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**A COMPARISON OF THE CONTENTS OF STATE
ADOPTED ARITHMETIC TEXTBOOKS WITH
CONTENTS OF THE ARITHMETIC SECTIONS OF
SELECTED STANDARDIZED ACHIEVEMENT
BATTERIES.**

The University of Oklahoma, Ed.D., 1965
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THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

A COMPARISON OF THE CONTENTS OF STATE ADOPTED ARITHMETIC TEXTBOOKS
WITH CONTENTS OF THE ARITHMETIC SECTIONS OF SELECTED
STANDARDIZED ACHIEVEMENT BATTERIES

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF EDUCATION

BY

LEE A. SMITH

Norman, Oklahoma

1965

A COMPARISON OF THE CONTENTS OF STATE ADOPTED ARITHMETIC TEXTBOOKS
WITH CONTENTS OF THE ARITHMETIC SECTIONS OF SELECTED
STANDARDIZED ACHIEVEMENT BATTERIES

APPROVED BY

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DISSERTATION COMMITTEE

DEDICATED

to my wife, Billie,

and children,

Don, Bob, Linda, and Scott

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The work done on this study was in partial fulfillment of the requirements for the Doctor of Education degree at the University of Oklahoma.

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A COMPARISON OF THE CONTENTS OF STATE ADOPTED ARITHMETIC TEXTBOOKS
WITH CONTENTS OF THE ARITHMETIC SECTIONS OF SELECTED
STANDARDIZED ACHIEVEMENT BATTERIES

CHAPTER I

INTRODUCTION

In October of 1963 the State Department of Education for the State of Oklahoma officially adopted under regulations of the Free Textbook Program five new arithmetic textbook series for use in Oklahoma schools. These books were used for the first time in Oklahoma schools under this program in September, 1964. In October, 1964, the Texas State Board of Education officially adopted new arithmetic textbook series for use in Texas schools under the Free Textbook Program of that state. These textbooks will be used initially as state adopted texts beginning in September of 1965.

The majority of the new arithmetic textbooks produced by publishers of this country within the past two years purport to have their content based on what is commonly termed "principles of the new or modern mathematics." Most of the school systems of Texas and Oklahoma use the state adopted arithmetic textbooks as the primary source of content for their programs in arithmetic. Most of these schools use, in varying degrees, standardized arithmetic achievement tests or standardized achievement test batteries containing a section on arithmetic to help in evaluating their

arithmetic programs.

At the same time these new textbooks were being officially adopted, most of the standardized achievement tests in common use throughout these states were also being revised by their publishers in order to maintain their use in the schools following the adoption of the newer arithmetic programs. With these changes taking place in both textbook content and standardized achievement test content, there is a need for some comparison between the two in order to ascertain how closely their contents now agree.

Related Research

Thomas and Swartout point out that the textbook holds a peculiar position in American Education even though it is discredited by many educators who condemn what they term "textbook teaching." The textbook continues to be the most widely used of all teaching materials at all levels--primary grades through the university. The controversy about the proper role of textbooks disturbs many conscientious teachers. They often feel guilty about relying on a text instead of creating their own materials or their own organization of subject matter. Advocates of the use of textbooks in the dominate position set forth six characteristics of the modern textbook to back up their beliefs: (1) Material can be organized ahead of time, (2) Facts are generally more accurate, (3) Material is organized more carefully, (4) There can be a continued pattern, (5) Modern texts are well illustrated, and (6) Basic learning material is in a single book.¹

Ragan states:

A good series of textbooks usually represents the best

¹R. Murray Thomas and Sherwin G. Swartout, Integrated Teaching Materials (New York: David McKay Co., Inc., 1963), pp. 55-59.

efforts of competent specialists in elementary education and the services of the editorial staff of the publisher. Good textbooks incorporate the most recent research in the various phases of elementary education and certainly have much to offer when used wisely.²

The publishers and authors of textbooks have indicated quite definitely the pattern they feel should be followed with regard to the use of their creations. They feel the really best way to judge a promising textbook is to try it out with the class. You don't really try a book out unless you use it the way the author intended it to be used. A teacher many times has used the textbook as a reference book, as a source of problem material, she's skipped around from one place to another, she's even told the children not to read the explanations of the text, and then she complains that the book is not satisfactory. The modern textbook is more and more thought of as an "assistant teacher in print." The author sets up as clearly as possible the aims which his teaching are to accomplish. He does this, not on the spur of the moment, nor in any catch-as-catch-can impromptu way, but thoughtfully and deliberately, with time to check and recheck, test, revise, and actually try out his material. He assumes the classroom teacher will cooperate with this teacher in print, using all his teaching ingenuity to make it work for him and for his pupils.³

In its influence upon the curriculum the textbook sometimes leads the way and sometimes follows. Always, however, it is a significant influence and it generally meets with public approval. Some, who think along lines of perfection, argue that society should provide sufficient library materials to take the place of the textbook. However, in the

²William B. Ragan, Modern Elementary Curriculum (rev. ed.: New York: Holt, Rinehart and Winston, Inc., 1960), p. 24.

³American Textbook Publishers Institute, Textbooks in Education (New York: American Textbook Publishers Institute, 1949), pp. 91-92.

past it has not done so, and neither is it likely to do so for a long time to come. To dispense with the textbook, then, is nothing short of folly, and to continue argument against its use is an educational fallacy.⁴

Cronbach indicates that investigations seem to find that teachers tend to follow the textbook with utter fidelity. Teachers neither rearrange material nor modify it, at least in a significant number of classrooms.⁵

Smith and others point out, "Textbooks are ordinarily designed to provide basic learnings, attitudes, and skills that should be supplemented by numerous other resources, many of which are indicated either in the textbook itself or in the teacher's guide that accompanies the textbook."⁶

There seems, then, to be strong indications that with many teachers the official textbook is the course of study. If this textbook makes reference to supplementary materials they are used in some cases, but if not, the text material is used almost exclusively.

In the following quotation, Ragan emphasizes the relationship that exists between the two areas of the curriculum--objectives and activities and evaluation. The recognition of these relationships would seem paramount to the success of the educational endeavor:

Evaluation procedures should be closely related to the objectives and activities of the curriculum. The evaluation procedures used will be determined by the nature of the objectives and the activities. To the extent that objectives, learning activities, or evaluation become independent, they become formal and unrelated to the

⁴J. Minor Gwynn, Curriculum Principles and Social Trends (New York: Macmillan Company, 1950), p. 768.

⁵Lee J. Cronbach, (ed), Text Materials In Modern Education (Urbanna, Ill.: University of Illinois Press, 1955), pp. 200-201.

⁶Edward W. Smith, Stanley W. Krause, and Mark M. Atkinson, The Educator's Encyclopedia (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1961), pp. 651; 310-311.

teaching-learning situation. Failure to realize the relation between objectives, activities, and evaluation has resulted in one group formulating objectives and another group doing the evaluating. Consequently, achievement tests are frequently given to pupils which stress materials that have not been studied or whose contents are not in line with the curriculum pattern followed by the school.⁷

When we discuss evaluation through the use of standardized achievement tests, this problem becomes especially pertinent to many public schools. Few school systems have the time, money, or facilities to produce their own standardized test battery for use with their own students. They purchase these instruments from commercial publishing firms and in selecting the test to use are not always motivated primarily by factors dealing with objectives, current activities, and basic curriculum patterns. This is not always the fault of the test or its producers, but is merely a fact which accentuates the idea that selection of an evaluation instrument is a highly important educational task.

Remmer and Gage point out that the standardized achievement test must strive for content which is common to a great many schools. This may result in an attempted evaluation of pupils' achievement using test items developed from one set of educational objectives whereas the particular students have been operating in their educational activities under somewhat different objectives. The content of standardized tests usually is selected by groups of subject-matter experts in close contact with the most respected textbooks and courses of study, statements of objectives, teaching methods, and expressions of "philosophy" of a subject. They further state regarding the validity of an achievement test, that estimating the validity of achievement test content to textbook content is useful because it insures to a

⁷Ragan, loc. cit., p. 385.

high degree that pupils will be evaluated on the basis of what they have read or studied. If test content so selected is found wanting, the blame must be laid not on the test constructors, but on the author of the textbook and those who have made use of it. Of course, the statement of instructional objectives which is embodied and implicit in any textbook has a specific and definite form; whereas, statements of objectives embodied in the usual course of study are far less detailed. Especially for subjects new to the curriculum, the textbook may embody the most useful statement of objectives available.⁸

Lindquist sums up the situation with this statement:

Practically all the standardized achievement tests and informal school examinations that have been constructed to date have been designed to measure achievement in established school subjects. Analysis of textbooks and courses of study has constituted the most common technique for validating educational achievement tests. Accordingly, just as the real objective of instruction has been to teach what is in the textbook; so, in many instances, the real objective in testing has, to an even greater degree, been to test what is now being taught. Many test builders have taken the position that, while it is their responsibility to keep pace in their tests with accomplished curriculum changes, it is not their business to bring about changes in curriculum. Their position, further, would be that as long as large numbers of teachers are teaching a subject in accordance with certain generally accepted immediate objectives, those teachers have a right to know how well they have accomplished those objectives, no matter how far those objectives may be out of line with the most advanced thinking concerning more remote objectives, or how little the subject as a whole really deserves a present place in the curriculum. Most teachers, for a variety of reasons, prefer standardized tests that differ from their own informal examinations only in that they are provided with norms, and that they are more reliable, more objective, more easily scored, and more highly refined technically than their own product. The standardized tests which are most closely adapted to the local curriculum in this sense are those most often

⁸H. H. Remmer and N. L. Gage, Educational Measurement and Evaluation (New York: Harper and Brothers, 1955), p. 67.

selected and used by the subject teacher. For the reasons given, test of course achievement concerned primarily with current instructional objectives will continue to be constructed and used as long as the subject organization of the curriculum is retained.⁹

Having reviewed the ideas and attitudes of those concerned with both the textbooks and the standardized achievement tests, it would seem to be evident that the teacher in the classroom tends to follow the textbook as her basic guide for the curriculum and desires the achievement test which she uses to be made up of such content as will evaluate her students' achievement effectively. Although in the most technical sense this may not always be completely possible, the constructors of most of our good achievement tests take this fact into account and gear the content of their tests to what is believed to be the basic content pattern of most schools' curricula.

The problem for the classroom teacher and school administrator, then, is to be able to select the particular standardized achievement instrument which best does the job for their particular situation. Since most public schools primarily use textbooks from their state's free textbook adoption list to form the basic pattern for their curriculum and since this list changes fairly regularly, these schools need to be constantly aware of how their current curriculum content (basically the textbook content) compares with the content of the standardized achievement test they are presently using. This is not an easy thing to do and most tend to be rather haphazard and untechnical in it. For this reason it would seem important that a relatively complete content comparison of the state adopted textbooks and commonly used standardized achievement tests be made. Although

⁹E. F. Lindquist, (ed), Educational Measurements (Washington, D. C.: American Council on Education, 1951), pp. 123-124.

this would be a monumental task with regard to the entire curriculum, it would seem to be of great value and within the realm of reason to select a certain portion of the school program which follows the pattern depicted previously and make such a comparative study. The area of fourth, fifth, and sixth grade arithmetic seems to fit this pattern quite well.

Basic to the study of any arithmetic or mathematics program is a knowledge and understanding of the primary concepts of the program. The great amount of study and research that has been done during the past few years in elementary school mathematics has emphasized the importance of mathematical concepts, structural features, and basic properties and relationships as well as the rationale of computation. It has long been observed that the content of the elementary arithmetic program should be organized and presented in accordance with the sequential nature of the subject. It should not be taught as a collection of unrelated skills, but rather as a mathematical system organized according to definite principles. The content, relationships, and unifying principles should be organized so that the logical, coherent structure of the subject is realized.¹⁰

The inclusion of elementary content from the fields of number theory, algebra, and geometry, as well as arithmetic, points up the mathematical influence on the elementary curriculum. A well rounded mathematics program at each grade level in the elementary school should result in a good foundation of elementary mathematical understanding.

Since the general plan for organization of the arithmetic curriculum is a spiraling plan, portions of all major areas of the elementary mathematics program should be included at each grade level to provide a well

¹⁰Frances Flournoy, Elementary School Mathematics (Washington, D. C.: The Center for Applied Research in Education, Inc., 1964), pp. 8-9.

balanced program in each grade. These basic concepts are extended at each grade level of mathematical insight. To accomplish these objectives, most of the modern-day elementary mathematics programs stress the following major areas in their scope and sequence: (1) Number and Numeration, (2) Number Operations, properties, and computational procedures with whole numbers, common fractions, decimals, percents, and integers, (3) Measurements (including understandings of standard units of measures, scales, graphs, tables, and computational procedures for these), (4) Geometry (including distances, shapes, areas, volume, lines, points, planes, and angles), (5) Problem Solving (verbal or word problems in single and multi-step situations using the several computational skills of basic arithmetic). Although there are slight variations in terminology with regard to these fundamental areas, there is sufficient agreement to justify using them as areas for classification of the content of the fourth, fifth, and sixth grade textbooks and arithmetic achievement tests which are to be examined in this study.

