ARITHMETICAL CONCEPTS IN SECOND GRADE READERS

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CHAPTER I

THE DEVELOPMENT OF THE PROBLEM

Introduction

The modern world reflects, on every hand, the applications of arithmetic. Almost every activity of the elementary school, however commonplace, uses arithmetic in some form. Not all teachers, however, have accepted the interrelationship between arithmetic and the other subjects of the curriculum.

This study is based upon the belief that much arithmetic is taught through information found in the readers used in the basic reading program, and that by a closer correlation of the reading and arithmetic programs, both reading and arithmetic could be taught more effectively.

The specific problem of the thesis is to determine the kind and number of arithmetical concepts found in the adopted readers for the second grade in the state of Oklahoma. While this report involves the results obtained from checking only five reading texts used by the second grade children, it is believed to be a fair sampling of the materials which second grade children read since it includes all basic texts adopted for use in the state.

In an investigation of the practices of fifty elementary school teachers enrolled in the 1941 summer session of Pennsylvania State College, Hilton[1] found that in 96 per cent of the classroom situations basal readers were used and that in 66 per cent of the classrooms every pupil in a given grade used the same basal reader. Since this was the situation reported by teachers who were giving their summer to professional training in this area, it may well be assumed that similar results would be obtained in comparable repetitions of the investigations.

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[1] Gladys Moulton Hilton, "A Study of Differentiated Language Instruction by Means of Questionnaire-Interview Technique." Seminar Research Project, Reading Clinic, Pennsylvania State College.

Experienced teachers know that the educational program in the United States, from grade one through the university, is so patterned that the printed page is the chief medium for acquiring knowledge. Grossnickle[2] estimates that 87 per cent of one's sensations come from the printed page.

Although the basic readers are planned and used primarily for developmental reading, the writer believes that a careful analysis of them will prove that they contribute to the development of skills, attitudes, and general information in many arithmetical situations. She further believes that if teachers were aware of the contributions which the readers make to the arithmetic program, better correlation could be achieved and that the teaching of both reading and arithmetic would be more effective.

Need for the Study

The basic aim of the arithmetic program in the second grade is a well-balanced program giving the child clear, concrete concepts of the quantitative aspects of things with which he deals, through activities demanding a wide and varied experience with numbers. There is also an almost universally accepted philosophy that number should be meaningful to the learner. There is little agreement, however, on what is meaningful or on what is correct procedure to use to secure meaning and understanding. In a paper presented at the Fourth Annual Conference on Arithmetic, Buswell urged teachers to seek a better understanding of how pupils think when working with numbers.

> Meanings for pupils are what they think, not necessarily what teachers think. In our concern for meaningful arithmetic we need to know both the array of mathematical meanings which make up the subject

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[2] Foster E. Grossnickle, "The Use of Multi-Sensory Aids in Developing Arithmetical Meanings," Arithmetic, p. 1. Supplementary Educational Monograph 66.

> of arithmetic and the levels at which these various meanings can be appropriately learned. In doing the latter, the main consideration is not the logical sequence in which these meanings may be arranged but rather the sequence in terms of pupil's learnings and understandings. We are blocked at present in doing this by the inadequate research findings that would show us the nature of meanings from the child's rather than the teacher's point of view.[3]

In his Psychology and Teaching of Arithmetic, Wheat has this to say concerning arithmetic:

> In spite of longer terms, better buildings, better equipment and presumably better courses of study and better teachers, the subject of arithmetic remains as the rock upon which the hopes and aspirations of teachers and pupils continue to be wrecked. Not only do pupils fail in arithmetic; their failures are cumulative. Year by year pupils continue to fail, and the failures of given pupils become more and more serious.[4]

There is constant criticism from the intermediate teachers that the pupils who come to them are not receiving the proper background for the required arithmetic work in those grades. A strong feeling exists also among the parents that their children are not doing adequate work in numbers. Many complain because the teacher will not allow the children to bring "problems" home to work. Nearly all contend that much more arithmetic was taught when they went to school.

In the older schools the textbooks did contain much meaningless drill, much purposeless problem work, and nothing approaching acceptable informational units in arithmetic. It is also undoubtedly true that the textbook of today uses easier words and teaches by context and pictures more than ever before. In a statement regarding the changes in making textbooks Buckingham states:

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[3] G. T. Buswell, "Methods of Studying Pupils' Thinking in Arithmetic," Supplementary Educational Monograph 70.

[4] Harry Grove Wheat, The Psychology and Teaching of Arithmetic, p. 156.

> The American textbook outranks any other and is continually improving. . . . Never in the history of our country has there been such feverish activity in the writing, revising, and publishing of textbook materials. From the child at his desk to the man in the services, the cry is for books, and yet more books - for books with invigorating ideas - for books accurately aimed at sharpened objectives - for books which put a cutting edge upon instruments dulled by disuse - for books which make up for the consequences of misspent childhood.[5]

In summarizing criteria for appraising a school's reading program, Tyler has this to say about "Integration":

> A second criterion emphasized by a number of speakers is that there should be a meaningful relationship between the reading experiences and the learning experiences provided in other aspects of the school program. This is the criterion sometimes called "integration" or "correlation." Gray, for example, states that "reading is only one of many aids to learning" and that the use of reading should be coordinated with other fields. Horrick asks whether the program is related to important elements of language-teaching. Miss Faulkner recommends that we relate reading and other learning experiences.[6]

There is a feeling on the part of the writer that the field of arithmetic and the field of reading are so closely related in purpose that opportunities for correlation of the two subjects should be created as soon as the child starts to school. If the child did not meet number ideas in his reader, the teaching of arithmetic would be of little value, since the reading furnishes the proper repetition of many of the number terms and thoughts so necessary to understanding.

