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Enrichment Activities and Materials for the Intermediate Grades' Arithmetic Program

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ENRICHMENT ACTIVITIES AND MATERIALS FOR THE
INTERMEDIATE GRADES' ARITHMETIC PROGRAM

A Research Paper
Presented to
the Graduate Faculty
Central Washington State College

In Partial Fulfillment
of the Requirements for the Degree
Master of Education

by
Paul R. Trammell

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THIS PAPER IS APPROVED AS MEETING
THE PLAN 2 REQUIREMENT FOR THE
COMPLETION OF A RESEARCH PAPER.

D. Basler
FOR THE GRADUATE FACULTY

TABLE OF CONTENTS

CHAPTER	PAGE
I. THE PROBLEM AND DEFINITIONS OF TERMS	
USED	1
The Problem	1
Statement of the problem	1
Importance of the study	1
Definitions of Terms Used	2
Intermediate grades	2
Enrichment material	2
Enrichment activity	2
II. REVIEW OF THE LITERATURE	3
Definitions of Enrichment	3
The Objectives of Enrichment	5
III. MATERIALS AND ACTIVITIES.	7
Exploring the Number System	7
Number systems with bases other than ten	7
Prime numbers	8
Number progression	8
Number Operations	8
Tests of divisibility	9

CHAPTER	PAGE
Easy steps in algebra	9
Cryptarithms	9
Casting out nines	10
Short-cuts based on aliquot parts	10
The Trachtenberg speed system	11
Recreational Arithmetic	11
A number oddity	11
Number puzzles	12
Arithmetic football	12
A game of squares	12
Magic squares	13
Cross-number puzzles	13
Geometric puzzles	15
Other Enrichment Activities	16
Excursions and field trips	16
Field work	16
Arithmetic club	17
Arithmetic corner	17
Arithmetic notebook	17
Use of the library	17
Films and filmstrips	18

CHAPTER	PAGE
Vocabulary development	18
Experience units	19
IV. SUMMARY	21
BIBLIOGRAPHY	22

CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

In this study an attempt was made to survey various sources of literature in the area of enrichment of arithmetic for the intermediate grades. It was intended to be only a starting point for the intermediate arithmetic teacher seeking challenging, creative activities. It is hoped that the activities and materials contained herein can be adapted to meet classroom situations and serve as inspiration for new and better activities.

I. THE PROBLEM

Statement of the problem. What are some worthwhile enrichment activities and materials for the intermediate grades' arithmetic program?

Importance of the study. Most authorities in the field of mathematics now agree that teaching arithmetic is more than page assignments, testing results, and recording grades. The program must be enriched with activities and materials that will challenge the student to increase his skills and abilities to the fullest extent. Charlotte Junge states, "When learning is at its best, it will provide

opportunities for the child to produce original ideas, to be active in his own learning, and to give range to his imagination" (16:341). It was the purpose of this study to (1) review the literature on the definitions and the objectives of an enrichment program and (2) identify some worthwhile enrichment activities and materials for the intermediate grades' arithmetic program.

II. DEFINITIONS OF TERMS USED

Intermediate grades. The term "intermediate grades" will refer to grades four, five, and six.

Enrichment material. The term "enrichment material" will refer to supplementary topics and aids in arithmetic which are of interest to the pupil, which challenge his ability, and which aid in understanding a mathematical principle.

Enrichment activity. The term "enrichment activity" will refer to any activity involving the use of enrichment material for the purpose of gaining and enlarging upon the interest of the pupil, challenging his ability, and aiding in understanding a mathematical principle.

CHAPTER II

REVIEW OF THE LITERATURE

In most classes in elementary schools there is wide variation in the stages of progress of children and in the rates at which they learn arithmetic. The teacher faces the problem of making adjustments to the content of the curriculum, as well as of methods and materials of instruction to meet these differences. The knowledge of many worthwhile enrichment materials and activities would be most valuable to the teacher. Various definitions of enrichment materials and activities are found in many sources of literature. Chapter II, then, will present various definitions and objectives of enrichment.

I. DEFINITIONS OF ENRICHMENT

Many definitions are given by various writers in the field of enrichment as to just what enrichment materials and activities mean. Several of these definitions will be given in the following paragraphs.

Sanders tells us, "Enrichment is a means of providing learning activities that challenge the child and expand and deepen his understanding" (25:69).

"Enrichment in arithmetic is not the assigning of more of the same type of problems, but the use of more challenging problems," states Adams (1:125).

Gallagher says, "Extra long division problems are busy work, but a new way of arriving at an answer to those same problems is enrichment" (9:21).