In the preface of one of the S. M. S. G. volumes, the authors set forth a basic premise upon which they operated in the development of the content of that material. The content is designed to give the pupil a much broader concept of what mathematics really is. There is less emphasis on rote learning and more emphasis on the construction of models and symbolic representation of ideas and relationships from which pupils can draw important mathematical generalizations. The basic content is aimed at the development of some of the fundamental concepts of mathematics. These include ideas about number, numeration, the operations of arithmetic, and intuitive geometry. The simplest treatment of these ideas is introduced early. They are frequently re-examined at each succeeding level

and opportunities are provided throughout the text to explore them more fully and apply them effectively in solving problems.¹¹

Statement of the Problem

The problem of this study is to compare the content of fourth, fifth, and sixth grade arithmetic textbooks adopted for public school use in Oklahoma and Texas with the content of five selected standardized arithmetic achievement tests used in these states. More specifically, the purpose of this study is to compare the differences of percentages between pages in the state adopted arithmetic textbooks for Oklahoma and Texas and items in the arithmetic sections of achievement test batteries most commonly used by schools in these states.

Hypothesis

This study attempts to test the following null hypothesis: There is no significant difference between the contents of newly state adopted arithmetic textbooks at fourth, fifth, and sixth grade levels for the States of Oklahoma and Texas and the contents of the arithmetic sections of five standardized achievement tests commonly used at these same levels in the schools of these states.

The following questions will need to be answered by this study:

1. What is the basic content of the newly adopted arithmetic textbooks in Oklahoma and Texas?
2. What is the basic content of the five widely used standardized achievement tests in the area of arithmetic for fourth, fifth, and sixth grade levels?

¹¹School Mathematics Study Group, Mathematics For The Elementary School, Grade 6, Part I (rev.ed.; New Haven, Conn.: Yale University Press, 1962), Forward.

3. How do the contents of the tests and new textbooks compare?
 - A. What percentage of the areas covered in each text is likewise significantly covered in the most commonly used achievement tests?
 - B. What percentage of the content of these arithmetic texts is not covered by the content of the most widely used arithmetic achievement tests?

Definition of Terms

The following definitions are adapted from Good and other sources and are consistent with the purposes of this study:

Achievement Test - A test designed to measure a person's knowledge skills, understandings, etc., in a given field taught in school.

Achievement Test Battery - A group of achievement tests standardized on the same population and thus yielding comparable scores. Frequently the tests are designed for measuring outcomes in most of the major instructional areas of specified grade levels.

Textbook - Any manual of instruction. A book dealing with a definite subject of study, systematically arranged, intended for use at a specified level of instruction, and used as a principal source of study material for a given course.

Free Textbook - Any textbook provided for pupil use without cost to the pupil.

Modern or New Mathematics - Program of study in mathematics based on experimental studies in mathematics such as the University of Illinois Arithmetic Project, University of Maryland Study Group, and several others. These projects primarily use the discovery method so that children may

arrive at their own conclusions through either inductive reasoning or the deductive approach to reasoning. These programs are designed to help students arrive at an understanding of number properties and techniques. They are also designed to help children think critically and to use problem-solving techniques in which they use reasoning ability rather than memorization. These programs are usually highly child-centered and start the teaching of many mathematics concepts at an earlier period in the pupil's school life than is ordinarily expected.¹²

Limitations of the Study

The study of the comparison of arithmetic textbooks with standardized achievement tests is limited to the state adopted arithmetic textbooks of the States of Oklahoma and Texas as officially selected in October, 1963, and October, 1964, respectively. These two states and their elementary arithmetic programs were selected specifically because of the recent adoption of new arithmetic textbooks and because of the personal interest of the author in the educational systems of these states. Only fourth, fifth, and sixth grade levels are being considered in this study since these are the levels in the elementary school at which more standardized achievement tests are used regularly to evaluate students' progress in arithmetic. These are also the levels in which the state adopted textbooks seem to be used most widely as the basic curriculum guide.

Textbook series officially adopted in the fourth, fifth, and sixth grades for the State of Oklahoma are as follows:

1. Growth In Arithmetic, Harcourt, Brace, and World, 757 Third Ave., New York, New York, 1962. (Grades 4-5-6, one book for each grade level).

¹²Carter V. Good, ed., Dictionary of Education (New York: McGraw-Hill Book Co., Inc., 1959), pp. 55, 567-568, 557.

2. Moving Ahead In Arithmetic, Holt, Rinehart, and Winston, 383 Madison Ave., New York, New York, 1963. (Grades 4-5-6, one book for each grade level.)
3. Arithmetic, Laidlaw, Thatcher, and Madison, River Forest, Illinois, 1963. (Grades 4-5-6, one book for each grade level.)
4. Seeing Through Arithmetic, Scott Foresman, Chicago, Illinois, 1963. (Grades 4-5-6, one book for each grade level.)
5. Modern Arithmetic Through Discovery, Silver Burdett, Morristown, New Jersey, 1963. (Grades 4-5-6, one book for each grade level.)

Textbook series officially adopted in the State of Texas for use in fourth, fifth, and sixth grade levels were as follows:

1. Elementary School Mathematics, Addison-Wesley, 3220 Porter Drive, Palo Alto, California, 1964. (Grades 4-5-6, one book for each grade level.)
2. The Modern Mathematics Series, American Book Co., 55 Fifth Ave., New York, New York, 1963. (Grades 4-5-6, one book for each grade level.)
3. Moving Ahead In Arithmetic, Holt, Rinehart, and Winston, 383 Madison Ave., New York, New York, 1963. (Grades 4-5-6, one book for each grade level.)
4. Arithmetic, Laidlaw, Thatcher, and Madison, River Forest, Illinois, 1963. (Grades 4-5-6, one book for each grade level.)
5. Modern Arithmetic Through Discovery, Silver Burdett, Morristown, New Jersey, 1963. (Grades 4-5-6, one book for each grade level.)

Tests which are used in this study are limited to the arithmetic sections of the five most widely used achievement batteries according to information furnished by testing services and official agencies of both states.

The achievement test batteries from which the arithmetic sections will be examined are listed below:

1. California Achievement Battery, 4 - 6, 1963 Edition, Del Monte Research Park, Monterey, California.
2. Iowa Test of Basic Skills, 3 - 9, 1964 Edition, Houghton Mifflin Co., 2 Park Street, Boston, Massachusetts.

3. Metropolitan Achievement Battery, Elementary 3 - 4, Intermediate 5 - 6, 1959 Edition, 757 Third Ave., New York, New York.
4. S. R. A. Achievement Battery, Multilevel Edition, Blue Level and Green Level, 1964 Edition, 259 East Erie Street, Chicago, Illinois.
5. Stanford Achievement Battery, Intermediate I Battery and Intermediate II Battery, 1964 Edition, 757 Third Ave., New York, New York.

Procedures for Collecting and Treating Data

The seven officially adopted arithmetic textbook series for Oklahoma and Texas have one book each for fourth, fifth, and sixth grades. Each of these textbooks had its content examined as to objectives and specific areas covered. All lessons contained in the three books of each series were classified according to basic areas of arithmetic or mathematics covered and objectives to be obtained. These raw data were then converted into a percentage of the entire number of lessons for that series of books and entered in a two-way table.

Each arithmetic section of the five achievement batteries was also examined and the items for each classified as belonging fundamentally to one specific area of arithmetic or mathematics. These data for each test were then also converted into a percentage of the entire number of items in the test and entered in a two-way table.

Major Areas of Mathematics

The five major areas of elementary school mathematics into which the lessons of the textbooks and items of the tests were classified are: (1) Numeration and Notation, (2) Number Operations, Properties, and Computational Procedures, (3) Measurements, (4) Geometry, and (5) Problem Solving (word or verbal problems).

The individual major areas contain the following breakdowns in

their subdivisions:

- I. Numeration and Notation
 - A. Concept of number and numeral.
 - B. Reading and writing numerals and number words.
 - C. Place values.
 - D. Equalities and equations.
 - E. Different bases and numeral systems.
 - F. Sets and set notations.
- II. Number Operations, Properties, and Computational Procedures
 - A. Whole Numbers.
 1. Properties.
 2. Relationships.
 3. Operations--Addition, Subtraction, Multiplication, Division (Because of the inverse relationships of addition and subtraction and the fact that their basic facts are presented simultaneously, they were counted together. Since the same situation exists for multiplication and division, the same plan was followed with these types, also.)
 - B. Rational Numbers: Common Fractions, Decimals, Percents
 1. Properties.
 2. Relationships.
 3. Operations--Addition, Subtraction, Multiplication, Division (All operations with rational numbers were counted together whether addition, subtraction, multiplication, or division; and whether the operation was on common fractions, decimals, or percent.)
 - C. Integers
 1. Properties.
 2. Relationships.
 3. Operations--Addition, Subtraction, Multiplication, Division.
- III. Measurements
 - A. Standard units of measure and operations with these units--time, linear, liquid, dry, weight, quantity, temperature, metric, area.
 - B. Charts, maps, tables, scales, graphs--reading, making and understanding these statistical tools.
 - C. Money--denominations, making change.
- IV. Geometry
 - A. Lines, points, planes--drawing, recognizing and measuring.
 - B. Angles--concept, measurement, construction.
 - C. Closed figures--circles, squares, rectangles, triangles, cubes, prisms, parallelograms, cylinders--identification and measurement.
- V. Problem Solving
 - A. Single or multi-step problems in word form using one or a combination of the basic operations (addition, subtraction, multiplication, division).

- B. Problems involving whole, rational or integer numbers in word form.
- C. Problems which require a certain proficiency in reading abilities at a given level of work.

In this study pages and items which are classified under the Problem Solving category are those which contain word or thought problems covering any of the ideas in other major areas. They are classified in this category because they are in word form and must be read and analyzed before they are put down in numerical form or any operation performed on the numerals. Since many of them deal with varying combinations of other major areas, their only unique quality is their word form.

In each arithmetic textbook examined there are some pages which are for general review or evaluation purposes. These pages contain types of problems which are classified in two or more of the five major areas. Since these pages cannot clearly be assigned to any one area, they are only classified as general review and not compared with areas of the tests.

Data Analysis

The statistical analysis of the data involved in this study was accomplished by comparing each major mathematical area for each textbook with each major mathematical area for each test. The frequencies in each area came from the specific classification given each lesson or item in each textbook and test. These frequencies were converted to percentages to facilitate the use of the critical ratio in the comparison.

A critical ratio, or Z score, was used to determine the statistical significance of the difference between the percent of pages in the various textbooks and the percent of items in the different achievement tests.¹³

¹³J. P. Guilford, Fundamental Statistics in Psychology (New York: McGraw-Hill Book Company, Inc., 1956), pp. 221-222.

Level of confidence for the Z was set at the 0.01 level. The following is the formula used to compute Z scores:

$$Z = \frac{P_1 - P_2}{\sqrt{(p_c q_c) (1/N_1 + 1/N_2)}}$$

where:

$$p_c = \frac{X_1 + X_2}{N_1 + N_2}$$

$$q_c = 1 - p_c$$

N_1 = Total number of textbook pages used in study

N_2 = Total number of test items used in study

X_1 = Number of textbook pages relating to a given mathematical area

X_2 = Number of test items relating to a given mathematical area

P_1 = Proportion of pages in a given textbook

P_2 = Proportion of items in a given achievement test

The appropriateness of the Z score lay in the fact that the data representing observed frequencies had been converted to percentages. The level of confidence, having been set at the 0.01 level, required a value that was equal to or greater than 2.57 for significance.

CHAPTER II

TEXTBOOK CONTENT

Introduction

A portion of this study is concerned with the content found in officially adopted arithmetic textbooks for the States of Oklahoma and Texas on the fourth, fifth, and sixth grade levels. There are seven different textbook series which fall in these classifications and each series has one book for each grade level. The content of each textbook was determined by examining the individual pages and categorizing each according to its objectives and types of exercises. The areas used to classify each page covered Numeration and Notation, Number Operations of whole, rational, and integer numbers, Measurements, Geometry, and Problem Solving. After each book in a particular series was examined, the proportion of pages in each category were combined for that series. The content for individual books in each series is included in this chapter with their resultant proportions for each area.

Elementary School Mathematics, Addison-Wesley

Grade 4 - 310 Pages

Numeration and Notation. The textbook in this series written for the fourth grade includes some 28 pages, or 9% of the total, developing lessons aimed at developing skills in reading and writing numbers through

the millions. Introduction is made to numbers in the billion and trillion range, but place value concepts through millions are stressed. The concepts of set union, subsets, partitioning of sets, product sets, and intersection of sets are reviewed and maintained by using with operations current to this level. Most of the basic mathematical notation symbols such as $+$, $-$, $\times$, $=$, $\div$, (n) , $(\square)$, $>$, $<$, $\{ \}$, and money symbols are reused for maintenance while the new symbol $\neq$ is introduced. Skip counting sequences and what is termed discovery-type sequences ($2n$ and $2n + 1$) continue to be used in this textbook. Odd and even numbers, together with prime numbers, are developed more fully in this content.

Number Operations. The basic operations on whole numbers as developed by this textbook covers 117 pages of the entire book, which amounts to 37.7% of the total. Since all basic addition and subtraction facts with answers through 18 and all basic multiplication and division facts with answers through 81 have been previously covered, they are extensively reviewed and used in the operations of algorithms for these four primary facts. Column addition with regrouping using one, two, three, and four addends, and subtraction with regrouping are presented. Adding and subtracting numbers in the tens, hundreds, thousands, and ten thousands are practiced. Addition and subtraction as inverse operations are again emphasized. The operations of multiplication and division of whole numbers with the corresponding principles, algorithms, and laws cover more of the textbook's content than any other one section (26%). Using the already presented facts, multiplication of whole numbers is presented as far as multiplying three-figure multipliers by three-figure multiplicands. Four-digit numbers multiplied by single-digit factors are also taught with the needed regrouping principles. Division of whole numbers is presented dealing with one- and two-digit

divisors into three- and four-digit dividends. Quotients up to and including three digits with and without remainders are presented in these problems.

