10	15	20	25	30	35	40	45
6	6	12	18	24	30	36	42	48	54
7	7	14	21	28	35	42	49	56	63
8	8	16	24	32	40	48	56	64	72
9	9	18	27	36	45	54	63	72	81

After the original presentations of charts, graphs and tables, have students suggest information that may be charted, graphed or tabled. Suggested time - 40 minutes for each concept.

Large Group Process

Students have discussed the types of information that may be charted, graphed or tabled so ask for volunteers to come to the chalkboard to make the constructions. Discuss. Suggested time - 40 minutes.

Small Group Process

Divide students into small groups and have them chart, graph or make a table showing the birth months of the students in the class. This may be a noisy activity because information must be assimilated, however, it will be a true learning experience. During this activity each group will chart, graph and table the information. If a group elected to chart the information the first time, then the next activity for that group will be graphing or tabling the information. Suggested time - 40 minutes.

Individual Instruction Process

Provide students with graph paper and ask them to prepare line graphs and bar graphs to illustrate the composition of the class.

Example:

Information to be graphed will include a list such as:

1. Number of students in class
2. Number of girls in class
3. Number of White in class
4. Number of Black in class
5. Number of Other in class

Suggested time - 40 minutes

Have students chart subjects taught each day and the number of minutes for each. Suggested time - 40 minutes.

Have students make a table of the linear measurement equivalents that were taught in the measurement unit. Suggested time - 40 minutes.

Value Activities

Graph:

Have students construct a circle graph. Based upon twelve hours as on the clock, have them graph the following:

1. How much time do I spend studying?
2. How much time do I spend sleeping?
3. How much time do I spend watching television?
4. How much time do I spend doing other things?

Chart:

Have students construct a "Who Am I?" chart. This will be constructed using "ing" and "able" suffixes with words in one column and the numerals 0 thru 10 across the top of the chart. Have students assign a value to each characteristic listed.

Example

Characteristic	0	1	2	3	4	5	6	7	8	9	10
Loving											
Capable											
Dependable											
Caring											

The above exercise would be an individual activity but could be used as a small group activity. Naturally, the teacher would expand the list for each process.

Example for small group activity:

Characteristic	Mary	John	Henry
Loving	7	3	9
Capable	2	6	4
Dependable	9	5	5
Caring	8	4	8
Sharing	9	3	7

This exercise could easily be correlated with language arts. Allow the students to suggest characteristics. Suggested time - 30 minutes.

Evaluation

The teacher will construct a completed graph, chart and table. The students will be required to interpret each with 80% accuracy. These worksheets will determine the understanding that the student has atained. If 80% accuracy is not indicated, the teacher will develop an individualized program.

UNIT X

UNIT X

Objective 16: The student can use all of the above skills to solve and and construct word problems related to everyday situations. Suggested time - 3 weeks.

Rationale : The purpose of this unit is to improve computational skills and to make practical applications in real-life situations now and in the future.

Content : Word problems and problem-solving skills.

In the introductory lesson, the teacher will discuss the technique for solving problems. These steps are applicable to solving textbook problems in arithmetic and are also valuable in non-textbook situations.

Steps to Problem Solving

1. Read the problem.
2. Decide what is given.
3. Decide what is to be found.
4. Decide which operations are necessary to take what is given and use it to find what is to be found.
5. Solve the problem.
6. Check the result.

Each step should be thoroughly discussed so that the student understands the process completely.

Example:

1. The problem should be read carefully and with understanding. (Children have a tendency to read problems too quickly.)
2. Although most textbooks give only the information necessary for the solution of a problem, this is not true in practical situations.

(To train pupils in determining the pertinence of data in arriving at a solution, design some word problems with extraneous information.)

3. Instruct pupils that in the statement of a problem, what is to be found frequently appears at the end of the statement.

4. This is the most difficult step. It is important to attune students to key words which give clues to the process or processes to be used.

Example:

Key Word	Operation
total	addition
in all	addition
altogether	addition
how much more	subtraction
how many more	subtraction
how many left	subtraction
have left	subtraction
if one costs, how much would 2 cost	multiplication
if two cost, how much would 1 cost	division

These words are simply indicators and should not be relied upon entirely.

5. It is necessary for students to know the fundamental process to accomplish this feat. If the other steps are within his realm of success, and they are not adept in computational skills, this step will become a stumbling block.

6. All answere should be checked, and this is accomplished through the use of the inverse process.

It is difficult to teach problem solving because it involves independent thinking. The process consists of logical reasoning and teachers can not teach or guarantee a student's ability to reason logically. Some useful devices in teaching problem solving are simplification of the problem, having students devise word problems of their own and using diagrams to aid in understanding the situation presented in the problem. Suggested time - 40 minutes.