According to Tyler,

> Education itself is a process that requires time to produce significant and lasting effects. Children do not develop habits, acquire fundamental attitudes, develop logical methods of thinking, or gain other

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[5] B. R. Buckingham, "Progress in Making Textbooks," Proceedings of the Annual Conference on Reading, pp. 213-239.

[6] Ralph W. Tyler, "Summary of Criteria for Appraising a School's Reading Program," Supplementary Educational Monograph, Vol. VII, No. 61, pp. 222-230.

> important educational results in a week, a month, or even a year. In some respects the process of education can be likened to the wearing-away of a rock by the dripping of water. It is the continuous emphasis, the continuous opportunity for desired learning to take place, the continuity of experience, which is so important for fundamental results.[7]

What is true of education generally applies particularly to arithmetic. Many phases of arithmetic need to be taught and then retaught several times at higher levels because it is easily discovered at each grade level that the pupils need such additional opportunities to learn.

The teacher of arithmetic expects the child to read from his textbook only a page or two each day. In the reading program he is expected to do extensive daily reading. Through the reading textbooks, as number situations re-occur, what has already been learned is not only learned again, but it is also learned more fully in new situations and at a more mature level when re-learned.

Purpose of the Study

The purpose of this investigation is to study the content of the five state adopted basic readers of the second grade for the kind and number of arithmetical concepts found in the books. Through a frequency word-count and the classification of the kinds of arithmetical vocabulary used, one may learn to some extent the value of a closer correlation of reading and arithmetic programs. By advocating a wider use of arithmetical knowledge through the integration of a reading and arithmetic program, the writer does not, however, suggest that all of the teaching difficulties in the arithmetic field have been solved.

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[7] Ibid.

The writer believes that the number concepts encountered in the texts being checked are in general very similar to those found in the studies designed for the purpose of ascertaining the knowledge of arithmetic needed by children of the second grade.

Procedures of the Study

The writer read and summarized pertinent research and related literature. From this reading a master list of arithmetical concepts needed by second grade children was developed. Next, the five adopted basal readers listed below were read and analyzed to determine the arithmetical concepts contained.

McKee, Paul and Harrison, M. Lucile. Come Along, Book Two. Boston: Houghton Mifflin Company, 1950.

Bond, Guy L. and Adler, Grace L. Down Our Way, Book Two. Chicago: Lyons and Carnahan, 1949.

O'Donell, Mable and Carey, Alice. Friendly Village, Book Two. New York: Row, Peterson and Company, 1941.

Gray, William S. and Gray, Lillian. Friends and Neighbors, Book Two. Chicago: Scott, Foresman and Company, 1946.

Ousley, Odille and Russell, David H. We Are Neighbors, Book Two. Boston: Ginn and Company, 1949.

The concepts found in the books were then compared with the master list compiled from the writings of authorities. The data were assembled in tables, found in Chapter III, which show the books in which the word was found and also its frequency of use. From these tables conclusions were drawn and recommendations made.

Summary

The specific problem of this study is to determine the kind and number of arithmetical concepts found in the adopted basic readers for the second grade in the State of Oklahoma. The procedure used is that of the word-count method. The vocabulary used is an outgrowth of lists of words based upon studies in the fields of arithmetic, reading, spelling, and other subjects.

Limited concepts and vocabulary are the source of much difficulty in reading and arithmetic at all levels and the primary grades are no exception. The findings of this study should prove helpful to teachers who are attempting to help children achieve integration of their learning as it shows interrelationship between the basal readers and those arithmetical terms which authorities deem essential for children in the primary grades.

CHAPTER II

SUMMARY OF RESEARCH AND RELATED LITERATURE

The method of attempting to determine the relative value of subject-matter through the frequency of use in printed materials has been used in all the fields more extensively than it has in the field of arithmetic. While some of the related studies mentioned in this chapter may seem somewhat remote to the general problem under consideration, the thread of similarity is the method employed in the determination of the frequency of use.

Many attempts to determine the importance of words or concepts in written and printed materials have been made. Among prominent educators employing the word count method are Ayres, Bagley, Caldwell, Curtis, Finly, Horn, Jones, Rugg and Thorndike.

Jones[1] presented a list of words based upon frequency of use in compositions written by 1050 pupils in grades II to VIII in Illinois, Maryland, Iowa, and South Dakota. He found 4,352 different words out of a running total of approximately 15,000,000 that were used by 2 per cent or over of the children in the grades in which the words first appeared. He found that the average vocabulary of the children in grades II to VIII is as follows: 521, 908, 1235, 1489, 1710, 1926, and 2135. In making his word count, words like "have" and "having", offering opportunity for misspelling were counted as two words, but words from the same basic words like "laugh" and "laughed", offering little opportunity for misspelling were counted as one word. On the basis of the frequency of the misspelling, Jones compiled his famous list of "One Hundred Spelling Demons".

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[1] F. W. Jones, Concrete Investigation of the Material of English Spelling.