The formal introduction to operations with one form of rational numbers (common fractions) is presented in 55 pages, or 17.7% of the lessons in this text. Specific principles regarding the terms, properties, and operations with rational numbers are introduced. The addition of rational numbers smaller than one and in mixed number form is also presented.

Measurements. There are 36 pages directly dealing with measurement type lessons found in this book. This entails 11.6% of the text. Units of length, area, and perimeter are dealt with substantially, and the concept of volume is extended from its introduction in the previous book. Liquid measures are used in problems which are intended to provide experience with these common units. The same principle is followed with the use of linear measures. The extension of ideas pertaining to charts, graphs, and scale drawings is developed somewhat in the content of this book. "Clock" or modular arithmetic is fully developed at this level.

Geometry. A number of aspects of geometry are presented on 18 pages of the text. Lessons giving intuitive experiences with circles, angles, triangles, parallels, and quadrilaterals are presented. Introduction to some principles of space geometry is made, but most of the experiences in this area deal with extension of skills with geometric shapes and figures and readiness for more formal abstractions to be presented later.

Problem Solving. There are 38 pages, 12.2% of the content, which use word problems to develop skills with the operations of the various other areas. These are scattered throughout each area and use single and multiple operations.

Elementary School Mathematics - Addison-WesleyGrade 5 - 313 Pages

Numeration and Notation. The fifth grade textbook of this series contains 23 pages devoted to this area. This number of pages is equal to 7.38% of the entire text. Included in the content of this area are the skills of reading and writing of whole numbers through thousands and millions and the place value concepts attendant to these skills. Ideas regarding billions and trillions are also introduced. Lessons involving intersection and union of sets are used to provide background for the study of common factors and common multiples. The principle of expanded notation is reviewed and extended.

Number Operations. Whole number operations for which lessons are included in this textbook involve addition, subtraction, multiplication, and division. The number of pages for such operations is 84, or 26.8% of the entire book. Areas included besides the standard algorithms are conceptual meanings, inverse relationships, distributive principles, rounding off of numbers, and short division. Basic facts reviewed and for which maintenance lessons are included are addition and subtraction through 18 and multiplication and division through 81. Also presented are multiplication algorithms through three-figure multipliers and multiplicands and division algorithms through two-figure divisors and four-figure dividends.

The presentation of rational number operations takes up 86 pages (27.4%). This portion of the textbook is involved with principles of addition and subtraction of common fractions, mixed numbers, and decimals. As readiness for multiplication and division of fractions, the ideas concerning factors and multiples are covered. Improper fractions are introduced together with the basic operational techniques concerning them. The

addition and subtraction of decimals is carried through the thousandths. Some time, rate, and distance problems are used in developing concepts with rational numbers at this level.

Measurements. The arrangement used for teaching of Measurements involves the development of concepts pertaining to standard units of measures along with the development of certain number operations which are needed in working with the measures. Standard units of length, width, perimeter, and area are covered along with ideas on the changing and conversion of these units. Graphs and tables are used extensively to provide data for problems, practice in reading and making up tables and graphs, and with the study of coordinates. Scale drawings are introduced and maintenance of map skills. The area of Measurements includes 31 pages, or 9.9% of the fifth grade textbook.

Geometry. The area of content involving Geometry is covered on 23 pages, which amounts to 7.4% of the textbook. This content includes maintenance and extension of work with such geometric figures as angles, triangles, parallelograms, quadrilaterals, circles, squares, and rectangles. The principles of area and volume are introduced along with the definition of space and plane geometric ideas. Basic concepts dealing with congruence of angles, triangles, and segments are covered in this text's content.

Problem Solving. The fifth grade textbook for this series contains 35 pages (11.2%) dealing specifically with word problems, the principles involved, and use of all four basic number operations in these problems. These problems deal with each of the other major areas in mathematics. The use of multiple operations is extended, together with development of ideas on number equations and their application to word problems.

Elementary School Mathematics - Addison-WesleyGrade 6 - 307 Pages

Numeration and Notation. The sixth grade book in this series continues the basic plan of developing skills and understanding in Numeration and Notation. Maintenance and extension lessons on reading and writing of large numbers are presented with place value concepts developed through the billions. Introduction is made to large numbers such as quadrillion, quintillion, and sextillion. An introduction to exponents, their use and notation, is given in conjunction with scientific notation. The text introduces the symbolism for square root, percent, negative variables, and union and intersection of sets. Lessons introducing and developing concepts on systems of numeration other than base ten are included. The base six system is given the most attention in this textbook. Addition and multiplication computations with base six numerals are presented. Extension of expanded notation lessons are given as well as introduction of this concept using exponents. This area of the text content is contained in 23 pages, which amounts to a little over 7% of the total book.

Number Operations. All operations with whole numbers are reviewed with extension of the skills carried out. This maintenance of skills for addition, subtraction, multiplication, and division of whole numbers takes up 50 pages, which amounts to about 9% of the complete textbook. Multiplication of two- and three-figure multipliers is covered, along with division of two- and three-figure divisors into five- and six-figure dividends. All the basic properties of operations on whole numbers are reviewed and maintenance exercises given. Integers are introduced by means of the set of negative numbers. Addition, subtraction, and multiplication of integers is introduced as a part of familiar physical situations.

Rational numbers are covered by 97 pages, which figures 31.6% of the total pages. Basic concepts for common fractions and mixed numbers are reviewed. Addition, subtraction, multiplication, and division of common fractions and mixed numbers are covered, along with the similar operations on decimal fractions. Principles of percent notation, percent equations, and operational concepts of percent are introduced to coincide with the area of ratio.

Measurements. This area entails 26 pages, or 8% of the textbook. Much of it is devoted to maintenance and extension of measurement concepts previously taught. It especially emphasizes the areas of volume, geometric measures used with angles, circles, and triangles. The metric system is introduced in comparison to the standard English units of measure. The extension of ideas on scale drawings, maps, charts, graphs, and plotting of functions is basic to this area of the content.

Geometry. There are 39 pages, 12.7%, devoted to the geometric phase of the program at this level. Much of these pages emphasize the abstract nature of geometry and the concepts of space geometry. Introduction to the principles of space figures and plane geometric concepts are made. The previously introduced ideas of surface areas, perimeters, and configurations are maintained. All basic geometric figures are used to assist in this maintenance of ideas. The Pythagorean Theorem is introduced at this level.

Problem Solving. This area includes word problems using the basic principles and algorithms which are primary to this textbook's content. Multiple operation problems are used extensively. The number of pages involved with these problems is 44, which amounts to 14.5% of the text.

Understanding Mathematics - American Book CompanyGrade 4 - 325 Pages

Numeration and Notation. The content of Understanding Mathematics which deals with the Numeration and Notation area includes 46 pages, 14%. It includes such items as reading and writing numerals and number words through millions, recognition of fraction symbols, decimal numerals, and percents. The basic place value understandings of ten as the unit in a decimal number system and the notations to the right of the decimal point including tenths and hundredths are presented. Emphasis on equivalent forms and expanded notation with whole and fractional numbers is given. Roman numerals through "C" (100) are covered. Elements of sets, set notations, equal sets, and one-to-one correspondence are all areas of study with sets which are extended in this level.

Number Operations. The operations on whole numbers as developed in this textbook involve 119 pages, or 36.6% of all pages. Since all addition and subtraction facts through 18 have been previously presented, this content deals primarily with review and extension of skills in using these facts. The renaming concept to four-digit numbers is presented. Addition with renaming of four addends with up to four-digit numbers, five addends with up to two-digit numbers, and horizontal addition of up to three digits is also developed. Subtraction of numbers with zeros in both numbers is presented in conjunction with regrouping procedures. This addition and subtraction of whole numbers section is also involved with basic teachings concerning order and grouping. The basic properties and relationships which are maintained in this text are commutative and associative properties of addition and multiplication, additive identity element, inverse relationships of both addition-subtraction and multiplication-division,

multiplication identity element, property of zero, and property of one. Whole number multiplication and division skills are extended to include four-digit numbers multiplied by a one-digit number, two-digit numbers multiplied by two-digit numbers, four-digit numbers divided by one- and two-digit numbers, remainders in division problems, and checking of standard multiplication and division problems. Throughout this section, the standard algorithms for multiplication and division are developed and extended.

The concepts of rational number identification and meaning has been previously introduced. This text maintains these concepts and extends this area into the addition and subtraction of fractions with like and unlike denominators. The operations of multiplication and division of fractions and whole numbers is introduced. Ideas pertaining to addition and subtraction of decimals of tenths and hundredths are also introduced. This section includes 54 pages, which is 16.6% of the text.

Measurements. The study of Measurements concepts is included on 13 pages, which amounts to 4% of the book. Standard units of measure in length, time, liquids, and money are extended from previous lessons and addition principles with regard to area and quantity are introduced. Data in chart and table form is presented.

Geometry. There are 50 pages devoted to the study of geometric concepts. This makes up 15.4% of the total textbook. Portions of this section develop lessons pertaining to points as locations, lines as a set of points, line segments, a ray as a set of points with one end point, and an angle as a union of two rays with the same end point. Other ideas set forth involve the recognition, definition, and classification of closed figures such as triangles, parallelograms, rhombus, circle radius

and diameter, right prisms and cubes, cylinders, and spheres. Introduction of new ideas concerning the set of points outside, inside, and on closed figures is presented.

Problem Solving. Pages of word problems included in this text cover 7.7% or 25 pages. Problems are included for all other major areas of study with skills developed on problem-solving analysis and writing of number sentences from data given in a word problem.

Learning Mathematics - American Book Company

Grade 5 - 320 Pages

Numeration and Notation. The fifth grade book in this series has 33 pages pertaining to Numeration and Notation concepts. This amounts to 10% of the total pages of the text. Included are lessons on reading and writing of numbers through billions, reading and writing fractions and decimals through hundredths, and place values which go along with these understandings. Further extension of ten as the basic unit in our decimal system is set forth. Roman numeral understanding through "D" and "M" are developed, with emphasis on the lack of a symbol for zero brought out. Counting in base five is introduced initially and the converting from base five to base ten is presented. Previously presented concepts on set notation and operations are maintained.

Number Operations. Whole number operations included herein amount to 20.3% of the pages of the book. A total of 23 deal with addition and subtraction of whole numbers and carry the student through addition of five addends, addition and subtraction of five- and six-digit numbers with renaming, and the principle of zeros in addition and subtraction of these larger numbers. Multiplication and division of whole numbers is presented on 42 pages. Besides the extension of grade four concepts, the

multiplication of five-digit numbers by one-digit numbers; three-digit numbers by two- and three-digit numbers; division of four- and five-digit numbers by one-digit numbers, three-digit numbers by two- and three-digit numbers; and expression of division remainders are presented initially. Also introduced is the principle of short division and the idea of casting out nines. The properties and relationships developed in previous grades are maintained and additional concepts involving the relationships of division to subtraction and addition to multiplication are introduced.

Included in the 180 pages (33.7%) which deal with rational numbers are such topics as common fraction precepts, decimal fractions, percents, and the relationships existing with regard to these segments of rational numbers. Specifically, addition, subtraction, multiplication, and division of common fractions; mixed numbers, and decimals are included in the text. Development of ideas on common denominators, lowest common multiples, simplification of fraction form, and changing terms of a fraction is set forth. The reciprocal relationships are introduced with a study of properties involving fractions. Percent is introduced by finding the meaning of percent with respect to its fractional equivalent.

Measurements. The 21 pages devoted to a study of Measurements at the fifth grade level are primarily concerned with maintenance and extension of understandings previously taught. New areas introduced are ideas pertaining to data on bar, circle, line, and picture graphs. Work with obtaining and recording data on tables is extended. Scale drawings are also introduced as new material. The Measurements area of the book includes 6.5% of its total pages.

Geometry. Lessons involving geometric principles cover 12.8% of the text and include 41 pages. The concepts enumerated for the fourth grade

text are extended and several areas of new ideas presented. Specifically, ideas dealing with planes, intersection of two lines in a plane, intersecting lines and angles, opposite and supplementary angles are introduced. Also developed as new material are principles regarding closed plane and space figures such as trapezoids, sectors of a circle, pyramids, cones, surface area of prisms and cylinders, and the formula for figuring the circumference of a circle. Extension of the previously taught skills regarding angles includes bisecting angles, copying line segments and angles and labeling them, and congruence of angles.

Problem Solving. There are 15 pages solely devoted to word problems and these include operational practice in each of the major areas. These problems include multistep procedures involving varying combinations of all the basic operations. This section includes 4.7% of the text.

Unifying Mathematics - American Book Company

Grade 6 - 347 Pages

Numeration and Notation. A total of 39 pages, which amounts to 11.3% of the book's lessons, are aimed primarily at developing concepts in this area. Besides reviewing and extending ideas taught at former levels, the reading of numerals for negative integers is taken up. Reading and writing of decimal numerals through thousandths is an extension of fifth grade teachings. Roman numerals through "M" are reviewed, with the additive and subtractive principles introduced. The base eight number system is introduced and related to the base ten system. Addition and subtraction operations in this system with the appropriate notations necessary are taken up for the first time. Set notation practices are maintained, and introduction of solution and replacement sets made.