Large Group Process

The teacher will write several word problems on the chalkboard. Each problem will be taken through the six-step process with students responding as the progression continues. This instruction process should extend over two forty-minute periods.

Small Group Process

Divide students into small groups. Allow ten minutes for each student to devise a word problem. After ten minutes the cards will be exchanged and each student will work the problem devised by another member of the group. This process continues until each person in the group has worked all the problems of each member of his group. The student who constructs the word problem will place the answer and his name on the back of the card. The teacher will collect cards and solutions and use a sampling at the chalkboard to illustrate problems and illustrations. (This will also serve as a check to determine those students who have a weakness in computation.) Suggested time - 40 minutes

Individual Instruction Process

Have each student construct problems which require at least two operations. These problems will be written on problem cards with steps to solution written

on the back of cards. The teacher will check the cards before storing them with the class-made activity cards. Suggested time - 30 minutes.

Evaluation

The teacher will use the resources to design a test which will include one and two operation problems. Each student will be expected to attain 80% mastery. For those students who are not successful in this achievement, the teacher will develop an individualized program.

CONCLUSION

It is the intent of the author of this course of study to provide teachers with innovative, flexible and open-ended lesson plans. The purpose of this curriculum design is to give the teacher an opportunity to veer away from the rigidly structured curriculum. This curriculum design will provide the opportunity for teachers to give their constituents a more realistic personalized instructional program.

Knowledge of the individual differences among students will stress the responsibility of the teacher and allow the determination of the curriculum, teaching strategies and methods and the materials to be utilized in attaining objectives. The classroom teacher is the only resource available to schools who can provide the motivation for learning, evaluation of achievement and individualization of programming and activities. It is, therefore, the opinion of this author that teachers be given the opportunity to use whatever methods, strategies, activities, etc., to attain the set level of achievement expected of the students.

Hopefully, this curriculum design will interest administrators and influence them to believe that teachers are capable of developing individual curricula that best serve the needs of their students. If administrators allow flexibility in the instructional process, the creativity of teachers will come to the surface and thus, provide the special instructional needs of the students. This project is one of many aids to help the teacher deliver the necessary services to the students.

Several processes have been suggested as approaches to each objective. The programmed processes are selective ones based upon the decisions of the individual teacher. The two tried and tested programmed instructional aids

that are recommended are Tutorgram and Telor. The suggested value activities may be used to reach the affective domain of the learning experiences of the students. These activities may be adapted to meet the needs of the individual school community.

This curriculum design suggests the implementation of several processes in order for the students to reach optimal potential. This appraisal is determined by observing the student's response to several alternative methods. The observation will determine the teaching strategies, methods and activities that achieve a specific instructional objective.

Any value that this project may have will be only through the efforts of resourceful and creative teachers who accept full responsibility of the children in their classes and who are determined that each child will receive the best instruction that can be provided.[21]

RESOURCES

Objective 1

Student's Glossary of Arithmetical - Mathematical Terms, Bernard H. Gundlach

Mathematics Teaching Tape, William E. Schall, et.al

Values Clarification, Sidney Simon, et.al.

Personalizing Education, Leland W. Howe and Mary Martha Howe

Games and Puzzles for Elementary and Middle School Mathematics, National Council of the Teachers of Mathematics, Seaton E. Smith Jr. and Carl A. Backman, eds.

Objective 2

Abacus

Placo, Games and Puzzles for Elementary and Middle School Mathematics, Robert C. Calvo

Scoring High in Math, Book A, Random House

Step-by-Step, Kit B, Unit II, Continental Press

Miquon Math Lab Materials, Level 5, Key Curriculum Project

Mathematics Teaching Tape Program, Intermediate Level, Houghton Mifflin

Reading and Writing Large Numbers, Allyn and Bacon

Values Clarification, Sidney B. Simon, et, al.

Check and Double Check!!, Bk. 4 and Bk. 5, Scholar's Choice Limited

Mathematics Improvement Program, SRA, Inc.

School Mathematics: Concepts and Skills, Grade 5, Duplicating Master, Houghton Mifflin

Growing Up With Arithmetic, Bk. 5, McCormick-Mathers

Electric Drill, Whole Numbers, Creative Publications

RESOURCES

Objective 3

Skill-Bank, Set B, Silver Burdett

Mathematics Improvement Program, SRA, Inc.

The Game Builder, Kit II, Creative Publications, Inc.