Bagley[2] in the Sixteenth Yearbook of the National Society for the Study of Education reports the results of a study undertaken for the purpose of determining the names and topics common to twenty-five textbooks for grades VII and VIII. The twenty-five textbooks represented four successive periods of publications between 1865 and 1912. The results present merely one list of the names and topics common to at least three-fourths of the books. Horn, in the same volume, reports a study in which a list of books recommended by the Departments of Political Science, Sociology, and Economics was analyzed to find the following: (1) the percentage of historical characters referred to in each book; (2) the specific and approximate dates included; (3) the historical characters referred to in each book; (4) the frequency of reference to each of the more important phases of history. Horn[3] gives some details of procedure, but his study is very largely a listing of the results.

Partridge[4] made an extended investigation to determine the number needs in children's reading activities. In her study, two types of materials were analyzed: textbooks and magazines read by children. The textbooks analyzed were those in grades III to VI inclusive, used by the California State Department of Education. A single issue of the ten magazines, mentioned most often as coming to the homes of the children and sometimes read by the children themselves, constituted the list of magazines analyzed. This list

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[2] W. C. Bagley, "Present Day Minimum Essentials in United States History as Taught in the Seventh and Eighth Grades," Second Report of the Committee on Minimum Essentials in Elementary School Subjects, pp. 143-155. Sixteenth Yearbook of the National Society for the Study of Education, Part I.

[3] Ernest Horn, "Possible Defects in the Present Content of American History as Taught in the Schools," Second Report of the Committee on Minimum Essentials in Elementary School Subjects, pp. 156-172.

[4] Clara Martin Partridge, "Number Needs in Children's Reading Activities," The Elementary School Journal, XXVI (January, 1926) 357-366.

included: Saturday Evening Post, Ladies Home Journal, National Geographic, American Magazine, Child Life, Delineator, Woman's Home Companion, American Boy, Good Housekeeping, and Youth's Companion. Partridge found in the material examined 3,950 references to number - 1,009 in the textbooks and 2,941 in the issues of the magazines. Of the 1,009 references appearing in the textbooks, 346 of them appeared in advanced geographies. While Partridge does not give any place in the article her principles for determining a mathematical reference or her method of classification, she indicates that 3,950 references were classified under the following heads: serial numbers, ordinals, fractions, decimals, United States money, Roman numerals, time measurements, thermometer readings, mathematical terms, references to processes, words with quantity meaning, and signs of arithmetical operations.

Other findings in this investigation present these facts:

> Words with a quantity content are most frequently encountered. The children in primary grades must have number experiences with these words in order to understand their full meaning. Among such words are: many, more, most, few, fewer fewest, little less, least, wide, wider, widest, tall, taller, tallest, single, double, pair.

In conclusion Partridge states that teachers from Kindergarten to grade VI must assume the responsibility of providing opportunities for experiences that will give the child definite conceptions of number relationships that will carry over and illuminate other subjects.

Wilson[5] in the Sixteenth Yearbook presents an analysis of 5,036 problems actually met in business and social life by 1457 persons in 18 different school systems. In collecting the problems, Wilson asked the parents to allow the children in grades VI, VII, and VIII to record the problems

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[5] Guy M. Wilson, "A Survey of the Social and Business Uses of Arithmetic," Sixteenth Yearbook of the National Society for the Study of Education, Part I, pp. 128-142.

actually solved by the parents in their daily activities for a period of two weeks. Analysis of the problems solved reveals that they are very brief and simple and suggests that many time-consuming arithmetical processes might well be eliminated from the course of study.

Similar studies by Mitchell[6], Moon[7], and Smith[8] represented later attempts to apply scientific method in the determination of the kind of arithmetic encountered in the activities of social life. Some of the studies emphasized adult needs; others, the needs of children. All were efforts to determine the demands of arithmetic in the activities of life.

In Willey's[9] study of children in grades I and II the following investigations have shown the needs of children for numbers; elementary school teachers recorded the arithmetic problems that arose spontaneously in the lives of children in natural situations in school periods not devoted to arithmetic instruction. The problems selected were those that were meaningful to the child and problems that satisfied a genuine need. During a period of 18 weeks, 639 problems were used by children in kindergarten and grades I and II. These problems were classified as follows: Money, 12 per cent; measurement, 10 per cent; time, 15 per cent; objects, 18 per cent; pets, 18 per cent; school subjects, 26 per cent; and distance, 1 per cent.

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[6]H. Edwin Mitchell, "Some Social Demands on the Course of Study in Arithmetic," pp. 7-17.

[7]Philo G. Moon, "The Child's Use of Numbers," Journal of Educational Psychology, (November, 1919), 462-467.

[8]Nila B. Smith, "An Investigation of the Uses of Arithmetic in the Out-of-School Life of First-Grade Children," Elementary School Journal, XXIV (April, 1924), 621-623.

[9]Roy De Verl Willey, "A Study of the Use of Arithmetic in the Elementary Schools of Santa Clara County," California Journal of Educational Research, XXXVI (January, 1943), 353-365.

A further analysis of these problems showed that the children used the following number processes: counting, reading and writing numbers, addition, subtraction, multiplication, division, common fractions, decimal fractions, denominate numbers, and mensuration.