Number Operations. Whole number operations take up a little over 30 pages, or 18% of the content. Basically all concepts in the four operations of addition, subtraction, multiplication, and division have been covered at previous levels. Exceptions to this include the property of order, the property of closure under addition and multiplication, the addition and subtraction of six digits with renaming, the multiplication of four-digit numbers by three- and four-digit numbers, and the division of four- and five-digit numbers by two- and three-digit numbers.

There are 112 pages (32.3%) which deal with operations on rational numbers. This includes pages on review and maintenance of principles previously taught and extension of some others. New to this level is the presentation of ratio and proportion. Operations with decimal numerals to thousandths is also new. The study of percent is extended to include meanings of 100%, less than 1%, and greater than 100%. Repeating and terminating decimal numerals is introduced as extension of basic concepts on decimal operations. Integers are initially introduced and the principle of their addition is shown by using the number line.

Measurements. Twenty-four pages are used to cover lessons with regard to measures. These pages make up 6.9% of the book. New to the study of basic units of measure are weight (tons), volume (cubic measure), the metric system, and fractional parts of measures. Operationally the conversion of linear, square, and volume measures are taken up. Simple addition, subtraction, multiplication, and division with measures is initially introduced. Work with graphs, charts, and tables, as well as scale drawings, acts to maintain and extend skills developed in previous books in this series.

Geometry. The 31 pages devoted to geometry contain material which

is primarily extension of ideas introduced at the fourth and fifth grade levels. By extending the concepts of angles, vertical angles are introduced; also, corresponding angles, alternate interior angles, and the intersecting of three lines in a plane. Extension of ideas on triangles brings in the subject of isosceles and right triangles and the algebraic formula for finding the area of a triangle. The algebraic formulas for finding the circumference and area of a circle are also given. This material makes up 8.9% of the pages of this text.

Problem Solving. There are 22 pages, amounting to 6.3% of the total, which primarily extend skills in reading, analyzing, and developing equations or number sentences for word problems. The pages devoted to this area of the content use the four basic operations with whole and rational numbers in a variety of different settings and are found in all parts of the book's basic areas.

Growth In Arithmetic - Harcourt, Brace and World

Grade 4 - 310 Pages

Numeration and Notation. This textbook includes 19 pages pertaining to the development and maintenance of ideas on Numeration and Notation. It takes the student through the reading and writing of six-place numbers and the attendant place value concepts. Roman numerals are taken up through XXX. This amounted to 6.1% of the total pages in the textbook.

Number Operations. This area covers whole numbers, fractions, and integers and includes 144 pages. Of this number, 24 pages deal with addition and subtraction concepts and operations of one-, two-, and three-place whole numbers with or without changing (carrying or borrowing). There are 103 pages used to develop concepts in multiplication and division

of whole numbers. The multiplication and division of 2's, 3's, 4's, and 5's are reviewed and the 6's, 7's, 8's, and 9's taught. Multiplication by three-place multipliers and division of three- and four-place numbers by one-place divisors is presented. Common fractions are presented in 17 pages and the addition and subtraction of proper fractions is taken up. Operations with decimals (exclusive of money), percent, and integers are not covered.

Measurements. The area of Measurements reviews the counting of change and reviews and extends measurements of liquids, weights, distance, temperature, and time. The relationship of measures in each category is presented. This area covers 28 pages. Bar and picture graphs are also included.

Geometry. Geometry is covered by only three pages and these deal primarily with the recognition and definition of geometric figures and terms such as circles, squares, rectangles, triangles, and parallel lines.

Problem Solving. Problem Solving, or the solving of word or verbal problems, is presented on 53 pages. These problems deal with concepts, operations, and areas covered in the different portions of the book. Most pages of verbal problems are for the purpose of maintenance and evaluation of concepts and operations, but some deal more specifically with helps in word problem techniques.

Growth In Arithmetic - Harcourt, Brace and World

Grade 5 - 307 Pages

Numeration and Notation. The fifth grade text maintains and extends the concepts on Numeration and Notation, taking the student through the reading and writing of number ideas through millions and the place value

concepts which are basic to these numbers. Roman numerals are presented to 1,000 with emphasis on the numerals through 300. There are 17 pages devoted to this area of mathematics.

Number Operations. This entire area is presented on 166 pages which includes 20 pages on addition and subtraction of whole numbers, 68 pages on multiplication and division of whole numbers, and 78 pages covering operation on rational numbers. Multiplication and division of whole numbers are carried through multiplication by three-figure multipliers and dividing by two-place divisors. Common fraction operations are maintained through addition and subtraction of proper fractions and mixed numbers where some changing is necessary. The multiplication of proper fractions times whole numbers and mixed numbers times whole numbers is presented as new material. Decimal concepts are presented through hundredths with adding and subtracting as the operations taught. Multiplication and division of decimals is not presented nor division of fractions. No lessons cover percent or integers.

Measurements. Thirty pages are devoted to the area of Measurements. Work with standard units of measure is maintained and extended through the operations of addition, subtraction, multiplication, and division of different measures. Reading and developing of bar, line, and picture graphs is presented along with work on varying types of data in table form and scale drawings.

Geometry. Presentation of concepts in the area of Geometry involves seven pages in this text. Perimeter and area of squares, rectangles, and triangles are presented.

Problem Solving. Thirty-seven pages are devoted to verbal problems covering problems from nearly all major areas.

Growth In Arithmetic - Harcourt, Brace and WorldGrade 6 - 309 Pages

Numeration and Notation. The sixth grade text of this series presents principles of Numeration and Notation on 25 pages. These lessons carry the student through the reading and writing of numerals up to and including billions in the Hindu-Arabic system. Understanding of these numbers and the place values involved are taken up. Roman numeral concepts from 500 through 2,000 are developed. A few pages deal with the understanding of number sentences. An optional chapter at the end of the textbook includes lessons for abler learners dealing with prime numbers and factors, least common multiples, and the base five number system.

Number Operations. This section includes 177 pages dealing with whole, rational, and integers numbers. Only eight pages deal with the maintenance and extension of addition and subtraction of whole numbers. There are 41 pages dealing with multiplication and division of whole numbers including three-figure multipliers, three-figure divisors and quotients. A large portion of the text deals with the concepts and relationships of multiplication and division of common fractions and mixed numbers. Principles of addition and subtraction of decimals are extended to include thousandths. Multiplication and division of decimals are initially introduced and carried through work with tenths, hundredths, and thousandths. Percent is introduced for the first time, along with ratios and the idea of commissions. In the optional chapter, proportion is also introduced. The text deals with operations and properties of rational numbers on 128 pages. An introduction to integers is discussed on one page located in the optional chapter.

Measurements. Skills in adding, subtracting, multiplying and

dividing standard units of measure are maintained with the additional concept of cubic measures being developed. This area covers 22 pages.

Geometry. This area is covered in 15 pages, most of which are found in the optional chapter at the end of the text. The extension of concepts dealing with rectangles and squares regarding their perimeters and areas is given, as well as an introduction to closed figure volume. In the optional chapter such geometrical items as points, lines, planes, and angles are introduced.

Problem Solving. This area is covered in 33 pages and these problems deal with concepts in all other major areas. Nearly half of these pages deal with lessons giving helps or techniques in the solving of verbal problems.

Moving Ahead In Arithmetic - Holt, Rinehart & Winston

Grade 4 - 350 Pages

Numeration and Notation. The fourth grade text in this series devotes 29 pages to cover the following items in this area: Reading and writing of numbers through the millions and the corresponding place value concepts, principles and concepts of odd and even numbers, reading and writing of Roman numerals through 100 (C), writing of numerals in expanded notation and the concepts of equality involved in this principle. The subject of sets, subsets, empty sets, and set notation is reviewed from previous work and extended.

Number Operations. This area covered 214 pages of the book. Whole number addition and subtraction concepts took up 54, just over 15%, of these pages. Review lessons on all addition and subtraction facts through the 18's, problems with up to four addends in column form, regrouping

through hundreds, and the bridging of tens are all covered. Addition and subtraction with thousands is covered, along with regrouping of even thousands. Concepts of addition and subtraction of money are taken up. With regard to fundamental laws of mathematics affecting addition and subtraction of whole numbers, the following are reviewed and concepts extended: Commutative law of addition, Associative law of addition, and Identity element for addition. Multiplication and division of whole numbers cover 136 pages, which is 38.9% of the text. A review of the multiplication and division facts of twos through nines is presented. Multiplication by tens, with carrying to both tens and hundreds, is developed. Divisors of even tens are used to divide into other tens and hundreds numbers. Mathematical laws and properties used which apply to multiplication and division of whole numbers are: Commutative law of multiplication, Identity element for multiplication, Distributive law of multiplication over addition, and Associative law of multiplication. The usual algorithms for these two operations are presented with whole numbers. Division as repeated subtraction and multiplication as repeated addition are also covered. Work in rational numbers deals primarily with common fractions. There are 24 pages, or 6.9%, dealing with this topic. Reviewing fractional parts of a whole, naming the parts of a fraction, adding and subtracting of like fractions and mixed numbers with like denominators, and readiness for decimals through work with money are all covered.

Measurements. This section of the text covered 18 pages, 3.4% of the book, and extends concepts in most of the standard units of measure. Units of measure are extended to include seconds, length measures to miles, weight measures to tons, temperature in degrees, values in money, and the changing to higher or lower units of measure. The subject of

perimeters is introduced as well as dry measures of pecks and bushels. Adding and subtracting of measurements of time is also a concept which is introduced. Use of tables for securing and reporting data, as well as bar, circle, and line graphs is covered. One lesson takes up reading a map.

Geometry. Geometric ideas are taken up on 15 pages, or 3.3% of the text. They include studies on line segments, rays, points, and angles. The recognition and construction of squares, rectangles, parallelograms, and the rhombus is developed.

Problem Solving. Sixty-two pages, which amounts to 17.7% of the total, are used in maintaining and extending verbal problem solving techniques. These problems include work in all the other major areas with some lessons devoted to explaining verbal problem patterns. Developing the concepts of writing number sentences for one- and two-step verbal problems is stressed.

Moving Ahead In Arithmetic - Holt, Rinehart & Winston

Grade 5 - 368 Pages

Numeration and Notation. The fifth grade text has 21 pages, or 5.7% of the entire book, devoted to lessons regarding this area. Specifically, the following sections of this area are covered: Extension of writing number sentences, reading and writing numbers through the millions and accompanying place value concepts, number equalities, extension of set terminology and working with sets, subsets, and empty sets. Also introduced is the idea of finite and infinite sets. Items for maintenance and extension of the concepts of expanded notation are presented.

Number Operations. A total of 153 pages, which is 41.3% of the book, are included in this area. Whole number addition and subtraction lessons

take up 16 pages, 4.3%, which basically was review and maintenance of skills taught at previous grade levels. Whole number multiplication and division included 67 pages, or 18.1% of the total pages. All multiplication and division facts and processes are reviewed, and the multiplication by two- and three-place numerals is developed. Division by two-digit numerals of two-, three-, four-, and five-digit numerals is presented. Problems whose quotients are named by three-digit numerals are introduced also. Naming of remainders in division as fractions is introduced at this level. All the fundamental properties developed in the fourth grade level for these operations are reviewed and maintained. Operations on rational numbers takes up 70 pages, 18.9%, and includes reviewing the adding and subtracting of like fractions and mixed numbers with like fractional parts. Initially taken up are the processes of adding and subtracting unlike fractions and mixed numbers with and without regrouping, renaming improper fractions as mixed numbers, and adding and subtracting decimals through hundredths. Ratio is introduced at this level.

Measurements. This area included 29 pages, which was 7.8% of the book. All the standard units of measure were reviewed and the introduction to the unit of acre. Abilities to use tables, bar graphs, line graphs, circle graphs, and maps are extended and scale drawings are presented.

Geometry. The portion dealing with geometric concepts contained 25 pages, or 6.7% of the entire textbook. Properties of the common quadrilateral, square, rectangle, parallelogram, and rhombus are reviewed and the trapezoid is introduced. Acute, obtuse, and right angles are specifically studied with respect to triangles. Equilateral, isosceles, right, and scalene triangles are presented. The ideas of perpendiculars, congruent angles, and line segments are also taken up.

Problem Solving. The continued use of verbal problems in all areas of the book is made. Skills already developed are maintained.

Moving Ahead In Arithmetic - Holt, Rinehart & Winston

Grade 6 - 320 Pages

Numeration and Notation. The area of Numeration and Notation covers 44 pages, which is 13.7% of the book. The skills of reading and writing numerals through the trillions with the attendant place values are taught. Ideas on use of expanded notation are extended along with factorization, primes, exponents, and common multiples. Concepts basic to the understanding of number bases other than ten are presented, and changing from base ten to a given base and the reverse is covered. Order of operations in mathematical sentences is taken up as well as some facts about the history of numbers. Work with sets, subsets, set terminology, and set operations is reviewed and extended.

Number Operations. This area, which deals with relationships and operations on whole, rational, and integer numbers, involves 155 pages, or 48.4% of the book. Addition, subtraction, multiplication, and division of whole numbers was discussed on 43 pages, or 13.4%. All work in addition and subtraction is basically maintenance of concepts taught previously, with the exception of adding and subtracting in other bases. Multiplication of whole numbers reviews multiplying by one, two, and three figures and takes up multiplying by four-digit numbers. Division problems dealing with three-digit divisors are presented as new material, whereas division by ones and tens are reviewed and further developed. The multiplication and division of whole numbers includes development of the concept that these two operations are inverse operations.