Roll-a-Sum, NCTM, Jane M. Heckman

Cuisenaire Rods

Activity Cards for Cuisenaire Rods, Cuisenaire

Step-by-Step, Kit B, Unit II, Continental Press

Reading and Writing Large Numbers, Allyn and Bacon

Scoring High in Math, Bk. B, Random House

Abacus

Growing Up With Arithmetic, Book 5, McCormick-Mathers

Skill-Bank, Set B, Silver Burdett

School Mathematics: Concepts and Skills, Book 5, Workbook, Houghton Mifflin

Electric Drill, Whole Numbers, Creative Publications

Objective 4

School Mathematics: Concepts and Skills, Grade 5, Workbook, Houghton Mifflin

Basic Skills in Mathematics, Unit 1, Allyn-Bacon

Mathematics Practice Pages, Grades 4 and 5, Continental Press

Drillsville, Route 4 and Route 5, National Textbook Co.

Skill-Bank, Set A, Silver Burdett

Mathematics Improvement Program, SRA, Inc.

The Game Builder, Kit II, Creative Publications, Inc.

Step-by-Step, Kit B, Unit III, Continental Press

RESOURCES

Cuisenaire Rods

Activity Cards for Cuisenaire Rods, Patricia Davidson, et,al., Cuisenaire

Mathematics Around Us, Grade 5, Scott-Foresman

Reading Problems in Mathematics, Grades 4 and 5, Continental Press

Mathematics for Individual Achievement, Workbook, Gr. 5, Houghton Mifflin

Mathemagination, Book B. Creative Publications, Inc.

Electric Drill, Whole Numbers, Creative Publications, Inc.

Games in Math Skill Building, Addition and Subtraction, Incentives for Learning, Inc.

Objective 5

Skill-Bank, Set A, Silver Burdett

Mathematics Improvement Program, SRA, Inc.

The Game Builder, Kit II, Creative Publications, Inc.

Controlled Reader Math Program, Set AR-4, Educational Developmental Laboratories

Reading Problems in Math, Grade 4, Continental Press

Step-by-Step, Kit B, Unit IV, Continental Press

Games in Math Skill Building, Addition and Subtraction, Incentives for Learning, Inc.

Check and Double Check!! Book 4 and 5, Scholar's Choice Limited

Basic Essentials of Mathematics, Part 1, Steck-Vaughn

School Mathematics: Concepts and Skills, Grade 5, Workbook, Houghton Mifflin

Growing Up With Arithmetic, Grade 5, Workbook, McCormick-Mathers

Tutorgram Teaching Systems, Program 6B, Enrichment Reading Corporation of America

RESOURCES

Objective 6

Simple Lattice Approach to Multiplication, Prentice-Hall

Skill-Bank, Set A, Silver Burdett

Game Builder, Kit II, Creative Publications

Electric Drill, Whole Numbers, Creative Publications

Math Improvement Program, SRA

Math Soup, Set D, Scott Resources

Step-by-Step, Kit B, Unit V, Continental Press

Basic Essential of Mathematics, Part 1, Steck-Vaughn

Mathematics Practice Pages, Grades 4 and 5, Continental Press

Reading Problems in Math, Grades 4 and 5, Continental Press

Mathematics for Individual Achievement, Workbook, Grade 4, Houghton Mifflin

Growing Up With Arithmetic, Grade 5, McCormick-Mathers

Objective 7

Arithmetic for Teachers, Wilbur H. Dutton and L.J. Adams

Mathematics Made Easy, Henry H. Thomas

S.L.A.M. Division, Prentice-Hall

Basic Essentials of Mathematics, Part 1, Steck-Vaughn

Controlled Reader, Set AR-4, Educational Developmental Laboratories

Handy Math, Creative Publications

Electric Drill, Whole Numbers, Creative Publications

Operations Bingo, Creative Publications

Games in Math Skill Building, Multiplication and Division, Incentives for Learning, Inc.

Check and Double Check!! Book 4 and 5, Scholar's Choice Limited

RESOURCES

Mathemagination, Book A, Creative Publications

Drillsville, Books 5 and 6, National Textbook Co.

Math Soup E, Scott Resources, Inc.

Objective 8

Skill-Bank, Set B, Silver Burdett

Mathematics Improvement Program, SRA, Inc.

Step-By-Step, Unit I, Continental Press

Scoring High in Math, Books A, B and C, Random House

Growing Up With Arithmetic, Book 5, McCormick-Mathers

Objective 9

Scoring High in Math, Book B, Random House

Growing Up With Arithmetic, Book 5, McCormick-Mathers

Miquon Math Lab Materials, Key Curriculum Project

Skill-Bank, Set A, Silver Burdett

Tutorgram Teaching Systems, Program 6B, Enrichment Reading Corporation of America

Mathemagination, Book C, Creative Publications, Inc.