A recent study by Koenker dealing with the preschool child's experiences with number concepts include the following uses of number:

> A summary of these studies shows that the average child, on entering school, possess the following concepts and abilities: rote counting by 1's to 100, rote counting by 2's to 20, rational counting by 1's through 20, arranging and identifying groups of objects to 10, number combinations to the sum of 6, understanding of one-half, several simple circles, understanding of such terms as many, few, some, small, large, tall, short, both, two, equal, etc. The child also possesses some knowledge of the use of methods of measurements such as the ruler, yardstick, scales, clock, calendar, speedometer, quarts, pints, gallons, bushel, thermometer, etc. He probably knows his age, height, weight, birthday, house number and telephone number.[10]

In determining the kinds of number ideas among children from 4 to 8 years of age, Russell summarizes his findings:

> 1. The results lead to the conclusion that the child's first concept of number is a "manyness" from which the quantity and serial aspects of number differentiate. Data were presented to show that the differentiation is a gradual process which, at the seven-year-old level and beyond does not reach the adults perception of the cardinal and ordinal ideas of number.
>
> 2. The present study substantiates the hypothesis that the cardinal and ordinal number concepts develop simultaneously. Ability to count in itself, is not a reliable measure of this development.
>
> 3. The seven-year-old uses such terms as "many", "most", "more". The words "same" and "equal" are not fully comprehended.
>
> 4. It is not likely (as many have maintained) that the first or second grade pupil will be mature enough to master completely and understand isolated addition and subtraction facts. Formal work such as drill over these arithmetic facts should be discouraged. The observations indicate that the initial training in arithmetic should be undertaken with the use of concrete materials.[11]

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[10] Robert H. Koenker, "Arithmetic Readiness for Primary Grades," Arithmetic 1949, No. 70, November.

[11] Ned M. Russell, "Arithmetical Concepts of Children," Journal of Educational Research, XXIX (May, 1936), 647-663.

An attempt to secure more emphasis on the teaching of vocabulary of arithmetic is described in an article by Olive Gray.[12] This report contains five lists of terms which pupils should understand. Another well-known list of arithmetical terms is the Pressey list[13] which contains about four hundred technical terms which, in the judgment of the compiler, are important. There seems to be room for considerable difference in judgment with respect to the inclusion or exclusion of certain terms, but the list was compiled when there was less objective material to be used as a basis for selection than there is at the present time. However, until more extensive research is done, personal judgment will continue to remain a major factor in determining whether a particular term is or is not to be considered arithmetical.

A review of the literature of the vocabulary of arithmetic should not omit the studies of Buckingham and McLatchy,[14] in which the number abilities of children entering the first grade were studied. In the report of this investigation, all significant previous investigations of a similar kind, both in this country and in Europe, are reviewed.

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[12]Olive Gray, "Teaching Pupils to Read Arithmetic and Other Subject Matter," Elementary School Journal, XXVI (April, 1926), 607-18.

[13]Luella Cole Pressey, The Technical Vocabularies of the Public School Subjects: Arithmetic.

[14]B. R. Buckingham and Josephine McLatchy, "The Number Abilities of Children When They Enter Grade One," Report of the Society's Committee on Arithmetic, pp. 473-524. Twenty-Ninth Year Book of the National Society for the Study of Education.

The following list of words is taken from a study made by Buswell[15] in which two second grade arithmetic textbooks were analyzed:

about	cord	from	no	sign
above	correct	full	none	size
add	cost	group	now	sold
addition	count	half	number	some
after	date	halves	oblong	sometimes
again	day	heavy	of	space
all	difference	high	on	spend
also	dime	hour	only	spent
always	dimensions	in	other	square
amount	distance	inch	ounce	straight
and	divide	into	out	subtraction
another	divisor	just	outside	sum
answer	dollar	large	over	table
any	down	left	own	take
around	dozen	length	paid	tall
at	each	less	pair	then
away	earn	light	part	third
back	empty	like	pay	time
begin	end	line	peck	times
below	enough	little	penny	together
besides	equal	long	piece	under
between	even	low	pint	up
big	every	make	point	upon
both	exact	many	pound	upper
bought	feet	measure	price	upward
but	far	middle	prove	usually
buy	foot	minute	quart	week
cent	figure	money	rest	weight
center	fill	month	sale	wide
century	first	much	save	width
change	following	near	score	with
charge	foot	never	second	without
circle	form	next	sell	yard
column	forward	nickel	short	year

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[15] G. T. Buswell and Lenore John, The Vocabulary of Arithmetic, pp. 107-116.

The original list consisted of five hundred terms commonly used in arithmetic as represented by twenty-seven arithmetic textbooks from grade II to VI inclusive. The chief purpose of the investigation was to record children's reactions to arithmetical terms and the development of their concepts of these terms from grade to grade. From this long list he selected a shorter list of one hundred terms for testing purposes.

Rosenquist[16] maintains that systematic instruction in number should begin when pupils enter school whether that be kindergarten or the first grade. This does not imply that a certain period be set aside each day in which numbers are specifically taught but that the teacher has in mind certain skills and understandings to be taught to the pupils and that the instructional activities are planned to teach these ideas. Aside from the learning of these particular skills, she has developed the following minimum word list of arithmetical ideas as an adequate vocabulary for the first and second grades:

add	dime	few	how much	longer
addition	divide	fewer	inch	longest
altogether	dollar	fewest	large	low
answer	dozen	fifth	larger	lower
big	each	first	largest	lowest
bigger	enough	foot	last	(as) many as
biggest	even	fourth	least	measure
both	every	fraction	left	minute
bought	feet	group	length	month
buy	far	half	less	more
cent	farther	height	less than	more than
change	farthest	high	light	most
circle	fast	higher	lighter	much
correct	faster	highest	lightest	narrow
cost	fastest	hour	line	narrower
count	foot	how many	long	narrowest

[16] Lucy Lynde Rosenquist, Young Children Learn to Use Arithmetic, p. 35.

near	one-fourth	score	smaller	third
nearer	pair	second	smallest	twice
nearest	part	separate	space	week
nickel	penny	several	spend	weigh
none	pint	share	square	wide
nothing	pound	short	straight	wider
number	price	shorter	subtract	widest
old	quart	shortest	sum	width
older	rect (of it)	sign	table	yard
oldest	right	slow	tall	year
once	row	slower	taller	young
one-half	scale	slowest	tallest	younger
one-third	same as	small	teens number	youngest
				zero

In addition to the mathematical phase of the arithmetic work of the primary grades Brueckner suggests the following outline of goals for social experiences:

a. Measurement - the study of measuring devices and ways of using them in a social situation.