All basic laws previously taught are maintained and used with larger numbers. Work with rational numbers was taken up on 112 pages, which consists of 35% of the book. All previous work with adding and subtracting of like and unlike fractions, mixed numbers, and fractions and whole numbers with and without regrouping is continued, while multiplication and division of fractions and mixed numbers is introduced. A review of addition and subtraction principles used with tenths and hundredths is presented, while extending the concepts of using these operations on thousandths. Multiplication and division of decimals is new material which is introduced in these pages. Work with ratios and rates is continued along with readiness concepts for percents as rates. Percent is taught as ratios in which the ratio is renamed in percent form. The principles of reciprocals are used in working with multiplication and division of fractions.

Measurements. Thirty-three pages, or 10.3%, deal with this area. All standard units of measure previously taught are reviewed with the introduction of calories, speed, time zones, and volume measures. All four basic operations with these units of measure are covered. Skills in reading and developing of data on tables, charts, graphs, and maps are extended with the introduction of plotting rate as a function of time and distance.

Geometry. This area covers 22 pages and involves 6.8% of the text. Basic extension of skills involving recognition of geometric figures, areas, and perimeters of rectangles and properties of quadrilaterals is covered. New topics taken up include areas of parallelograms, triangles, and trapezoids, properties and volume of rectangular prisms, measuring of angles, and working with circles.

Problem Solving. The extension and maintenance of skills previously developed in former work make up the lessons in this area.

Arithmetic, Laidlaw - Grade 4 - 296 Pages

Numeration and Notation. The fourth grade text for this series contains ten pages dealing with this area. This amounts to 3.4% of the content. Counting numbers through nine is reviewed and the reading and writing of numbers through thousands is presented. Number equalities and the renaming of numbers expressed by two- and three-digit numerals are discussed. Zero as a place holder is extended to cover the larger numbers introduced. Skills in reading numerals in addresses, dates, telephone numbers, and other such notations are presented. The comparing of Roman numerals which have non-positional features with the more common positional Arabic numeral system is introduced. The operation and properties of sets and subsets are used to develop clarification of properties and relationships with numbers.

Number Operations. The whole number operations of addition, subtraction, multiplication, and division take up 123 pages, or 41.4% of the text. Addition and subtraction of whole numbers makes up 11.4% of this figure, while multiplication and division includes 30%. Addition principles dealing with four addends of two, three, and four digits are presented. Renaming of these numbers is developed, along with the commutative, associative, and inverse properties of addition. Subtraction as the inverse of addition is presented; and the subtraction operation on two-, three-, and four-digit numbers with and without renaming is explained. Addition and subtraction facts of one to ten are reviewed and those from eleven to eighteen are developed as extension. Multiplication and

division facts one through nine are reviewed and extended. The use of these facts is presented by developing the multiplication algorithms for one-digit multipliers and two-, three-, and four-digit multiplicands and two- and three-digit multipliers by two- and three-digit multiplicands. Division algorithms are presented to include dividing two-, three-, and four-digit numbers by one-digit numbers. The inverse relationship of these operations is developed, as are the associative, commutative, and distributive properties. Multiplication and addition relationships are shown as well as the relationship between subtraction and division.

Operations on rational numbers are included on 40 pages, which makes up 13.5% of the book. This section includes extensive review and extension of the understandings of what common fractions numbers are and the kinds of common fractions (proper, improper, and mixed numbers). Changing the form of fractions, changing to lowest form, and expressing fractions in their simplest form are introduced. Addition and subtraction of fractions and mixed numbers with common denominators are also introduced.

Measurements. The area of Measurements has 6.4%, or 19 pages, devoted to it. Standard units of linear measure through miles, liquid measure through gallons, weight through tons, time through years, dry measures through bushels are all reviewed and extended. Also developed are measures of temperature in degrees. Introductions to maps, scale drawings, pictographs, and reading data from simple tables are presented. Finding the perimeter of squares, rectangles, and triangles is also introduced.

Geometry. This area of content includes seven pages, or 2.5% of the book. It primarily deals with the extension of recognition of geometric shapes. These include circles, squares, rectangles, and triangles.

Problem Solving. There are 56 pages, 18.9%, used in developing concepts and skills in solving word problems. All four primary operations are covered while reviewing and extending skills for problem analyzing, translating problem data into number sentences or equations, and performing more than one operation in a problem. These problems are found throughout all other major areas in the content.

Arithmetic, Laidlaw - Grade 5 - 294 Pages

Numeration and Notation. Twenty-three pages, which is 7.8% of the content for the fifth grade, deal with this area. The concepts involved with reading and writing of number words and numerals through billions is introduced. Place value ideas concurrent with these larger numbers are also developed. The operation of zero as a place holder in our Hindu-Arabic numeration system is presented. Comparing the Arabic, Roman, and Egyptian numeration systems as far as being positional or non-positional is taken up, as well as the rules of repetition as applied to addition and subtraction in these systems.

Number Operations. The portion of this area dealing with whole number operations is included on 81 pages, or 27.6% of the entire text. All four primary operations are included with addition and subtraction making up 6.8% and multiplication and division 20.8%. Addition of whole numbers is basically review, with the exception of an extension of skills for adding numbers of more than four digits. All properties and relationships dealing with addition and subtraction of whole numbers are reviewed. Extension of previously introduced subtraction concepts is accomplished by presenting subtraction of four- and five-digit numbers from numbers of five digits.

Multiplication and division skills as presented are primarily extensions of concepts previously taught. Multiplication skills are extended by introducing multiplication of four-digit numbers by numbers of three and four digits. The introduction of the order of factors in multiplication also is presented. Division skills are likewise extended through taking up two-digit divisors as used with two-, three-, four-, five-, and six-digit dividends. Throughout these sections, skills in estimating and finding trial quotients are developed. Concepts of all properties and relationships applicable to these operations are reviewed and maintained.

The portion of this text devoted to operations with rational numbers uses 50 pages, or 17.1% of the total book. The content basically is involved with lessons on addition and subtraction of common fractions and mixed numbers with like and unlike denominators, and addition and subtraction of decimal numbers of tenths and hundredths. Operational properties introduced are the associative and commutative. Readiness concepts for multiplication and division operations with common fractions are briefly presented.

Measurements. Concepts of measurement are presented initially or reviewed on 38 pages, which amounts to 12.9% of this textbook. Much of this content is extension of ideas developed on the previous levels. Specifically, the new standard units of measure introduced are: Rods, fluid ounces, hundred-weight, Fahrenheit and Centigrade degrees, decades and centuries, time zones, and square measures (feet, inches, yards, miles, rods, acres). The precision principle, or approximate nature, of measure is explained. Use of tables, charts, and scale drawings is extended. Bar, line, and circle graphs are introduced. Finding the area of rectangles

and squares is presented, along with the idea of square measures.

Geometry. The area of Geometry makes up 5.1% of the textbook content and uses 15 pages. Besides the portion devoted to maintenance of skills on recognizing simple geometric figures, the following topics are introduced for the first time: Intersecting and parallel lines, planes, rays and endpoints, angle vertex, right angles, and quadrilaterals and their angles.

Problem Solving. Pages dealing with problem-solving exercises totaled 47 in number. This amounted to 15.9% of the total pages classified. These pages contained problems which reviewed and extended skills formerly presented. All areas of the content were found to include this type problem.

Arithmetic, Laidlaw - Grade 6 - 294 Pages

Numeration and Notation. The total number of pages used in this textbook to cover this area is 13. This number is 4.4% of the entire book. Skills for reading and writing large numbers through hundred billions are reviewed and extended. The reading and writing of decimal numbers is presented through millionths. Place value concepts involved with these numbers are developed simultaneously. Extension in the understanding and use of operational and relationship symbols is given. Emphasis is placed on the difference between number and numeral.

Number Operations. All four whole number operations (addition, subtraction, multiplication, and division) involve 36 pages (12.3%). Addition and subtraction of whole numbers makes up 10 pages, while multiplication and division deal with 26 pages. Primarily, the pages devoted to addition and subtraction are for the purpose of maintenance of skills

with some extension. The addition and subtraction of numbers with more than five digits is presented. The property of closure in addition is initially presented and all other relationships and properties reviewed. Skills in multiplication and division of whole numbers, in like manner, are extended to include use of these algorithms with larger (three-, four-, five-, and six-digit) numbers. All relationships and properties applicable to these operations are also reviewed.

The sixth grade textbook contains 103 pages which deal with operations on rational numbers. This figure amounts to 35% of the book's total content. All four operations on common fractions and decimals are included, as well as the topics of ratio, proportion, and percent. Common fractions and mixed numbers with like and unlike denominators are added, subtracted, multiplied, and divided. Decimals through tenths and thousandths are also used with all four basic operations. The relationships existing with regard to percent, ratio, fractions, and decimals are explained.

Measurements. Measurement concepts were included on 49 pages, for a percentage of 16.6. The principal topics introduced as new material in this section deal with the metric system of measures and the conversion of the units found in this system to the English units. Metric units for length, liquids, weight, and square measures are included. Addition, subtraction, multiplication, and division operations on measures are covered in this book. Use and construction of frequency distribution tables is also initially introduced.

Geometry. There are 18 pages (6.1%) devoted to this area in the sixth grade textbook. Review of concepts from previous levels is given and new materials on topics such as volume of three dimensional figures

in cubic inches, cubic feet, and cubic yards; infinite lines, parallel line segments, and parts of planes, use of a compass in working with and drawing circles, chords, and the concept of equidistance, polygons, and equilateral triangles are presented.

Problem Solving. The area of Problem Solving is contained on 34 pages scattered in all sections of the textbook. This number of pages figures 11.5% of the total. Some emphasis is placed in this book on the concepts needed for two or more operations in the same problem. Continued review and extension of skills in analyzing problems and translating this information into equation form is given.

Seeing Through Arithmetic - Scott Foresman

Grade 4 - 250 Pages

Numeration and Notation. The fourth grade Scott Foresman text contains 33 pages dealing with lessons in this area. This figures 13.2% of the book. Skills involved with the reading and writing of numbers through millions and the corresponding place value concepts are developed. Roman numerals to XXXIX are introduced and principles of this system developed.

Number Operations. Addition and subtraction of whole numbers is covered on 32 pages, 13.2% of the book. All combinations through 18 have been previously taught and are reviewed. The principles of adding and subtracting two- and three-digit numbers are developed. Addition problems with three one-figure addends are also introduced. Concepts involving the checking of addition and subtraction problems are initially introduced. Principles of regrouping and borrowing are reviewed and extended. Multiplication and division of whole numbers is covered on 78 pages in this textbook. The basic facts through 36 are reviewed and those remaining

through 81 are introduced. The multiplication and division algorithms involving two- and three-figure divisors and multipliers are presented and the process of checking these problems introduced. Principles determining the use of zero and one in multiplication and division are also taught at this level. Division problems with remainders are used initially. Ideas with regard to the order of factors are likewise developed.

There are 15 pages, amounting to 6% of the entire textbook, devoted to rational numbers and their operations. Basic concepts regarding common fractions, equivalent fractions, improper fractions, and mixed numerals are maintained and developed. Comparing fractional parts along with unit and non-unit fractions are taught as readiness concepts for adding, subtracting, multiplying, and dividing of fractions taught in subsequent levels.

Measurements. Lessons involving this area were contained in 31 pages of the text. These pages make up 12.4% of all the lessons. The standard units of measures were either reviewed or extended at this level as follows: Temperature (Fahrenheit); liquid--ounces, tablespoon, cup, pint, quart, and gallon; dry--pint, quart, peck, and bushel; weight--ounce, pound, and ton; length--inch, foot, yard, and mile; time--second, hour, day, week, month, and year. Introduction to the concept of the reduction of measurement units is made. Abbreviations for all standard units of measure are given. Initial concepts regarding linear scale on a map are introduced.

Ideas dealing with money--the denominations, making change, and reading and writing of numerals representing money are reviewed and extended.

Geometry. There are only three pages, or 1.2%, dealing with this area in the book. These pages deal with recognition of squares, triangles

circles, parallel lines, right angles, and rectangles.

Problem Solving. The pages devoted to the Problem Solving area number 42 in all. This figures 16.8% of all the book. The problems are found throughout the text and are involved with all areas. They are problems of one and two operations and involve skills designed to strengthen operational processes and principles of transforming data in a problem to equation or number sentence form.

Seeing Through Arithmetic - Scott Foresman

Grade 5 - 265 Pages

Numeration and Notation. This area contains 44 pages in the fifth grade textbook of this series. These pages are 16.5% of the entire book. Much of this work deals with maintaining and extending concepts of reading and writing numbers through the millions, place values through the millions, rounding off numbers, difference between a number and numeral, and Roman numerals through XXXIX. New ideas introduced deal with Roman numerals through the thousands and place values two places to the right of the decimal point.

Number Operations. Whole number operations involving addition, subtraction, multiplication, and division are found on 57 pages, which amounts to 21.6% of the book. The basic facts, algorithms, relationships, and checking principles are all maintained and extended to greater numbers involving three and four digits in the area of addition and subtraction. In the area of multiplication and division, previously taught principles, algorithms, and facts are reviewed and extended to encompass larger numbers of three and four digits. Ideas regarding properties are all maintained and extended.