Mathematics Improvement Program

Mathematics for Achievement, Course 1, Book 5, Houghton Mifflin

Objectives 10, 11 and 12

Mathemagination, Book D, Creative Publications

Fraction Bars Lab, Workbook I, Scott Resources, Inc.

RESOURCES

Objectives 10, 11 and 12

Fraction Dominoes, Creative Publications

Skill-Bank, Set B, Silver Burdett

Mathematics Improvement Program, SRA, Inc.

Game Builder, Kit II, Creative Publications

Step-by-Step, Kit B, Unit VII, Continental Press

Basic Essentials of Mathematics, Part I, Steck Vaughn

Growing Up With Arithmetic, Book 5, McCormick-Mathers

Mathematics Practice Pages, Grades 4 and 5, Continental Press

Let's Play Games in General Mathematics, National Textbook Co.

Mathematics for Individual Achievement, Book 6, Workbook, Houghton Mifflin

Reading Problems, Grades 4 and 5, Continental Press

Electric Drill, Fractions, Creative Publications

Handy Math, Creative Publications

School Mathematics: Concepts and Skills, Grades 4 and 5, Duplicating Masters, Houghton Mifflin

Objectives 13

School Mathematics: Concepts and Skills, Grade 4, Duplicating Masters, Houghton Mifflin

Reading Problems in Math, Grade 6, Continental Press

Mathemagination, Book F, Creative Publications

Practice in Mathematics, Grade 4, Duplicating Masters, Heath

Basic Essentials of Mathematics, Part II, Steck-Vaughn

Mathematics for Individual Achievement, Grades 3 and 4, Workbook, Houghton Mifflin

RESOURCE

Objective 13

Growing Up With Arithmetic, Book 5, McCormick-Mathers

Miquon Math Lab Materials, Key Curriculum Project

Cuisenaire Rods and Activity Cards, Cuisenaire

Useful Arithmetic, Volume II, Workbook, John D. Wool

Mathematics Teaching Tape Program, Intermediate Level, Houghton Mifflin

Measurement Chart, Ideal

Tutorgram Teaching Systems, Program 6 B, Enrichment Reading Corporation of America

Handy Math, Creative Publications

Step-by-Step, Kit B, Unit 9, Continental Press

Moving-Up in Time, Developmental Learning Materials

Modern Mathematics, Grade 5, Continental Press

Objective 14

Geometric Figures and Solids, Milton Bradley

Skill-Bank, Set C, Silver Burdett

Mathematics Improvement Program, SRA, Inc.

Lennes Essentials of Arithmetic, Books 4 and 5, Laidlaw Brothers

Basic Essentials of Mathematics, Part II, Steck-Vaughn

Geometric Figures and Concepts, ESP, Inc.

Mathemagination, Book F, Creative Publications

Game Builder, Kit II, Creative Publications

Miquon Math Lab Materials, Key Curriculum Project

RESOURCES

Objective 15

Step-by-Step, Kit B, Unit 10, Continental Press

Graphs in Everyday Life, J. Weston Walch

Learning New Skills in Arithmetic, Grade 4, Part 2, Continental Press

Mathematics for Individual Achievement, Grade 4, Workbook, Houghton Mifflin

Reading Problems in Mathematics, Grade 5, Continental Press

School Mathematics: Concepts and Skills, Grade 5, Workbook, Houghton Mifflin

Objective 16

Reading Problems in Math Grade 4, Continental Press

Reading Problems in Math Grade 5, Continental Press

School Mathematics: Concepts and Skills, Grade 4, Duplicating Masters, Houghton Mifflin

I'm a Number Game, Creative Publications

Invitation to Mathematics, Webster Publishing Co.

Step-by-Step, Kit B, Units 3 - 10, Continental Press

Game Builder, Kit II, Creative Publications

Check and Double Check!! Scholar's Choice Limited

Skill-Bank, Set C, Silver Burdett

Tutorgram and Telor selected math programs may be used to meet all of the objectives in this course of study.