(1) Value, including coins, stamps, tokens, money
(2) Time, including clock, watch, calendar
(3) Liquid measure, including pint, quart, gallon
(4) Distance, including ounce and pound and use of scales
(5) Weight, including ounce and pound and use of scales
(6) Temperature, including thermometer
(7) Volume or capacity, including boxes and bushel basket
(8) Quantity, as dozen, pair

b. Using numbers to locate things when the need arises

(1) Addresses of homes, places of business, room numbers
(2) Pages in books, including table of contents, index, etc.
(3) Dates on calendars
(4) Objects, in catalogs, cases, files, racks, exhibits
(5) Maps, charts and tables
(6) Highway and street numbers
(7) Directions, such as north, southwest

c. Vocabulary and symbols for expressing quantitative ideas

(1) Quantitative vocabulary for size, amount, shape, value
(2) Words used to name groups, as pair, herd, crowd
(3) Comparisons and differences of size, shape, amount, etc.
(4) Reading and speaking vocabulary used in all areas of the curriculum
(5) Labels, abbreviations, signs, advertisements

d. Understanding social institutions and practices, past and present, involving common uses of numbers

(1) Buying food, tickets, books, clothing, etc.
(2) School bank
(3) Post office, stamps, etc.
(4) Cooking and baking
(5) Numbers used in sports and games
(6) Planning a party, getting amount and cost of things needed
(7) Paper sale, candy sale, flower sale
(8) A school grocery store
(9) The meanings and uses of money
(10) Using the telephone
(11) Sharing things
(12) School lunches, milk supply
(13) Travel - time, speed, cost
(14) The weather bureau and weather records
(15) How the grocer conducts details of his business; similarly, other businesses.
(16) Arithmetic in the library - fines, rentals, card numbers, etc.
(17) Arithmetic in the home
(18) Time-tables, schedules, etc.
(19) Planning a school or home garden[17]

Summary

The investigations reviewed suggest the need for careful checking of the reading materials required of children in the primary grades. Many of these studies fail to indicate, however, the exact methods which were used in determining their findings. They do suggest that with the emphasis placed so strongly on the social use of arithmetic that much formal use has been eliminated from the second grade. The variety and amount of arithmetic and the demands made upon the reader for good interpretations are greater than ever before. If the demands for reading and arithmetic are different from those of twenty-five years ago, these demands should be reflected in the objectives of a reading and arithmetic program.

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[17] Lee J. Brueckner and Foster E. Grossnickle, How to Make Arithmetic Meaningful, pp. 160-169.

There should be a greater clearness than has formerly been achieved in the presentation of both learning activities, if the needs of the learner are to be satisfied and he is to be enabled to meet with reasonable success the demands which society imposes on him.

CHAPTER III

PROCEDURE AND FINDINGS

The procedure used in this investigation involved four distinct steps: (1) careful reviewing of existing literature similar in subject-matter or in method; (2) the formulation of a set of principles for guidance in checking the textbooks; (3) the development of master sheets based upon the suggestions obtained from the review of available studies; (4) the actual process of reading and recording the data.

Principles Governing Checking and Tabulating

The writer faced the necessity of selecting from numerous lists a sufficient number of arithmetical terms which could be considered of pertinence to the particular investigation. It was not the purpose of the writer to compile an exhaustive list of words, but to obtain merely a sampling of the number and kinds of arithmetical terms found in the basic second grade readers. The Rosenquist minimum word list for the first and second grades, as mentioned in Chapter II, is used as a basic list for this study. The following words, which are common to most of the other lists, were added:

bank	front	night	today
behind	little	over	tomorrow
bottom	many	round	tonight
day	money	sell	top
earn	morning	some	under

In addition to the words included in the master list, number words are listed separately. The following number words are included:

One	five	nine	twenty
two	six	ten	twenty-five
three	seven	eleven	hundred
four	eight	twelve	

Principles Governing Checking and Tabulating

1. Tabulation of frequencies will be made under the following captions:

   (a) concepts of place
   (b) concepts of time
   (c) concepts of quantity
   (d) concepts of size
   (e) concepts of measurement
   (f) ordinals
   (g) concepts of form
   (h) concepts of speed
   (i) numbers expressed in words
   (j) concepts of money
   (k) miscellaneous arithmetical terms

2. Numbers and arithmetical terms appearing in the table of contents and the preface if specifically addressed to the pupils, will be counted; otherwise, not.

3. Tabulation of a given item will be made in one of two places: either in the tables under the proper captions or in the list of miscellaneous arithmetical terms. No items will be tabulated under two captions.

4. Only the root word of the arithmetical term shall be listed. No plural forms will be tabulated.

The next step was the preparation of master sheets which included all of the arithmetical expressions arranged in alphabetical order. Each word was recorded under the name of the book in which it was found. After the five books were checked, the words were then arranged in tables showing the frequency of their occurrence.