"Enrichment is a special effort to challenge the abilities of each student in his experiences in and out of the classroom," says Laycock (20:75).

Brown compares enrichment with a dog going for a walk in the country with his master. The man walks straight along the road and arrives back home in an hour and a half. The dog covers the same road and comes home at the same time. But during that hour and a half the dog has traveled not five, but fifteen miles of countryside. He has investigated openings in drains and hollow logs, and pursued his quota of squirrels. He has sniffed at strange objects, bristled and barked at other dogs, chased two real and eleven imaginary rabbits, and run, intermittently, in every direction. As a result of these experiences, his life has been enriched. He has arrived home a wiser and stronger dog (3:532).

II. THE OBJECTIVES OF ENRICHMENT

The teacher must keep in mind the objectives of an enrichment program when various enrichment materials and activities are used if they are to be beneficial to the students. Norma Cutts lists eight general objectives of any good enrichment program. They are as follows:

1. Challenge the full use of abilities.
2. Broaden the base of knowledge.
3. Deepen understanding.
4. Increase the level of skills.
5. Develop a love of learning.
6. Inculcate desirable methods of learning, thinking, and sharing.
7. Encourage initiative.
8. Give play to creativity (8:43).

The major objectives of enrichment in the field of arithmetic may be briefly stated as follows:

1. To develop broader skills and a richer background of technical knowledge about number and the uses of arithmetic.
2. To develop greater sensitivity to methods of using number in analyzing and interpreting quantitative aspects of experiences in all areas of the curriculum and in the affairs of daily life.
3. To stimulate the learner to higher levels of operation and problem solving.

4. To discover, explore, and stimulate interests, aptitudes, and potentialities of children in the field of mathematics.
5. To establish independent study and work habits and the effective use of printed materials of all kinds (12:399).

CHAPTER III

MATERIALS AND ACTIVITIES

Much literature has been written and many books have been published recently supplying a variety of sources of enrichment materials and activities for the intermediate arithmetic teacher. Several of the activities and materials in exploring the number system, number operations recreational arithmetic, and others will be given here.

I. EXPLORING THE NUMBER SYSTEM

The learning of arithmetic is greatly enriched by an understanding of how the number system operates in computational procedures, by an insight into the meanings of the operations, and by the perception of generalizations and relationships underlying number facts and processes (12:400). The following three methods of exploring the number system are but a few of many excellent means.

Number systems with bases other than ten. Children often find that developing and working with number systems with bases other than 10 is most interesting and challenging. To have a number system to the base 5, for example, it is necessary to have

five symbols. These symbols may be 0, 1, 2, 3, and 4. Then to write the numbers from 1 to 8 to the base 5, we would write: 1, 2, 3, 4, 10, 11, 12, and 13. The 10 means 1 five and 0 ones. Problems involving the four fundamental processes may be worked using other number bases (11:33).

Prime numbers. Any natural number whose only divisors are one and the number itself is a prime number (13:81). The first ten prime numbers are 2, 3, 5, 7, 11, 13, 17, 19, 23, and 29. The children may be asked to write all the prime numbers from 1 to 100.

Number progression. A number progression is a series of numbers in which the sequence is constructed according to a certain plan. The following number progressions are types that might be given to the students with the assignment to find the next two or more numbers in the series:

1. 3, 6, 9, _____.
2. 1, 3, 6, 10, _____.
3. 1, 4, 9, 16, _____.
4. $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, _____.

II. NUMBER OPERATIONS

There are many number operations that students will find interesting as well as most helpful in their arithmetic. A few of

these are listed in the following paragraphs.

Tests of divisibility. Few people know the rules by which large numbers can be tested quickly for divisibility by single digit numbers. The teacher might give the tests of divisibility by various numbers or let the students attempt to discover and formulate rules on their own. The following rules can be discovered:

To test for 2: A number is divisible by 2 if and only if the last digit is even.

To test for 4: A number is evenly divided by 4 if and only if the number formed by its last two digits is divisible by 4.

To test for 5: A number is divisible by 5 if and only if the number ends in 0 or 5 (10:232).