FOOTNOTES

1. Ben Brodinsky, "Back to the Basics: Movement and Its Meaning," Phi Delta Kappan 58 (March 1977): 522.
2. Henry C. Morrison, The Curriculum of the Common School, (Chicago, 1940), p. VII
3. Jere I. Hochman, "A Concepts Model for Curriculum Development," (St. Louis, 1978), p. 2.
4. Morrison, p. 2
5. Ibid., p. 5
6. Herbert R. Kohl, On Teaching, (New York, 1976), p. 23
7. Wilbur H. Dutton and L. J. Adams, Arithmetic for Teachers, (Englewood Cliffs, 1961), p. 1
8. Ibid., p. 5
9. William A. Brownell, Arithmetic in Grades I and II, (Durham, 1941), p. 46
10. Dutton, p. 5
11. John I. Goodland, "The Changing School Curriculum," (The Georgian Press, 1966), p. 11.
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13. Ralph W. Tyler, Basic Principles of Curriculum and Instruction, Chicago, 1949), p. 1.
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15. Kohl, p. 22
16. Audrey Nicholls and S. Howard Nicholls, Developing a Curriculum, (Boston, 1972), p. 56

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17. Ibid., p. 58.

18. Jean Piaget, Science of Education and the Psychology of the Child, (New York, 1977), p. 68.

19. Nicholls, p. 57.

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21. Robert R. Farrald and Richard G. Schamber, A Mainstream Approach to Indentification, Assessment and Amelioration of Learning Disabilities, Handbook 1, (Sioux Falls, 1973), p. 5.

GLOSSARY

GLOSSARY

Abacus. A device used in teaching place-value arithmetic.

Add. To combine; to unite into a new group.

Addend. The name given to each of the numbers to be added.

Addition. The process of adding and determining the quantity in the new group without one-by-one counting.

Area. The measurable enclosed plane surface.

Arithmetic. A mathematical system based upon the set of positive numbers, all numbers greater than zero, under the operations of addition, subtraction, multiplication, division, powers and roots, and any combination of these operations.

Arithmetic Progression or Sequence. A series of numbers each differing from the preceding number by a fixed amount, e.g., 2, 5, 8, 11, ... and 15, 13, 11, 9 ..... The fixed amount determining the sequence is called the common difference.

Arrange. To put in order or in a certain pattern.

Array. Arrangement of numerals or other symbols, often in rows and columns.

Associative Law of Addition. When three numbers are to be added in a stated order, the sum is independent of the grouping.
$(2 + 3 + 4) = (4 + 3 + 2)$

Associative Law of Multiplication. When three numerals are to be multiplied in a stated order, the product is independent of the grouping.

GLOSSARY

Average. A single numeral which represents a collection of numerals. Divide the sum of a group of addends by the number of addends.

Base ten. A system of numeration using the value of ten as its base value.

Borrowing (Re-naming; Re-groupint). A term used to denote changing the form of the minuend to facilitate the subtraction. It is used when a digit in the subtrahend is larger than the corresponding digit in the minuend.

Cancel. In multiplying fractions, this term denotes the action of dividing any numerator and any denominator by the same number.

Example: $\frac{\cancel{2}^{1}}{\cancel{3}_{1}} \times \frac{\cancel{3}^{1}}{\cancel{4}_{2}}$

In this example 2 and 4 have each been divided by 2; and 3 and 3 were divided by 3. This reduces the product before the multiplication is performed.

Cardinal number. Any number used in counting or to answer the question how many, such as one, two, three, etc.

Carrying (Re-naming; Re-grouping). A term used in addition or multiplication to denote changing the form of the sum or product. It is used when the sum or product is equal to or greater than the value of the base.

Check. To verify the correctness of an answer or solution.

Chord. A straight line segment having its endpoints on a circle. It does not necessarily pass through the center of the circle.

Circle. A simple closed plane curve all of whose points are the same distance from a fixed inside point, called the center.

GLOSSARY

Circumference. The distance around a circle.

Closed figure. A figure that can be traced completely without lifting the pencil from the paper and without retracing the path to return to the starting point.

Column. A vertical arrangement of things, numerals, or any other symbols.

Combine. To unite, collect or join.

Commutative Law of Addition. The sum of two numbers is not affected by reversing their order.

Commutative Law of Multiplication. The product of two numbers is not affected by reversing their order.

Compare. To look for or determine like and unlike qualities between objects, groups of objects, numerals and any other symbols.

Congruent. Corresponding. In geometry congruent figures are figures which coincide in all corresponding parts.

Connect. Join.

Correspondence. A one-to-one matching relationship.

Count. To number the units in a collection one-by-one succession to ascertain how many are in the whole collection; the result of the total or cardinal number of a set.

Counting numbers. Positive whole numbers; the set of natural numbers, symbolized as 1, 2, 3, 4, 5, _ _ _ _ _ _ _ _.

Cube. A geometric solid with six equal square faces.

Cylinder. A surface resembling a tin can.

Decade. A group of ten, usually used in defining a set of ten years.