In interpreting the following tables the reader must keep in mind that the numbers shown in the frequency tables will apparently be small, since the study is limited to only one form of the word. Plurals, possessives, derivatives would increase the list. Considering the fact that on many of the pages the illustrations consume a good part of the page, leaving only a small portion for reading, this is in agreement with the writer's assumption that number concepts are common to almost every reading experience.

Many of the pages examined contained illustrations. Frequently the picture involved one or more arithmetical concepts, even though these concepts were not found in the material to be read by the child. While these picture concepts were not counted as a part of this study, the writer believes that the pictures do furnish further evidence to justify the belief that number concepts are common to almost all of the child's reading experiences.

TABLE 1

THE TYPE AND AMOUNT OF MATERIAL CHECKED

Name of Reader	Publishing Company	Place of Publishing	Date of Publishing	Name of Author	Number of Pages Read
Come Along	Houghton Mifflin Co.	Boston	1950	McKee Harrison McCowen Lehr	253
Down Our Way	Lyons and Carnahan	Chicago	1949	Bond Adler Wise Cuddy	247
Friendly Village	Row, Peterson and Co.	New York	1941	O'Donnell Carey	243
Friends and Neighbors	Scott, Foresman and Co.	Chicago	1946	Gray Gray	237
We Are Neighbors	Ginn and Co.	Boston	1949	Ousley Russell	237
Total Number					1217

Table 1 shows that 1217 pages of material are contained in the five textbooks designed for basic reading which children in the second grade are expected to understand. While this report involves results obtained from checking all five readers, it is a mere sampling of the kinds and amount of literature found in the work of children in the second grade. Future investigation might stress material found in other subjects.

TABLE 2

MASTER SCALE SPEAKING FREQUENCY OF USE OF ARITHMETICAL CONCEPTS IN THE FIVE BASIC READERS OF THE SECOND GRADE

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
add	6					6
addition						
altogether						
answer						
bank	13		1			14
behind	15	7	7	11		40
big	100	53	55	67	127	407
bigger	22	7	4	13		46
biggest			2	14	1	17
both	12	6		20	4	42
bottom	8	7				15
bought			5		2	7
buy	6	23	12	18	10	74
cent	4					4
change						
circle						
correct						
cost						
count						
day	51	26	46	49	61	213
dime						

TABLE 2 --Continued

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We are Neighbors	Total
divide						
dollar	3		10			13
dozen						
each	23	21		1		45
earn	8	4	2		5	19
enough	5	21	17	22	9	74
even						
every	20	20	31	24	15	110
fact						
far	17	7	14	8	11	57
farther						
farthest						
fast	12	11	13	18	18	72
faster	10		7	12	14	43
fastest						
feet						
few			9			9
fewer						
fewest						
fifth	1					1
first	8	19	17	24	8	76
foot						

TABLE 2 --Continued

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
fourth						
fraction						
front(in)	2	6	10	2	13	33
group						
half						
height						
high	6	7	8	10		31
higher	10					10
highest						
hour						
inch						
large		25		10		35
larger						
largest						
last	2	1	19	11	2	35
least						
left	9		5			14
length						
less			2			2
less than						
light		2				2
lighter	1					1

TABLE 2 —Continued

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
Lightest						
like	2			30		32
little	75	39	46	105	191	506
long	23	52	53	23	23	150
Longer	10		5			15
Longest						
Low						
Lower						
Lowest						
Many	11	24	30	11	10	86
(as) many as	3	4	3			10
how many	3	1	3			7
measure						
minute			25	10		35
money	29	58	29	7	29	113
month			1			1
more	39	6	29	37	10	113
more than	4	1	3	1	4	13
morning	13	21	57	49	25	156
most		5	6		3	14
much	22	13	22	9	9	75
how much	1	4	2			7

TABLE 2 --Continued

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
narrow						
narrower						
narrowest						
near		25	11	10	9	55
nearer			2			2
nearest						
nickel	17		10	8		35
night	9	8	10	8	8	42
none	6					6
nothing	5		10	9	8	27
number	9		3			12
old	19	9	25	18	32	103
older			1			1
oldest						
once	21	7	29	21		78
one-half						
one-third						
one-fourth						
over	36	46	80	38	51	247
pair						
part	11					11
penny	15		3			18

TABLE 2 --Continued

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
pint						
pound						
price						
quart						
rest (of it)		1	5			6
right						
round		8	20	10	11	49
row		3				3
sale						
same as	10		5			15
sell		21	14		2	37
score						
second	2		7	11		20
separate						
several						
share						
short	1	10		11		22
shorter						
shortest						
sign	6	10	2	8	4	30
slow	1			3		4
slower				9		9

TABLE 3 --Continued

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
almost						
small		21	4	11		36
smaller						
smallest						
some	52	71	46	46	65	270
space						
spend						
square						
straight						
subtract						
sum						
table						
tall					10	10
taller						
tallest						
teens number						
third	1			10		11
today	3	10	7	16	22	58
tomorrow	10		8	9	15	42
tonight	1					1
top	7	7	6	13	15	48
twice						
under	16	5	9	19	15	60

TABLE 2 —Continued

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
week		6	2			8
weigh		3				3
wide						
wider						
widest						
width						
yard						
year			12			12
young						
younger						
youngest						
zero						
Total	852	730	966	905	861	4296

Table 2 shows the total number of times each concept was found and the number of times it was found in any given book. Although 166 words appear on the master list, 85 words did not appear at all in the readers surveyed. Forty-two words appeared less than 25 times; 19 words appeared between 26 and 50 times; 11 words appeared between 50 and 100 times; 5 words appeared between 100 and 200 times; 3 words appeared between 200 and 300 times; 1 word appeared between 400 and 500 times and one word between 500 and 600 times.