Of the total number of pages in this textbook, 24.3% (or 64) are involved with operations on rational numbers. Primary concepts about common fractions are reviewed and the processes of adding and subtracting proper fractions and mixed numbers are introduced and developed. Problems involving both like and unlike fractions are used in this section. Reduction of fractions and use of common denominators are ideas also developed in these lessons. The understandings needed for recognizing and reading decimals through hundredths are presented initially. Readiness materials for percent are introduced at this level in the form of ratios expressing rate and comparison.

Measurements. The area of Measurements is involved with 36 pages. This proportion of the book, 13.6%, mainly deals with extension of standard units of measure introduced previously. The concepts involving units of acre, standard time and time zones, square inches, square yards, and square miles are all introduced. The principle of measurement approximation is extended at this level. The study and use of pictographs and bar graphs is developed and an extension of scale drawing concepts given. The processes of finding perimeter and area of rectangles and polygons are introduced with the concept of square measures.

Geometry. Geometric ideas are presented on eight pages, which amounts to 3% of this textbook. The recognition of parallel lines, right angles, rectangles, triangles, squares, and circles is reviewed and ideas pertaining to dimensions describing circles and polygons are presented.

Problem Solving. The thirty-three pages designed for practice and development of problem solving skills comprises 12.4% of this text. These pages are located throughout the book involving problems of two or more operations in all basic areas of the book.

Seeing Through Arithmetic - Scott ForesmanGrade 6 - 280 Pages

Numeration and Notation. All skills for reading and writing numbers through millions and the attendant place value concepts are reviewed in this book. The number line is used to introduce the integer concept. The idea of an infinite number of points between two given points on the number line is also introduced. This area includes 31 pages, or 11% of the total in the book.

Number Operations. Whole number addition and subtraction is reviewed briefly to maintain the skills previously taught. Multiplication and division of whole numbers is handled in a similar manner except for the extension of skills in division to include operations with three-figure divisors. All basic laws (associative, distributive, and commutative) are reviewed. The proportion of this text dealing with these whole number operations is just over 7%.

The 124 pages devoted to operations on rational numbers comprise 44.2% of the total text. The addition and subtraction skills with proper fractions and mixed numbers are all reviewed and additional practice given. Introduced at this level are the multiplication and division processes for common fractions and mixed numbers. Along with these skills there are lessons extending the concepts of ratio with more complex applications. Concurrent with this development is the introduction of the idea of percent. This work with percent is used as an area of extension for decimal number concepts in the processes of addition, subtraction, multiplication, and division.

Measurements. Several new units of standard measures are introduced in the 27 pages, which comprise 9.6% of this textbook. Metric

units of gram, meter, liter, kilogram, kilometer, and centimeter are all initially presented. Cubic measures involving cubic foot, cubic inch, and cubic yard are introduced also. Continued work with graphs and tables develop new concepts of reading and understanding statistical data from these instruments.

Geometry. New materials introduced in the 26 pages devoted to geometric ideas deal primarily with the concepts of volume, recognition, and measurement of solids. Ideas relating to the area of parallelograms and surface area of rectangular prisms are reviewed and extended. This area comprises 9.3% of the total pages in the textbook.

Problem Solving. Most of the exercises in the Problem Solving area deal with multiple-step problems concerning mathematical concepts basic to this level of work. Problems dealing with ratio comparisons involving rate and percent are used. Word problems using common fractions and decimals are also presented. There are 26 pages, or 9.3%, devoted to this area in the sixth grade textbook.

Modern Arithmetic Through Discovery - Silver Burdett

Grade 4 - 282 Pages

Numeration and Notation. The fourth grade textbook for this series has 29 pages (10.3%) devoted to developing understandings in this area. Reading and writing of numbers through the hundred millions and corresponding place value concepts are covered. Patterns of number sequences, ideas on comparing numbers using such terms and symbols as greater than, less than, and the differences between a numeral and a number are set forth. Roman numerals through 500 (D) are presented and a comparison with the decimal system is made. The place of zero is emphasized as highly significant in the decimal system of numeration.

Number Operations. Whole number operations involving addition, subtraction, multiplication, and division are covered in 114 pages, about 40% of the entire text. Addition and subtraction of whole numbers takes up 25 of those pages and includes principles regarding adding and subtracting on the number line and number sentences with variables ($?$, $\square$, N) in different positions. The concept of addition and subtraction as inverse operations is presented. Adding and subtracting of two-, three-, and four-place numerals, with and without regrouping, is covered. Column additions, using higher-decade facts with or without bridging, is presented as is higher decade subtraction. The commutative and associative principles are developed in the content of this text. Whole number multiplication and division skills are covered in 89 pages. These pages make up 32% of the total number used in this book. All multiplication and division facts through 81 have previously been presented and these are reviewed. The commutative principle of multiplication, one as the identity element for multiplication, and the distributive principle of division are all presented. Multiplication and division of two-, three-, and four-place numbers by two-place numbers are covered. Division with remainders is also presented. Division is explained as successive subtraction. Multiplication as successive addition is likewise introduced.

There are 27 pages devoted to rational numbers, covering such topics as equivalent fractions, terms of a fraction, and different names for the same fraction numbers. Addition and subtraction of like fractions and changing fractions to their lowest terms are covered. Proper and improper fractions are also presented. These items make up 9.6% of the textbook's content.

Measurement. Measurement concepts are reviewed and extended on 39

pages. These concepts include linear units through the mile; weight measures of pound and ounces; liquid measures of gallon, quart, pint, half pint, and cup; time measure to seconds; and dry measures of peck, bushel, and ton. Picture, line, and bar graphs are presented as well as the introduction to scale drawings.

Geometry. This section includes 13 pages, which is 4.6% of the text. It includes reteaching recognition and properties of such geometric shapes as squares, rectangles, triangles, and circles. The ideas of points and lines are introduced intuitively. Line segments and the difference between them and a line is presented. At this level the topic of angles is introduced along with concepts pertaining to rays.

Problem Solving. The fourth grade textbook includes 43 pages which emphasize the Problem Solving area of its content. This is 15.2% of all the pages. The exercises deal with all types of problems using single and multiple operations. All four basic number operations are used with both whole and rational number situations. Some pages deal with lessons designed specifically to help students analyze problem data and correctly put it in number equation form.

Modern Arithmetic Through Discovery - Silver Burdett

Grade 5 - 282 Pages

Numeration and Notation. Twenty-nine pages of the fifth grade book deal with the area of Numeration and Notation. This amounts to 10.3% of the book's total content. Review and extension of reading and writing large numbers to hundred millions is a basic part of this area. Roman numerals through the thousands are presented in reteaching and extension lessons for items covered at lower levels. The reading and writing of

numerals placed to the right of a decimal point is introduced. Base five number system is introduced and a comparison with the more common base ten system is made.

Number Operations. Basic number operations on whole numbers are presented on 82 pages of this text. Of this number, 22 pages deal with addition and subtraction and 60 pages are concerned with multiplication and division of whole numbers. Addition and subtraction skills using three- and four-place numbers are reviewed and extended to include five-place numbers with regrouping. The commutative and associative properties in these two operations are emphasized at this level also. Multiplication and division of whole numbers is carried through the stage of multiplying and dividing three- and four-place numbers by two-digit numbers. Division with and without remainders is covered in these pages. The associative, commutative, and distributive properties of multiplication are used and dividing by using a distributive principle in division is introduced. The short division algorithm is initially presented as such in this text. Reteaching of the concept that multiplication and division are inverse operations is made.

The section dealing with rational numbers and operations on these numbers takes up 80 pages, or 28.3% of the textbook's pages. Primary understanding of common fractions and mixed numbers is retaught. Skills for adding and subtracting fractions and mixed numbers with like denominators is presented initially. Regrouping when subtracting unlike fractions is also covered, as is finding the least common denominator. Operations on decimals included in this text are addition and subtraction. These two operations are used with decimal numbers through thousandths and involve regrouping. Mixed decimal fractions are also presented and skills for

adding and subtracting them developed. A preliminary idea of ratio as the comparing of two numbers is given, although no formal rules are introduced.

Measurements. This area involves 42 pages, which amounts to 14.9% of the entire textbook. All standard units of measures are reviewed and extension of these understandings given. Especially important is the presentation in this book of the concept of precision of measurements. Addition and subtraction skills with standard measures are introduced, as are concepts of square units for use with areas. Bar, line, and pictographs are retaught with the vertical and horizontal forms of the bar graph presented. Lessons involved with principles of making bar and line graphs are presented.

Geometry. The concepts of geometry for this level are presented on 17 pages (6.0%) of the book. A review of previously developed ideas is given, and extension of the ideas of lines, line segments, rays, and angles is made. Closed figures are presented initially along with polygons and quadrilaterals. Although angles were introduced at an earlier level, an extension of these ideas to include right angles is made in this book. In conjunction with the study of right angles, the text develops ideas on right triangles and right angles in squares and rectangles. Rectangular prisms are introduced also. The circle, its diameter and radius, and the concept of arcs of circles and their measurement in degrees are presented in this text. Spheres are introduced using the globe as an example.

Problem Solving. The area dealing with this type content contains 21 pages and includes 7.5% of all pages. It involves all types of problem situations covered at this level with single and multiple operations. Analyzing and summarizing the data of these problems is stressed as well as the computation.

Modern Arithmetic Through Discovery - Silver BurdettGrade 6 - 282 Pages

Numeration and Notation. The presentation of concepts in this area covers 9.6% of the textbook in 27 pages. It basically includes much reteaching of place value and extension to billions. It again uses Roman numerals in comparison with the decimal system of numerals. Initial ideas on exponents and powers are presented. Lessons on principles and operations with the base six numeral system are developed as extension to base five numbers previously covered. Negative number concepts are introduced by using the thermometer and number line.

Number Operations. Whole numbers and the addition, subtraction, multiplication, and division operations on them are covered by 34 pages. Of this number, six are basic review of addition and subtraction concepts. The remaining 28 pages cover the algorithms for multiplication and division and extend these skills to include division of five-place numbers by two-place numbers with remainders being expressed in fraction form. A brief introduction to the process of adding positive and negative numbers is presented.

The section of the text covering rational numbers includes 119 pages, which amounts to 42.3% of the entire book. Addition and subtraction of common fractions, mixed numbers, and decimals are reviewed with an extension of these skills with decimals made to include numbers to ten-thousandths. Multiplication and division of common fractions, decimals, and mixed numbers are presented. Percent is introduced and related to the idea of ratio presented in the fifth grade text. The relationships of percent to fractions and decimals is developed.

Measurements. There are 36 pages devoted to this area in the sixth

grade text. In this content all standard units of measure are reviewed, and the operations of addition, subtraction, multiplication, and division with these units introduced. The exercises using these operations develop the concept of converting from one unit to another. Throughout, the idea of precision of measurements is emphasized. An extension of the topic of area is taken up, and skills in finding the area of squares, rectangles, and triangles developed. Bar, line, and pictographs are reviewed and circle graphs introduced initially. An extension of the concepts regarding bar graphs is made through the topic of divided bar graphs. Use of scale drawings is further developed.

Geometry. This area is covered on 36 pages, or 12.8% of the textbook. Extensive review covering lines, line segments, rays, planes, closed figures, polygons, angles, circles, cubes, and quadrilaterals is given. New topics introduced are exterior and interior angles; parallel, perpendicular, and intersecting lines; central angles; properties of rectangular prisms; measurement of angles with a protractor; cylinders; cones; and pyramids.

Problem Solving. There are 21 pages dealing with exercises on Problem Solving skills and concepts in this book. They include all four basic operations with problems from all the other major areas.

CHAPTER III

ACHIEVEMENT TEST CONTENT

Introduction

The comparison of arithmetic textbook content with the content of the arithmetic sections of selected achievement test batteries involves the classification of the items in the individual tests. Each of the arithmetic portions of the five achievement test batteries selected for this study contained at least two sections, and some had three. These sub-divisions were all designed to evaluate concepts, computation, and problem solving.

Each item in each test was examined and classified as basically pertaining to one of the five major mathematical areas (Numeration and Notation, Number Operations, Measurements, Geometry, or Problem Solving). After all items in a given achievement test had been classified, the total for each mathematical area was converted to percentages and a summary written describing the various types of items included in each test.

California Achievement Test - Fourth, Fifth, Sixth Grade Levels

The California Achievement Test Battery has two principal divisions devoted to arithmetic. The first of these is entitled "Arithmetic Reasoning" and contains three sections covering meanings, signs and symbols, and problems. The second main division is called "Arithmetic Fundamentals"

and has four sub-sections devoted to computational operations. These sections cover addition, subtraction, multiplication, and division. There are 125 items in the arithmetic portion of the California Achievement Test Battery.

Numeration and Notation. This area contained 12.8% of the total items by having 16 classified as pertaining to its concepts. The principles of reading and writing whole numbers through the thousands and Roman numerals through "C" are contained in these items. Skills of reading and writing numerals representing money are also covered. Recognition of symbols used in the four basic arithmetical operations are evaluated as well as the symbol for square root. Place value concepts are tested through items where the smallest of a series of numbers must be chosen.