GLOSSARY

Decimale point. The dot written between two digits used to separate the whole numeral from the fractional part; the dot used to separate dollars from cents.

Denominator. The lower term in expressing a fractional number.

Diameter. A straight line segment which passes through the center of a circle joining two opposite points on the circle.

Difference. The answer or result of the subtraction process.

Digit. Any one of the ten Hindu-Arabic numerals 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.

Disjoint sets. No element of one set belongs also to the other. The sets $\{2, 4, 6\}$ and $\{3, 5, 7\}$ are disjoing.

Distance. The measurable length of a straight line segment.

Distributive Law. The product of a number and the sum of two numbers is the same as the sum of the products obtained by multiplying each of the other numbers by the first number.

Example: $3\ (4 + 5) = 3 \times 4 + 3 \times 5$

Divide. The splitting of a group into equal sized parts when either the number of parts or the size of the parts is known.

Dividend. The name of the term which is to be divided in a division problem.

Divisible. Always refer to division with zero remainder.

Divisibility. The property of a number to be divisible (with zero remainder).

GLOSSARY

Division. The process of dividing. Division is the inverse of multiplication.

Divisor. The number in the division process by which the dividend is to be divided.

Double. Twice or two times as large as a given value; multiplication by 2.

Dozen. A collection of twelve objects or a set having the cardinal number twelve.

Element. The name given to the members of a set.

Empty Set. The name for a set having no elements or members.

Endpoint. A name in construction geometry used to denote any one of the two points which determine a straight line segment or the one point of a ray.

Equality. The property of being equal.

Equation. A statement of equality between two expressions.

Equilateral. All sides of a given figure have the same measure.

Equivalent. Possessing equal value though not necessarily equal forms.

Example: $2 \times 12 = 4 \times 6$

Even Number. Any number ending in 2, 4, 6, 8 or 0.

Exterior. Outward.

Factor. Any of the numbers to be multiplied to form a product.

Family. One of the many synonyms for set or collection.

Figure. A shape, form or outline represented by a drawing, design or pictorial pattern.

First Place. A somewhat colloquial term used for the ones' place in a place - value system of arithmetic. It always refers to the digit which stands at the right of a numeral.

GLOSSARY

Fraction. A part of a whole; an indicated division. A fraction is a ratio of two values. The top member is called the numerator and the bottom member is called the denominator.. The denominator indicates the number of equal parts into which the whole has been divided. The numerator indicates the number of those equal parts.

Fundamental Operations. The four fundamental operations of elementary arithmetic: addition, subtraction, multiplication and division.

Geometry. Elementary geometry is concerned with points, collection of points, sets of lines and planes.

Graph. A drawing designed to show relations between two (in some cases more) sets of values. Common forms of graphs are the bar graph, the line graph, the circular graph and pictorial graphs.

Greater Than, More Than. This term states the result of comparing two groups of objects. The full expression is "..... is greater than ....." and the symbol is 7.

Example: $7 > 6$

Gross. Twelve dozen or one hundred forty-four objects.

Half. Any one of two equal parts.

Half Dozen. A collection of six things.

Heptagon. A closed plane straight-line figure having seven sides and seven interior angles.

Hexagon. A closed plane figure having six sides and six vertices.

Horizontal. A straight line following the direction of the horizon; across as opposed to up and down.

GLOSSARY

Identity Element. A number and its symbol which does not change the value when a certain operation is performed. Zero (0) is called the identity element for addition and subtraction, since, for example, $3 + 0 = 3$ and $3 - 0 = 3$. One (1) is the identity element of multiplication and division, since, for example, $3 \times 1 = 3$ and $3 \div 1 = 3$.

Inequality. A statement that one expression is greater than, less than, or not equal to another. It is symbolized by $>$ (greater than), $<$ (less than), or $\neq$ (not equal to).

Inside. The part closed in by a boundary surface or boundary line.

Intersect. To meet or cross in a point or confined space. In set theory the term denotes a subset produced by two sets which have a certain part in common.

Inverse. Opposite in order or operation.

Invert. To form the reciprocal of a numeral.

Join. To unite or add.

Larger. Having greater value than something else.

Less than. Having a smaller value than another value.

Line. A set of points without endpoints.

Line segment. A section or portion of a line; it has two endpoints.

Linear. Pertaining to straight lines.

Match. To find the corresponding part.

Member (Term). The expressions which make up an equation.

Minuend. The number from which another number is to be subtracted.

Minus. A word and operational symbol (-) used between two quantities to denote that the second is to be subtracted

GLOSSARY

from the first.

Mixed number. A number form consisting of a whole number and a fraction.