Easy steps in algebra: Many students in the intermediate grades can be given introductory experiences in solving basic algebraic equations. This might consist of finding the values of letters in such equations as these:

1. $3 + 5 = n$

4. $1/4n = 8$

2. $n - 6 = 9$

5. $5 \times n = 20$

3. $14 - n = 7$

6. $n - 6 = 3 \times 4$ (12:409)

Cryptarithms. A cryptarithm is an ordinary problem in addition, subtraction, multiplication, or division in which letters have been substituted for figures. Each letter stands for a certain

figure throughout the problem. No two letters stand for the same figure. The children will find solving cryptarithms very interesting and a challenge to construct their own. The following are examples of some:

$$\begin{array}{r}
 \text{HOCUS} \\
 \text{POCUS} \\
 \hline
 \text{PRESTO}
 \end{array}
 \qquad
 \begin{array}{r}
 \text{SEND} \\
 \text{MORE} \\
 \hline
 \text{MONEY}
 \end{array}
 \qquad
 \begin{array}{r}
 \text{ABCDE} \\
 - \text{EDBE} \\
 \hline
 \text{FDBC}
 \end{array}
 \qquad (18:8)$$

Casting out Nines. Most intermediate students can learn to use "casting out nines" in checking problems; they usually find it fascinating. "Casting out nines" means to divide all the groups of nines out of a number, then the quotient is disregarded or cast out, and you work with the excess or remainder. To check the multiplication example below, divide each factor by 9 and write the excess as shown. Find the product of 7 and 3, and then divide this product, 21, by 9 to find the excess. Is the excess also 3? It will be if 516 is correct.

$$\begin{array}{r}
 43 \text{ ---- } 7 \text{ (excess)} \\
 \times 12 \text{ ---- } 3 \text{ (excess)} \\
 \hline
 86 \qquad 21 \\
 43 \\
 \hline
 516 \text{ ---- } 3 \text{ (excess)} \quad (24:392)
 \end{array}$$

Short-cuts based on aliquot parts. The use of aliquot parts of a number makes possible computational short-cuts. If one number is divisible by another number, the smaller number is an aliquot part of the larger number. Thus 8 is an aliquot part of 32.

The use of aliquot parts of 10,000 or 1,000 frequently is possible in multiplication or division. Since 25 is an aliquot part of 100, or $\frac{1}{4}$ of 100, one may multiply a number by 25 by first multiplying by 100, and then dividing by 4. Similarly, one may divide by 25 by first dividing the number by 100, and then multiplying the quotient by 4.

The Trachtenberg speed system. Many students at this level might enjoy working several problems using the speed methods created by Jakow Trachtenberg. In addition, for example, a person never has to add beyond eleven.(7:52).

III. RECREATIONAL ARITHMETIC

Most youngsters enjoy the challenge of riddles and puzzles. Some youngsters take a real interest in arithmetic for the first time through the medium of an interesting arithmetical game. The following examples are just a few of many such problems that can be devised by the teacher and the students.

A number oddity. The following numbers are examples of number oddities. The pupils will find it a real challenge to investigate other numbers and operations in discovering as many number oddities as possible.

$$8 \times 8 \times 8 = 512 \quad \text{-----} \quad 5 + 1 + 2 = 8$$

$$17 \times 17 \times 17 = 4913 \quad \text{-----} \quad 4 + 9 + 1 + 3 = 17 \quad (19:7)$$

Number puzzles. Think of a number, multiply it by 2, add 18, divide the result by 2, subtract the original number, and the result is always 9.

Write twenty using only four 9's. $(9 + \frac{99}{9} = 20)$

A bottle and a cork cost \$1.10 and the bottle cost \$1.00 more than the cork. How much does each cost? (26:113)

Arithmetic football. Arithmetic football is a game played without the aid of pencil on paper. The teacher or students make up several problems of various types on small pieces of paper. The easier the problem, the less "yards" it is worth. Each problem carries a gain or loss. If the problem is correctly solved, the pupil or team gains yardage; if incorrect, a loss of yardage. The use of this game has been highly successful in stimulating rapid and accurate computation without pencil and paper. (17:212-13)

A game of squares. A pattern of dots is given to start the game. The idea is to start at any place and to connect each dot, and try to complete as many whole squares as possible. No diagonal connections are permitted. You cannot take pencil off the paper, nor retrace or cross any previous lines. Points can be allowed for each

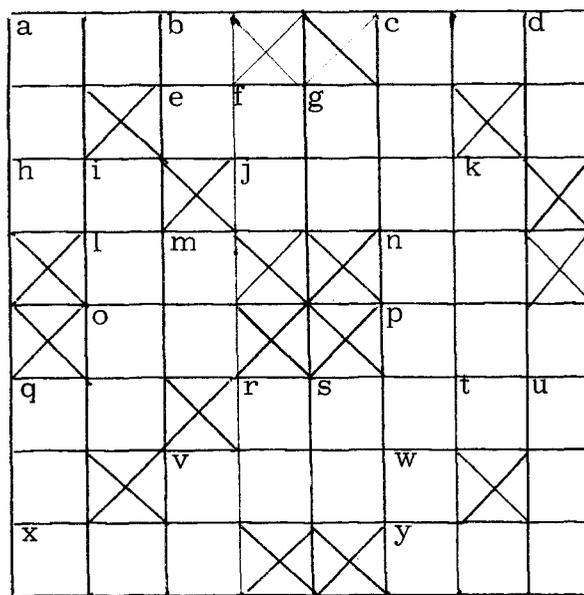
completed square (15:211).