Number Operations. There were 86 items classified as belonging to this area. Whole number addition and subtraction skills were covered by using items involving numbers in the tens, hundreds, and thousands. The addition items contained problems with as many as four addends. Both addition and subtraction items used the principles of regrouping (carrying or borrowing). Whole number multiplication and division was well covered in the test. The multiplication items involved tens and hundreds numbers multiplied by one-digit numbers and hundreds and thousands numbers by two- and three-digit numbers. The principle of zero is covered in these problems. The division of whole numbers is evaluated by means of items using numbers in hundreds and thousands being divided by numbers in the tens and hundreds. These items use even division and division with remainders. Rational number operations as covered in this test include the skills of adding and subtracting proper fractions and mixed numbers with like and unlike denominators. Also covered are items evaluating

addition and subtraction of decimal fractions as small as ten-thousandths. The addition problem involving decimals included as many as four addends. Concepts of multiplication and division of rational numbers as evaluated by this test were covered by items involving proper fractions, mixed numbers, and decimal fractions. Mixed decimals were multiplied by decimals as small as ten-thousandths and divided by decimals of tenths and hundredths. Two items covered the recognition and notation of percent with one word problem involving a percent of an amount of money.

Measurements. This test had 6.4% of its items covering the area of measurements. These items primarily were concerned with the recognition of symbols and abbreviations for standard units of measure. Those units covered were seconds, ounces, foot, degree, and the cent sign in money. The skills needed for adding, subtracting, and multiplying units were also included with conversion from one unit to another required. Several of the word problems involved units of measures.

Geometry. This area of mathematical understanding was not covered in this test.

Problem Solving. There were 15 items included in the California Achievement Test to evaluate the skills of reading, analyzing, and computing problems in word form. These problems included all four arithmetical operations in single and multiple step problems. As noted before, they also include concepts of measures, fractions, and percent. These items amounted to 12% of the total arithmetic items in the battery.

Metropolitan Achievement Test

Elementary Battery and Intermediate Battery

The Metropolitan Achievement Test has two batteries which cover the

grade levels used in this study. The Elementary and the Intermediate Batteries were both observed and their items classified as pertaining to one of the five major mathematical areas designated in this study.

Numeration and Notation. There were 18 items in both batteries designated as involving concepts of Numeration and Notation. This number amounts to 10.1% of the total items. Included in this area were principles concerned with reading numbers as large as hundred thousands and the place value ideas associated with these numbers. Roman numerals of less than 100 were also evaluated as well as rounding off of numbers, completion of number sequences, and vocabulary terms concerning arithmetical operations.

Number Operations. A total of 95 items (53.4%) were classified as belonging to the area of Number Operations. These items include processes of whole number addition, subtraction, multiplication, and division. Rational number operations are also covered with all four operations enumerated for whole numbers being used with common and decimal fractions. The whole number addition and subtraction problems in the test involve numbers as large as six digits with regrouping. Addition problems of three and four addends are also included. Numbers as large as thousands and ten thousands are used in items evaluating whole number multiplication and division concepts. These division problems include the principle of remainders. Rational number operations are covered in the test to the extent of adding, subtracting, multiplying, and dividing common and decimal fractions. Proper fractions and mixed numbers with like and unlike denominators are used in addition and subtraction problems. Decimal fractions which are used to evaluate skills in the four operations include tenths and hundredths. Fractional equalities and the principles of fraction relationships are included in items for this area.

Measurements. Items classified as pertaining to the Measurements area totaled 6.7% of the entire arithmetic section. Standard units of measures, their notation, and computational skills using these units are all included in these items. Units of time, dry measures, weight, money, and linear distance are used in these problems. Two items involving data from line and bar graphs are also included in this area. One item in the Problem Solving area concerns surface area and its computation.

Geometry. There are no items in either of these batteries which deal with geometrical concepts.

Problem Solving. Problems in word form which must be read, analyzed, and one or more operations performed make up 29.8% of the items in these batteries. They include whole numbers, common fractions, decimals, units of measure, and money concepts. All four basic operations are covered in these 53 problems at varying degrees of difficulty.

Iowa Test of Basic Skills

Fourth, Fifth, Sixth Grade Levels

The Iowa Test of Basic Skills is a multi-level test which contains over-lapping sections beginning with the third grade and going through the ninth grade. The items analyzed in study are designated to be used in the fourth, fifth, and sixth grades. The two sections of the test which contain the items used in this study are entitled "Arithmetic Concepts" and "Arithmetic Problem Solving." The total number of items examined in the Arithmetic Concepts Section was 81. The Arithmetic Problem Solving Section contained 58 items for these grade levels.

Numeration and Notation. Items covering this basic area of mathematics number 16 in this test. This number figures 11.5% of the total items designated for use at the fourth, fifth, and sixth grades. These

items contain problems which evaluate place value concepts through the billions. Roman numerals are evaluated through the thousands by two items. Other topics covered in this section of the test include odd and even numbers, "n" as an unknown quantity in an equation, and number sequences.

Number Operations. The percentage of this test devoted to Number Operations equals 29.5% of the total 41 items. Six were used for whole number addition and subtraction, and 13 take up whole number multiplication and division. The items dealing with addition and subtraction of whole numbers cover both carrying and borrowing numbers in the tens and hundreds. Multiplication and division concepts with whole numbers are evaluated by means of items involving fact groups, multiplication as a short way for addition, and operations with the multiplication algorithm using tens and hundred numbers. Also included are problems where units numbers are divided into hundreds and the principle of a remainder in the long division algorithm. Rational number operations are covered by 22 items in the part of the test examined. These items concerned the basic understandings of common fractions with regard to size, relationships, terminology, and equivalents. Operations on fractions which were covered by these items include addition and subtraction of like and unlike proper fractions, changing to simplest form proper fractions and mixed numbers, and multiplication of proper fractions.

Measurements. The 21 items devoted to evaluating the area of Measurements in this test make up 15.1% of the test. Understandings of standard units of measure make up the greatest part of these items. Basic type of measurement units included in the 21 items are linear, weight, time, dry, temperature, liquid, and money denominations. The concepts of making proper change is evaluated and perimeter and area of rectangles are also covered.

Geometry. Only three items could be classified as evaluating geometric concepts. This makes up 2.2% of the test items examined. These items deal with the recognition of such figures as the square, rectangle, circle, and triangle.

Problem Solving. The 58 items designated for the fourth, fifth, and sixth grades in the Arithmetic Problem Solving Section of the test were classified as belonging to this mathematical area. They include single and multiple step problems using all four basic operations. Whole numbers, common fractions, and decimals (money form) are used in these problems as well as different units of measure. These problems amount to 41.7% of all the items examined in this test.

S. R. A. Achievement Series - Multilevel Edition

Blue and Green Sections

The S. R. A. Multilevel Achievement Test contains three sections according to a color code. The two sections used in this study were the Blue and Green levels of the test. The test contains three distinct sections entitled "Arithmetic Reasoning," "Arithmetic Concepts," and "Arithmetic Computation."

Numeration and Notation. There were ten items of this test classified as dealing with the area of Numeration and Notation. They form 5.1% of the total items examined. They deal with place value concepts through the billions and the ability to read these numbers in word or numeral form. Some of these items also evaluate the skills of reading and recognizing place values to the right of the decimal point through ten-thousandths. Concepts involving Roman numerals through the thousands are also covered by these items. Notational symbols and concepts included deal with the

ideas of $<$, $=$, $>$, $\neq$, $\square$, and equations using letter designations for unknowns (n). One item deals with the principles of powers of whole numbers and the designation thereof.

Number Operations. This portion of the test included 91 items. It amounts to 46.2% of the total number of items classified. Whole number addition and subtraction concepts and problems were covered through the use of nine items. These items included problems with two-, three-, four-, five-, and six-digit numbers being added and subtracted to or from numbers with a similar numerical composition. The problems involving these operations use both of the principles of carrying and borrowing. The concept of zero as a place holder is evaluated in some of these items. Skills pertaining to whole number multiplication and division are evaluated by 21 items of this test. The multiplication items contain two- and three-figure factors with carrying. The division skills covered include the dividing of three-, four-, and five-figure numbers by one- and two-digit divisors. These items contain some division problems with remainders and some without. The area of rational number operations is covered by 61 items in the S. R. A. Test. These items include problems using addition, subtraction, multiplication, and division of proper fractions and mixed numbers. These problems involving operations with common fractions use both like and unlike denominators, borrowing and carrying, and the concept of common denominators. The principles of changing fractions to simplest form are also covered. The four basic operations on decimals are also evaluated by these items. Multiplication problems using decimal numbers involve the concepts of multiplying thousandths, hundredths, and tenths. Division of decimals is covered to the extent of dividing whole numbers and tenths by tenths. The concepts dealing with percent are covered by

problems where fraction-percentage equivalents are determined, finding the percent a given number is of an unknown number, and determining the percent one number is of another.

Integers are covered by two items using the degrees of temperature and number line principles.

Measurements. The area of Measurements is evaluated by 23 items, which amounts to 11.7% of the test sections classified. These items cover the standard units of measure such as linear, dry, liquid, time, weight, and one not as commonly taught--the Kilowatt hours. Two items cover money denominations and the making of change. The concepts covering perimeter and area of rectangles are both covered by items in this area.

Geometry. There were five items concerned with geometric concepts in the portion of this test examined. This number amounts to 2.5% of the total items. The ideas of parallel line segments, horizontal lines, diagonal lines, and names for three-dimensional shapes are contained in this section.

Problem Solving. The test section entitled Arithmetic Reasoning was used for classification in this area. This section includes nine mathematical stories which the individuals taking the test must read and analyze. Using this information, seven problems in word form can be worked. All four basic operations are used in these problems and the primary concepts of money, units of measure, and averaging. Work with whole numbers and rational numbers are both involved in these problems. These problems require that the one taking the test be able to identify the pertinent facts, decide on the proper operation or operations, and then complete the answer.

Stanford Achievement TestIntermediate I and Intermediate II Batteries

The Stanford Achievement Tests which cover the fourth, fifth, and sixth grade levels of work are included in two separate batteries. The Intermediate I Battery covers the fourth grade and initial half of the fifth grade. The Intermediate II Battery contains items designated for the final half of the fifth grade and all of the sixth grade. These two batteries contain 214 items in three sections--Arithmetic Computation, Arithmetic Concepts, and Arithmetic Application.

Numeration and Notation. The 30 items classified in this major area amount to 14% of the total from these two batteries. Place value concepts as large as ten thousands are evaluated as well as Roman numerals. Number sequences and number sentence notations are evaluated by these items. Skills in reading numbers in word form is involved in certain items.

Number Operations. This area of mathematical understanding is covered by 112 items (52.4%). All four operations with whole numbers are involved in the items extending from operations with tens numbers to ten thousands numbers. Addition problems include as many as four addends with regrouping or carrying. Subtraction problems deal with the borrowing concept. Multiplication and division of whole numbers are evaluated in items using numbers containing zeros as place holders. Division problems contain even division and those requiring remainders in fractions and whole number forms. Figuring of averages of numbers is also covered by these items. Rational number operations included in the items of these batteries are addition and subtraction of proper fractions and mixed numbers with like and unlike denominators, multiplication and division of proper fractions and whole numbers, addition of decimals in money form, finding

the percent of numbers, and multiplication and division of decimals. Concepts of changing improper and proper fractions to their simplest form as well as equivalent forms are evaluated.

Measurements. Principles of Measurement are involved in 14 of the items, which amounts to 6.5% of the total. Standard units of time and money are covered. Skills of acquiring and using data from graphs and tables are also evaluated. Also covered by one item is the concept of surface area.

Geometry. Geometric concepts regarding equal angles, recognition of geometric shapes, and use of cubic measurement for figuring volume of a box are included in the three items in this area.

Problem Solving. These batteries contain 55 items which could be classified in the Problem Solving area as set forth in this study. These items contain all of the operations with whole numbers, common fractions, and money. Units of measures are involved in some of these word problems, as are percents. These 55 items amount to 25.7% of the total in both batteries.

CHAPTER IV

TREATMENT OF DATA

Addison-Wesley Textbooks and California Achievement Test

The comparison of the contents in this textbook series and this test revealed that in two of the major mathematical areas a difference large enough to indicate statistical significance was found. The difference between the percentages of textbook pages and the proportion of test items dealing with the area of Number Operations was sufficient in size to yield a Z score of 3.212 and the area of Geometry obtained a Z score of 3.298. In the case of Number Operations, the greater proportion of observations favored the California Achievement Test, but with Geometry, the greater number was found in the Addison-Wesley Textbooks.

For the other areas, Numeration and Notation, Measurements, and Problem Solving, the difference in percentages of pages and items did not yield critical ratios that were statistically significant at the 0.01 level of significance. The obtained critical ratios were 1.814, 1.250, and .185, respectively.

TABLE 1

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS
IN ADDISON-WESLEY TEXTBOOKS AND CALIFORNIA ACHIEVEMENT TEST

	<u>Addison-Wesley Text</u>		<u>California Test</u>		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	75	7.8	16	12.8	1.814
Number Operations	499	53.7	86	68.8	3.212**
Measurements	93	10.0	8	6.4	1.250
Geometry	80	8.6	0	0	3.298**
Problem Solving	117	12.6	15	12.0	.185
General Review	66	7.3			

** 0.01 Level of Significance

American Book Company Textbooks and California Achievement Test

The comparison of percentages of textbook pages and test items for the area of Numeration and Notation in these two educational tools yielded a critical ratio of .279, as shown in Table 2. This score does not indicate a statistically significant difference between the proportions for these textbooks and this test.

The comparison of percentages in Number Operations was the first of two areas which received a Z score large enough to indicate a significant difference. This score amounted to 3.349, which is well above the needed value at the 0.01 level of significance. This difference favored the California Achievement Test.