Twenty-five words were common to all five readers; 11 words were common to four of the readers; 10 words were common to 3 of the readers; 16 words were common to 2 of the books; while 19 words were found in only one book.

These were the words appearing most frequently: big, day, every, little, long, money, more, morning, over, some.

The words appearing least frequently are: fifth, less, light, lighter, month, nearer, older, row, tonight, weigh.

TABLE 3

FREQUENCY OF USE OF CONCEPTS OF PLACE

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
Behind	15	7	7	11		40
bottom	8	7				15
far	17	7	14	8	11	57
farther						
farthest						
(in) front	2	6	10	2	13	33
height						
high	6	7	8	10		31
higher	10					10
highest						
last	2	1	19	11	2	35
near		25	11	10	9	55
nearer			2			2
over	35	43	80	38	51	247
top	7	7	6	13	15	48
under	15	5	9	18	13	60
Total	117	115	166	121	114	633

Table 3 shows that 17 place concepts were encountered 633 times. The most frequently used word in this table was "over", which appears 247 times.

The following words were common to all readers: "far", "in front", "last", "over", "top", and "under".

The words "farther", "farthest", "height", "highest", "nearest" were not found in any of the readers.

TABLE 4

FREQUENCY OF USE OF CONCEPTS OF TIME

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
day	31	26	46	49	61	213
hour						
minute			25	10		35
month			1			1
morning	13	21	57	40	25	156
night	8	8	10	8	8	42
today	3	10	7	16	22	58
tomorrow	10		8	9	15	42
tonight	1					1
week		6	2			8
year			12			12
Total	66	71	168	132	131	568

Table 4 shows the extensive use of the time concepts. There is a frequency of 568 for the 10 time words listed and the word "day" was recorded the highest number of times. The words "tonight" and "month" were found in only 1 reader. The word "hour" was omitted by all. The three words "morning", "night" and "today" were common to all five of the readers.

TABLE 5

FREQUENCY OF USE OF MEASUREMENT

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
feet						
foot						
inch						
measure						
pint						
pound						
quart						
weigh		3				3
yard						
Total		3				3

"Weigh" is the only arithmetical term, among the measurement concepts, which was found in the readers. It appeared in only one reader, as seen in Table 5.

TABLE 6

FREQUENCY OF USE OF ORDINALS

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
first	8	19	17	24	8	76
second	2		7	11		20
third	1			10		11
fourth						
fifth	1					1
Total	12	19	24	45	8	108

The ordinals are tabulated in Table 6. There are 108 uses of these concepts. The ordinal "fourth" did not appear in any of the readers, whereas "first" and "fifth" were common to all five.

TABLE 7

FREQUENCY OF USE OF FORM CONCEPTS

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
circle						
line	2			20		22
round		8	20	10	11	49
row		3				3
square						
straight						
Total	2	11	20	30	11	74

Table 7 shows a total of 3 form concepts which appeared 74 times. None of these concepts appeared in all 5 books surveyed. "Round" was the only concept appearing in 4 texts. "Line" appeared twice and "row" only once. "Circle", "square" and "straight" did not appear in the readers.

TABLE 8

FREQUENCY OF USE OF SPEED CONCEPTS

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
fast	12	11	13	18	18	72
faster	10		7	12	14	43
fastest						
slow	1			3		4
slower				9		9
slowest						
Total	23	11	20	42	32	128

Table 8 indicates that 3 speed concepts are encountered 128 times in the different textbooks. The most frequently used was "fast". "Fastest" and "slowest" do not appear in any of the readers.

TABLE 9

FREQUENCY OF USE OF MONEY CONCEPTS

Concepts	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
bank	15		1			16
bought			5		2	7
buy	6	26	12	18	10	74
cent	4					4
change						
cost						
dime						
dollar	3		10			13
earn	8	4	2		5	19
money	20	38	20	7	20	113
nickel	17		10	8		35
penny	15		3			18
price						
sale						
sell		21	14		2	37
spend						
Total	96	90	77	33	43	359

In Table 9, concepts involving the use of money are shown with a frequency total of 359. The word "money" was used most frequently according to this classification, as it appeared 113 times in the five books. There were also 74 instances where the word "buy" occurred. The following words in the master list were not found in any of the readers: change, cost, dime, price, sale, and spend.

TABLE 10

FREQUENCY OF USE OF SIZE CONCEPTS

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
big	100	58	55	67	127	407
bigger	22	7	4	13		46
biggest			2	14	1	17
large		25		10		35
larger						
largest						
least						
length						
little	73	69	46	105	191	504
long	23	32	59	25	23	159
longer	10		5			15
longest						
low						
lower						
lowest						
narrow						
narrower						
narrowest						
short	1	10		11		22
shorter						
shortest						

TABLE 10 -Continued

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
small		21	4	11		36
smaller						
smallest						
tall					10	10
taller						
tallest						
wide						
wider						
widest						
width						
Total	329	242	174	254	352	1251

The greatest number of concepts found in any one classification was in the concepts of size, as shown in Table 10. There were 1251 uses of the size concepts with the word "little" receiving the count of 504 and "big" appearing 407 times.

"Big", "little", and "long" were common to all five of the readers. Twenty-one of the size concepts were not found in any of the readers.