Magic squares. In a magic square the sums in each row, column, and diagonal are the same. Students enjoy solving magic squares, and many find it very challenging to construct their own to try on fellow classmates. The following is just one example of a magic square:

2	9	4
7	5	3
6	1	8

(13:60)

Cross-number puzzles. Most students enjoy working cross-number puzzles. This is an excellent method of teaching old learnings in arithmetic in a new way. Many students will enjoy attempting to construct their own puzzles. The following is an example of a cross-number puzzle involving the use of measures:



Across

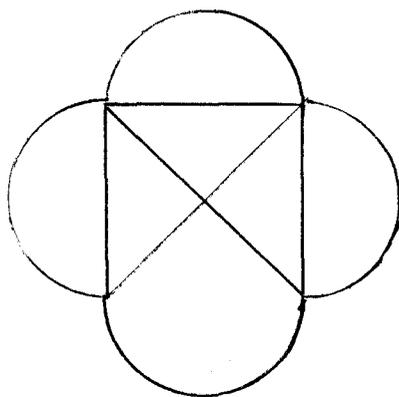
- a) A gross
- c) Inches in 9 feet
- e) Feet in 1 mile
- h) 4 decades plus 1 year
- j) Ounces in 3 pounds
- k) Nickels in \$2.00
- l) Hours in 3 days
- n) Quarters in \$7.00
- o) Quarts in 6 gallons
- p) Minutes in $1 \frac{1}{4}$ hours
- q) Inches in $\frac{1}{2}$ yard
- r) Area of square 7 in. on a side
- t) Feet in 2 rods
- v) Digits whose sum equals the years in a decade
- x) Pounds in $\frac{1}{5}$ ton
- y) Days in 15 weeks

Down

- a) Weeks in 2 years
- b) 9 inches more than 1 yard
- c) Area of rectangle $5' \times 2'$
- d) Yards in $\frac{1}{2}$ mile
- f) Hours in 1 day
- g) Quarts in 11 pecks
- i) Area of land $72' \times 24'$
- k) Digits whose sum equals the ounces in $1 \frac{1}{4}$ pounds
- m) Months in 2 years
- n) 3 days less than a month
- q) Sq. in. in sq. ft.
- r) Minutes in $\frac{3}{4}$ hour
- s) Sq. ft. in 10 sq. yd.
- u) Days in 1 year
- v) Two and a half dozen
- w) $10 \frac{1}{2}$ pairs

(27:223)

Geometric puzzles. Most children find geometric puzzles very intriguing and interesting to solve. The following example is just one of numerous puzzles that can be constructed by the teacher or the students. The student is to construct the figure without raising his pencil from the paper nor is he to cross or retrace any line.



IV. OTHER ENRICHMENT ACTIVITIES

Many other methods can be used to provide enrichment for the intermediate arithmetic program. Some of the most commonly used methods are mentioned in the following paragraphs.

Excursions and field trips. There are many places, rich in contact with numbers, to which excursions and field trips can be made. These experiences when carefully planned will do much to add meaning to the enrichment of the arithmetic program. The following list suggests just a few places of interest:

1. Weather station
2. Airport
3. Bank
4. Grocery store
5. Post office
6. Tax office (4:538-39).

Field work. There are many experiences in the nature of field work that offer excellent opportunities to enrich the learning of arithmetic by applying it in such concrete situations as the following:

1. Finding the length of a city block.
2. Laying out an acre of ground.
3. Finding the area of the school playground.
4. Checking the dimensions of a basketball court.
5. Finding the volume of the classroom.
6. Checking your time in walking a known distance.
7. Laying out a baseball diamond. (12:419).

Arithmetic club. Many elementary schools have arithmetic clubs available to enrich the limited time available in the regular class periods. Often even the poorer arithmetic students gain much from the informal approach of these clubs. Programs are geared to the interests of the children. Some of the club's activities might be: constructing scale models, making individual reports, taking a field trip to points of interest, and viewing films (23:274).