Multiplicand. The number being multiplied.

Multiplication. The process of multiplying.

Multiplier. The number by which the other is multiplied.

Multiply. To combine like groups.

Number. A concept of quantity.

Numeral. Symbols used to denote numbers.

Numeration System. Any system of representing numbers.

Numerator. The part of a fractional number which is written above the fraction line; the top term of a fraction.

Operation. An interaction or rule of combination between quantities.

Order. Any regular arrangement of parts in some sequence.

Ordinal. A form or type of numeral which refers to the ordered place in a sequence or arrangement.

Outside. That portion of a plane or space which is not enclosed by a bounding line or surface.

Pair. Two of a kind.

Parallel Everywhere equidistant; two straight lines or curves that do not intersect however far extended.

Parallelogram. A quadrilateral having one pair of opposite sides equal and parallel.

Partial Product. A part of a product but not the whole.

Partial Quotient. A part of a quotient but not the whole.

Pentagon. A closed plane geometric figure having five sides and five interior angles.

GLOSSARY

Perimeter. The distance around a plane closed figure constructed by line segments.

Perpendicular. Two lines intersecting to form right angles.

Place-value. The value given to a digit by virtue of the ordered place which it holds in the numeral.

Plus (+). A word and operational symbol used between two quantities to denote that the second quantity is to be added to the first.

Problem. A situation which is to be solved.

Process. Any pattern of computational procedures in arithmetic.

Product. The numerical result of multiplication.

Protractor. An instrument for the numerical measure of angles.

Quadrilateral. Any closed geometric figure having four sides and four interior angles.

Radius. The straight line from the center of a circle to any point on its circumference.

Ray. A straight line extending from a point; it is a straight line which has a beginning but no end.

Reciprocal. The interchanging of the numerator and denominator of a fraction.

Rectangle. A quadrilateral having one pair of equal and parallel sides and four right angles.

Remainder (Difference). The result in a subtraction problem; the undivided part in a division problem.

Result. The final outcome of an operation or series of operations.

Right Angle. A 90^{o} angle.

Right Triangle. A plane triangle containing one right angle.

GLOSSARY

Square.	A plane closed figure having four equal sides paralled in sides and four right angles.
Subtract.	To withdraw; to take away.
Subtraction.	The process of subtracting.
Subtrahend.	That which is to be subtracted.
Table.	A systematic arrangement of data.
Times.	A term denoting multiplication.
Trapezoid.	A closed plane figure having one pair of opposite sides parallel but not equal.
Triangle.	A closed plane geometric figure having three sides.
Unequal.	Not equal.
Union.	A set term referring to the sum of all elements of one set and all elements of another set.
Vertical.	Up and down, at right angles to the horizon.
Width.	The dimension of a figure measured across.
Word Problem.	A quantitative situation stated in words and demands that the solver is able to translate the word statements into arithmetical statements which can be solve.
Zero.	The numeral indicating none.

APPENDIX

APPENDIX A

Gameboards for Math Match Game

8	2	1	5	7
7	5	4	10	3
9	Cards		Used Cards	8
3	1	9	2	6
4	10	6	1	2

Figure 1

4	1	7
2	Cards	9
8		2
10	Used Cards	3
6	3	5

Figure 2

Mini-board for introductory concepts.

As new concepts are taught and new terms are introduced, add cards and board in Figure 1.

APPENDIX A

Suggested cards for Math Match game. Cut 3 x 5 index cards in half.

2 + 2 4 1	addends 2	2 + 2 4 3	sum 4	+ 5	added to or plus 6	4 - 2 2 7
nuend 8	4 - 2 2 9	subtra- hend 10	— 11	subtracted 12	2 x 2 4 13	multi- plicand 14
2 x 2 4 15	multi- plier 16	X 17	times or multiplied by 18	2) 4 19	2 2) 4 20	2 2) 4 21
visor 22	dividend 23	quotient 24	÷ 25	divided by 26	product 27	difference or remainder 28
4 - 2 2 29	2 x 2 4 30					

Card 28 matches card 29, card 27 matches card 27,

card 21 matches card 24, etc.