TABLE 11

FREQUENCY OF USE OF QUANTITY CONCEPTS

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
dozen						
enough	5	21	17	22	9	74
few			9			9
fewer						
fewest						
left	9		5			14
less			2			2
less than						
many	11	24	30	11	10	86
many (as)	3	4	3			10
many (how)	3	1	3			7
more	29	8	29	37	10	113
more than	4	1	3	1	4	13
most		5	6		3	14
much	22	13	22	9	9	75
(how) much	1	4	2			7
none	6					6
nothing	5		10	9	3	27
number	9		3			12
part	11					11
rest		1	5			6
several						

TABLE 11--Continued

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
same as	10		5			15
share						
some	52	71	45	45	65	278
twice						
Total	180	153	199	134	113	779

The frequency of use of quantity concepts is set forth in Table 11 and shows that quantity concepts appeared 779 times in the material studied. The word "some", which appeared more than twice as often as any other quantity concept, appeared 278 times.

The following words were not found in any of the readers: "dozen", "fewer", "fewest", "less than", "several", "share" and "twice".

"Enough", "many", "more", "more than", "much", "some" are common to five of the readers. Seven words are not found in the readers.

TABLE 12

FREQUENCY OF MISCELLANEOUS ARITHMETICAL TERMS
WHICH CANNOT BE PLACE IN ANY OF THE OTHER CLASSIFICATIONS

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
add	6					6
addition						
altogether						
answer						
both	12	6		20	4	42
correct						
count						
divide						
each	23	21		1		45
even						
every	20	20	31	24	15	110
fact						
fraction						
group						
half						
light		2				2
lighter	1					1
lightest						
old	19	9	25	18	32	103
older			1			1
oldest						

TABLE 12 --Continued

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
once	21	7	29	21		78
one-half						
one-third						
one-fourth						
pair						
score						
separate						
sign	6	10	2	8	4	30
space						
subtract						
sum						
table						
teen numbers						
young						
younger						
youngest						
zero						
Total	109	75	63	92	23	315

The results shown in Table 12 indicate that 30 miscellaneous arithmetical terms, that cannot be placed in any other classification, are included in the readers. The frequency of this group of words was 315 with the word "every" appearing most often. "Every" is found 110 times, and "old" occurs 103 times. Three of these miscellaneous terms are common to all five of the

readers; "every", "old", and "sign". Twenty-eight concepts are not found in any of the readers.

TABLE 13

FREQUENCY OF USE OF NUMBER WORDS

Concept	Come Along	Down Our Way	Friendly Village	Friends and Neighbors	We Are Neighbors	Total
one	125	81	117	111	66	500
two	46	13	32	22	12	125
three	15	12	7	16	20	70
four	13	3	10	13	6	45
five	35	12	7	16		70
six	10		3	13	4	30
seven	10	7	7		3	27
eight			3			3
nine						
ten			10	22		32
eleven						
twelve			4			4
twenty			3			3
twenty-five			4			4
hundred			2			2
Total	254	128	209	213	111	915

In addition to the words listed on the master sheet, a tabulation was made, as shown in Table 13, of numbers expressed in words. These words appeared a total of 915 times. The most frequently used number word in all the books was "one". "One", "two", "three", and "four" appeared in all 5 books. The word "nine" did not appear in any; "eight" was found in only one book.

From the data shown in Tables 1 to 13, conclusions were drawn and recommendations made as found in Chapter IV.

CHAPTER IV

CONCLUSIONS AND SUMMARY

Conclusions

The studies reviewed in Chapters II and III suggest that emphasis on social utility has greatly reduced the amount of arithmetic actually used for the purpose of calculation in the second grade, but they also suggest that the demands upon arithmetic from the standpoint of an intelligent appreciation of the social needs of life may be much greater than for mere calculation.

The data presented in this study show that:

1. The readers checked include many arithmetical terms which must be understood if the material read is to have meaning and be appreciated. In many cases actual manipulation involving the arithmetical processes underlying the terms may often be necessary to give adequate understanding and appreciation of the processes under consideration.

2. The arithmetical concepts found in the readers are in general very similar to those found in the arithmetic program designed for use in the second grade.

3. Many terms used in the arithmetic program do not appear in the readers.

4. Although arithmetical terms are introduced in a surprisingly large number of situations there is no systematic way of introducing them. A large per cent of the words used in the readers occurred only one, two, or three times. If frequent repetition is essential to mastery, it is evident that pupils will be unfamiliar with many words which apparently should be learned at this level of advancement.

Summary

This investigation involves a more sampling and future studies may include both other types of materials and other grade levels. The study has presented, only in a broad outline, the number and kinds of arithmetical concepts that are used by the second grade child.

Continued improvement in the fields of reading and arithmetic is a joint responsibility promoted best by whole-hearted co-operation among educators, authors, and publishers in these particular fields. There is need for more co-operative activity, especially in making a penetrating examination of the present programs to identify strengths to be perpetuated and weaknesses to be overcome. In this way substantial development in both fields may be anticipated.

In the interest of research, all teachers should be zealous students of arithmetic. They should apply the findings of scientific studies in their attempt to improve their techniques of teaching arithmetic. They should make use of scientific methods in the daily study of classroom problems. They should make more careful analysis of materials used in the various subject-matter areas to determine relationships and possibilities for correlation. Only through the co-operation of all the agencies interested in the arithmetic program can an adequate solution of both the theoretical and practical issues that are involved be achieved.

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TYPIST PAGE

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