Arithmetic corner. A classroom corner for puzzle books, arithmetic recreation books, with pamphlets and books on various mathematical topics should be available for the children to browse and to go to for references for specific topics of interest. Reference books such as The World Almanac and encyclopedias are of great worth (22:142).

Arithmetic notebook. A notebook used to keep information of arithmetical interest has proved to be of value in some arithmetic classes. Constructing and keeping graphs of scores in arithmetic tests, reading rate, as well as keeping a growth chart of individual height and weight are but a few items that can be inserted into each notebook (21:386).

Use of the library. "The library is the key to an enrichment program," states Brueckner. Most libraries provide many materials

for children to use in investigating various areas of interest. Some of the topics the students could do research on might be as follows:

1. Ways time has been told down through the ages.
2. How many miles an hour a spot on the equator moves.
3. The amount of water in some of our fruits and vegetables.
4. How the speed of the wind is measured.
5. How to find the distance around a bicycle tire.
6. The Dewey Decimal System used in libraries.
7. Measuring devices found in automobiles.
8. The history of our number system.
9. The history of measures. (4:105)

Films and filmstrips. Visual aids are an integral part of the program for making arithmetic meaningful to the pupil. There are many films and filmstrips adaptable for the intermediate grades' arithmetic. They are generally most effective when planned and integrated into the unit of study (4:426).

Vocabulary Development. Johnson suggested a list of activities that may be used with students to enrich their understanding of words used in arithmetic. Some of these activities included the following:

1. Using the dictionary to find the meanings of words.
2. Using given words in sentences.
3. Matching words with definitions, objects, pictures.
4. Grouping or classifying mixed lists of words under proper headings.
5. Giving words having similar meaning.
6. Performing some action to show meaning.
7. Restating expressions in other words.
8. Giving opposites or synonyms of words(14:97-110).

Experience units. The use of experience units provide an excellent means of enrichment. The units are based on real-life experiences and have activities that will challenge all levels of achievement. An analysis of the major kinds of activities that may take place in units of experience is given below:

1. Problem-solving activities involving
 - a. The formulation of a problem
 - b. Consideration of the scope and significance of the problem
 - c. Planning a method of attack
 - d. The assignment of tasks to individuals or groups
 - e. The location and gathering of necessary information from persons and printed sources
 - f. Research and experimentation needed to get new data
 - g. The assembling, organizing, and presenting of findings
 - h. Drawing conclusions and making decisions
 - i. Taking steps to carry out decisions
2. Construction activities, such as
 - a. Making graphs, charts, and diagrams
 - b. Making working models of various kinds, designs
 - c. Preparing exhibits, displays
 - d. Carrying on experiments
 - e. Constructing equipment, tools, utensils
 - f. Participating in surveys, drives, campaigns
 - g. Buying, selling, building, collecting, etc.
 - h. Exploring meanings by manipulating and grouping objective materials
3. Appreciation activities, such as
 - a. Viewing slides, films, pictures
 - b. Reading stories, books, articles, bulletins
 - c. Hearing radio programs
 - d. Viewing plays, dramatizations, performances
 - e. Hearing talks by local people, experts
 - f. Looking at exhibits, displays

4. Creative activities, such as
 - a. Painting, drawing
 - b. Making murals, decorating
 - c. Writing original imaginative materials
 - d. Planning improvements
 - e. Suggesting original novel solutions
 - f. Inventing new methods, means, and materials
 - g. Dramatizing, performing

5. Excursion, to such places as
 - a. Places of business, banks, stores
 - b. Industries, factories, warehouses
 - c. Farms, dairies, orchards, etc.
 - d. Transportation centers and facilities
 - e. Libraries, museums, art centers
 - f. Historical spots
 - g. Hospitals, medical centers
 - h. Housing projects, slum areas
 - i. Governmental buildings, post office

6. Practice activities, such as
 - a. Using reading skills
 - b. Using language skills, both oral and written
 - c. Using number and computational skills
 - d. Locating and using sources of information
 - e. Using tools, equipment, apparatus
 - f. Applying algebraic and geometric concepts

(6:285-86).

CHAPTER IV

SUMMARY

The purpose of this study was to survey various sources of literature in the area of enrichment of arithmetic for the intermediate grades, and to record the activities and materials that might be adapted to meet classroom situations.

Chapter I stated the problem, gave the importance of the study, and listed the definitions of terms used in the paper. Chapter II contained the review of the literature listing several authors' definition of enrichment materials and activities, the objectives of any enrichment program, and the specific objectives of an enrichment program in the field of arithmetic. Chapter III consisted of specific arithmetic activities and materials that can be used in many classroom situations.

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