APPENDIX B

Write the numerals in expanded notation:

1.) 265 =

2.) 307 =

3.) 784 =

4.) 561 =

5.) 400 =

6.) 132 =

7.) 999 =

8.) 608 =

9.) 830 =

10.) 555 =

Fill the chart in with numerals in the proper column:

	Hundreds	Tens	Ones	Standard Form
11.) 60 + 200 + 8=				=
12.) 500 + 9 + 80=				
13.) 40 + 6 =				
14.) 400 + 70 + 2=				
15.) 3 + 200 + 40=				
16.) 20 + 6 + 300=				
17.) 7 + 40 + 700=				
18.) 30 + 5 + 200=				
19.) 10 + 7 =				
20.) 300 + 2 + 10=				

APPENDIX C

Write the numerals for the following:

1.) Four hundred seventeen = _____

2.) Four thousand seventeen = _____

3.) Four thousand, one hundred seven = _____

4.) Four thousand, one hundred seventy = _____

5.) Forty thousand, seventeen = _____

6.) Forty thousand, one hundred seven = _____

7.) Forty thousand, one hundred seventy = _____

8.) Forty-one thousand, seventy = _____

9.) Forty-one thousand, seven = _____

10.) Forty-one thousand, seven hundred = _____

Expand list to include nine-digit numerals.

APPENDIX D

ROLL A SUM				
41	36	31	44	33
50	40	45	35	52
34	30	54	43	47
46	51	53	32	42

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Arrange the following numbers on each board:

30, 31, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 50, 51, 52 53, 54 and 55. These numerals will be the sums of the suggested numerals on the faces of the cubes. Boards may or may not vary because the only player to cover a numeral is the one who rolls the dice.

A master key may be prepared to include all addition combinations used in the game. This will be a self-checking device.

APPENDIX E

Gameboards:

30 - 19 =	27 - 18	423 - 267
42 - 26	200 - 162	106 - 57=
91 - 68	263 - 97=	462 - 194

Problem Cards:

1 1

Front

A list of all problems have the answer which appears on the front side of the card.

Back

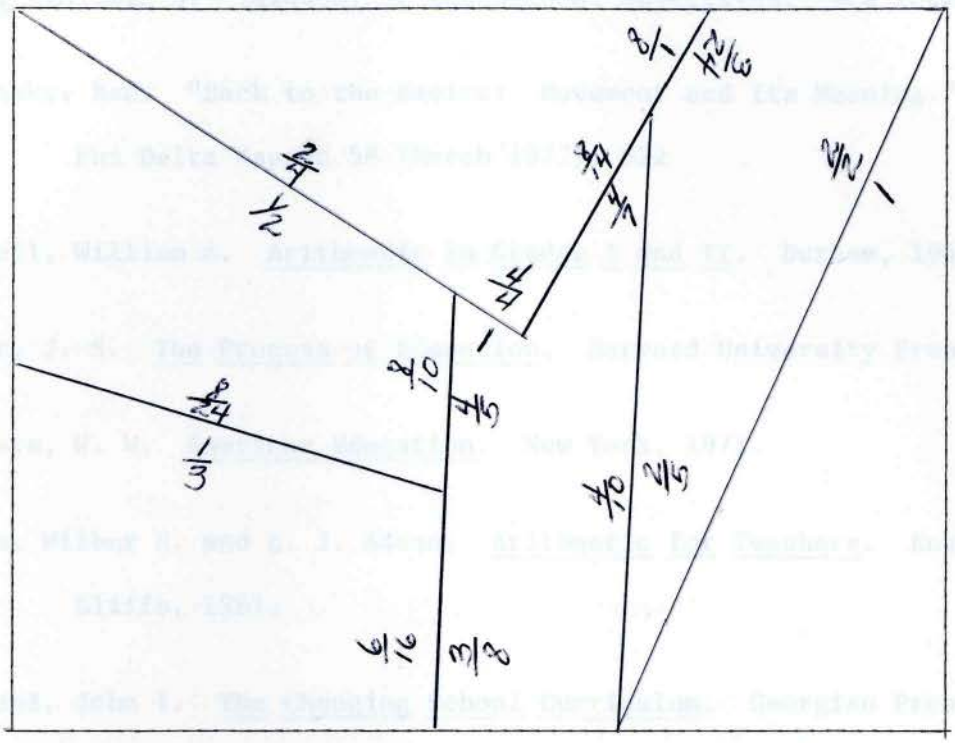
APPENDIX F

Gameboard

X	1	2	3	4	5	6	7	8	9
1									
2									
3									
4									
5									
6									
7									
8									
9									

The playing cards will have the products of intersecting factors. A completed multiplication grid will be the checking device for each group. A checker could be assigned to each group.

APPENDIX G



This is a sample of how the puzzle may be designed. It may be as simple or as complex as the teacher desires. After construction is complete, cut the pieces apart and distribute a puzzle to each group. A different puzzle design, different fractional equivalents and different colors should be used for each puzzle. The team to first complete a puzzle will score a point and then puzzles will be exchanged and game starts again.

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