In the Measurements area, the comparison of textbook page percentages

with test item percentages obtained a Z score of .213 and thus this difference was not considered as significant.

The area of Geometry was the second area to be classified as having a significant difference when the percentages of test items were compared with percentages of textbook pages. This comparison yielded a Z score of 4.003, which exceeds the 0.01 level requirements. For this area the American Book Company textbooks contained a greater percentage of pages than the California Achievement Test contained items.

When Problem Solving percentages for textbook pages and test items were compared, they indicated no significant difference existed because they obtained a Z score of 2.253.

TABLE 2

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS
IN AMERICAN BOOK COMPANY TEXTBOOKS AND CALIFORNIA ACHIEVEMENT TEST

	<u>American Book Co. Text</u>		<u>California Test</u>		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	118	11.9	16	12.8	.279
Number Operations	526	53.2	86	68.8	3.349**
Measurements	58	5.9	8	6.4	.213
Geometry	122	12.4	0	0	4.003**
Problem Solving	62	6.3	15	12.0	2.253
General Review	104	10.4			

** 0.01 Level of Significance

Harcourt, Brace, and World Textbooks andCalifornia Achievement Test

In this section of our comparison of test item percentages and textbook page percentages, the one major mathematical area which obtained a Z score sufficiently large to indicate a significant difference was the area of Number Operations. Its score was 3.502 and favored the California Achievement Test.

The four critical ratios received by the remaining areas when their percentages were compared were all less than the 0.01 requirement and thus indicate that no significant difference exists between the Harcourt, Brace, and World Textbooks and the California Achievement Test. These critical ratios were: Numeration and Notation, 2.311; Measurements, .808; Geometry, 1.708; and Problem Solving, .375.

TABLE 3

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS IN HARCOURT, BRACE, AND WORLD TEXTBOOKS AND CALIFORNIA ACHIEVEMENT TEST

	<u>Harcourt, Brace, and World Textbooks</u>		<u>California Test</u>		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	61	6.6	16	12.8	2.311
Number Operations	487	52.6	86	68.8	3.502**
Measurements	80	8.7	8	6.4	.808
Geometry	25	2.7	0	0	1.708
Problem Solving	123	13.3	15	12.0	.375
General Review	149	16.1			

** 0.01 Level of Significance

Holt, Rinehart, and Winston Textbooks
and California Achievement Test

The areas of Number Operations, Geometry, and Problem Solving each obtained a Z score larger than that needed to indicate statistically significant differences when the proportions of textbook pages and test items were compared during this phase of the study. The critical ratio for Number Operations was 5.196, and the greater proportion of observations lay with the California Achievement Test. The area of Problem Solving received a Z score of 3.242. The Holt, Rinehart, and Winston textbooks were found to have a greater percentage of pages classified in this area. Geometry was another area in which the comparison of differences between the percentages of textbook pages and achievement test items yielded a critical ratio statistically significant. This score was 2.908. The percentage of pages in the Holt, Rinehart, and Winston textbooks was larger than the percentage of items in the California Achievement Test.

The two remaining areas for which percentages of pages and items were compared, Numeration and Notation and Measurements, received Z scores of 1.240 and .485, respectively, and thereby could not have their differences classified as statistically significant.

TABLE 4

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS IN HOLT, RINEHART, AND WINSTON TEXTBOOKS AND CALIFORNIA ACHIEVEMENT TEST

	Winston Textbooks		California Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	94	9.1	16	12.8	1.240
Number Operations	460	44.1	86	68.8	5.196**
Measurements	80	7.7	8	6.4	.485
Geometry	75	7.3	0	0	2.908**
Problem Solving	170	16.3	15	12.0	3.242**
General Review	159	15.4			

** 0.01 Level of Significance

Laidlaw Textbooks and California Achievement Test

Numeration and Notation was one of two areas which had a proportionate difference between textbook pages and test items indicative of significance at the 0.01 level. This was substantiated by the Z score of 2.102. This difference favored the California Achievement Test.

The second area obtaining a large enough Z score to indicate a significant difference was the area of Number Operations. This score was figured at 4.165 and is well above the 0.01 level of significance required. Again this significant difference favored the California Achievement Test.

None of the major areas remaining where comparisons of the percentages of textbook pages and test items were made received Z scores sufficiently large to be termed statistically significant. Measurements obtained a

score of 1.736, Geometry a score of 2.250, and .963 for the Problem Solving area.

TABLE 5

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS
IN LAIDLAW TEXTBOOKS AND CALIFORNIA ACHIEVEMENT TEST

	<u>Laidlaw Textbooks</u>		<u>California Test</u>		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	46	5.2	16	12.8	3.102**
Number Operations	433	49.0	86	68.8	4.165**
Measurements	106	12.0	8	6.4	1.736
Geometry	40	4.5	0	0	2.250
Problem Solving	137	15.5	15	12.0	.963
General Review	123	13.8			

** 0.01 Level of Significance

Scott Foresman Textbooks and California Achievement Test

The critical ratio yielded by comparing percentages of pages and percentages of items in the area of Number Operations was the only one in this part of the study which was larger than the 2.57 required at the 0.01 level of significance. This score was 4.066 with the California Achievement Test having the larger percentage of tallies for this area.

In the remaining areas--Numerations and Notation, Measurements, Geometry, and Problem Solving--the differences in percentages of pages and test items obtained Z scores less than the value needed for significance. The obtained critical ratios were .236, 1.725, 2.412, and .333, respectively.

TABLE 6

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS IN
SCOTT FORESMAN TEXTBOOKS AND CALIFORNIA ACHIEVEMENT TEST

	<u>Scott Foresman Texts</u>		<u>California Test</u>		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	108	13.6	16	12.8	.236
Number Operations	391	49.3	86	68.8	4.066**
Measurements	94	11.8	8	6.4	1.725
Geometry	37	4.7	0	0	2.411
Problem Solving	101	13.1	15	12.0	.333
General Review	64	7.5			

** 0.01 Level of Significance

Silver Burdett Textbooks and California Achievement Test

The Numeration and Notation, Measurements, and Problem Solving areas were compared with regard to the percentages of textbook pages and test items and yielded critical ratios which did not indicate significant differences. These Z scores were .905, 2.303, and .641, respectively, and all fell below the 2.57 needed at the 0.01 level of significance.

The area of Number Operations obtained a Z score of 3.127, which indicated significance in the difference when the proportion of test items and textbook pages were compared. This difference in proportions favored the California Achievement Test.

The difference in percentages of textbook pages and test items for the Geometry area also yielded a large enough Z score to be classified as

significant at the 0.01 level. This score was recorded as 3.185 and the Silver Burdett Textbooks had the greater proportion of tallies.

TABLE 7

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS IN SILVER BURDETT TEXTBOOKS AND CALIFORNIA ACHIEVEMENT TEST

	Silver Burdett Texts		California Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	85	10.6	16	12.8	.905
Number Operations	456	54.0	86	68.8	3.127**
Measurements	117	13.9	8	6.4	2.303
Geometry	66	7.8	0	0	3.185**
Problem Solving	85	10.1	15	12.0	.641
General Review	36	4.1			

** 0.01 Level of Significance

Addison-Wesley Textbooks and Iowa Test of Basic Skills

The achievement test used in this section was the Iowa Test of Basic Skills, Multi-Level Edition for Grades 3-9. Since the content of this test covered a wider grade level range than had been selected for this study, only those items indicated by the authors for use with fourth, fifth, and sixth grades were scrutinized. This gave a total of 139 items in the selected grade levels.

When compared with the percentage of pages in the content of the Addison-Wesley Textbook Series, the percentage of items in the Iowa Test of Basic Skills indicated no significant difference in three of the basic

mathematics areas as indicated in Table 8. The area of Numeration and Notation obtained a Z score of 1.419, Measurements a Z score of 1.760, and Geometry a score of 2.55. None of these three critical ratios was large enough to be statistically significant, although the one for Geometry, which favored the Addison-Wesley Texts, was almost significant at the 0.01 level.

The area of Number Operations did have a difference between proportions of textbook pages and test items large enough to yield a critical ratio indicative of significance at the 0.01 level. This ratio was 5.319 and favored the Addison-Wesley Textbooks.

The difference between test item and textbook page percentages was large enough to produce a statistically significant critical ratio of 8.401 for the area of Problem Solving. The larger portion of observations tallied in this area was found in the Iowa Test of Basic Skills.

TABLE 8

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS IN ADDISON-WESLEY TEXTBOOKS AND IOWA TEST OF BASIC SKILLS

	Addison-Wesley Texts		Iowa Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	75	7.8	16	11.5	1.419
Number Operations	499	53.7	41	29.5	5.319**
Measurements	93	10.0	21	15.1	1.760
Geometry	80	8.6	3	2.2	2.55
Problem Solving	117	12.6	58	41.7	8.401**
General Review	66	7.3			

** 0.01 Level of Significance

American Book Company Textbooks and Iowa Test of Basic Skills

Table 9 points out that four of the five major areas of mathematics used in the comparison of these tools of learning revealed differences of sufficient magnitude to be classified as statistically significant. The single area in which the difference between the percentages of textbook pages and test items yielded a Z score less than that required at the 0.01 level was the area of Numeration and Notation. This score was .131.

All four remaining areas, Number Operations, Measurements, Geometry, and Problem Solving, revealed a difference large enough to indicate statistical significance. The differences between the percentages of test items and textbook pages involving these areas yielded Z scores of 5.234, 3.788, 3.439, and 12.144, respectively. All these critical ratios exceed that required by the 0.01 level of significance.

The areas of Number Operations and Geometry favored the American Book Company Textbooks, while the areas of Measurements and Problem Solving produced a higher proportion of observations in the Iowa Test of Basic Skills.

TABLE 9

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS
IN AMERICAN BOOK COMPANY TEXTBOOKS AND IOWA TEST OF BASIC SKILLS

	American Book Company Textbooks		Iowa Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	118	11.9	16	11.5	.131
Number Operations	526	53.2	41	29.5	5.234**
Measurements	58	5.9	21	15.1	3.788**
Geometry	122	12.4	3	2.2	3.439**
Problem Solving	62	6.3	58	41.7	12.144**
General Review	104	10.4			

** 0.01 Level of Significance

Harcourt, Brace, and World Textbooks and Iowa Test of Basic Skills

Two areas in this comparison as shown in Table 10 obtained scores high enough to warrant being classified as significant differences. The difference between the percentage of textbook pages and percentage of test items for the area of Number Operations yielded a critical ratio of 5.089, which favored the Harcourt, Brace, and World Textbooks. The other area whose Z score was large enough was Problem Solving. This score of 7.757 was in favor of the Iowa Test of Basic Skills.

For the remaining three areas, the difference between the percentage of textbook pages and the proportion of test items did not yield critical ratios that were significant at the 0.01 level of significance. These areas and their attendant Z scores are: Numeration and Notation,

1.922; Measurements, 2.235; and Geometry, .316.

TABLE 10

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS
IN HARCOURT, BRACE, AND WORLD TEXTBOOKS AND IOWA TEST OF BASIC SKILLS

	Harcourt, Brace, and World Textbooks		Iowa Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	61	6.6	16	11.5	1.922
Number Operations	487	52.6	41	29.5	5.089**
Measurements	80	8.7	21	15.1	2.235
Geometry	25	2.7	3	2.2	.316
Problem Solving	123	13.3	58	41.7	7.757**
General Review	149	16.1			

** 0.01 Level of Significance

Holt, Rinehart, and Winston Textbooks and Iowa Test of Basic Skills

The comparison made here resulted, according to Table 11, in two of the five areas receiving scores indicating differences of a non-significant nature. The differences between percentages of textbook pages and test items for the areas of Numeration and Notation and Geometry did not produce critical ratios large enough to be considered statistically significant at the 0.01 level of significance. The obtained ratios for Numeration and Notation and Geometry were .849 and 2.118, respectively.

The three areas having large enough differences between the proportion of textbook pages and test items to yield critical ratios which were statistically significant at the 0.01 level were Number Operations, 3.231;

Measurements, 2.721, and Problem Solving, 6.693. The first of these three, Number Operations, favored the Holt, Rinehart, and Winston Textbooks; whereas, the remaining two favored the Iowa Test of Basic Skills.

TABLE 11

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS IN HOLT, RINEHART, AND WINSTON TEXTBOOKS AND IOWA TEST OF BASIC SKILLS

	Winston Texts		Iowa Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	94	9.1	16	11.5	.849
Number Operations	460	44.2	41	29.5	3.231**
Measurements	80	7.7	21	15.1	2.721**
Geometry	75	7.3	3	2.2	2.118
Problem Solving	170	16.3	58	41.7	6.693**
General Review	159	15.4			

** 0.01 Level of Significance

Laidlaw Textbooks and Iowa Test of Basic Skills

In the comparison of the Laidlaw Textbooks and the Iowa Test of Basic Skills, it was found, as Table 12 indicates, that there were three mathematical areas in which the differences between percentages of pages and items yielded critical ratios of sufficient size to be statistically significant. The areas of Numeration and Notation, Number Operations, and Problem Solving received Z scores of 2.711, 4.246, and 6.904, respectively. In the case of Number Operations, the greater proportion of tallies was received by the Laidlaw Textbooks; whereas, the areas of Numeration and

Notation and Problem Solving had the greater percentage of tallies recorded for the Iowa Test of Basic Skills.

The differences in percentages of textbook pages and achievement test items for the areas of Measurements and Geometry obtained Z scores of .971 and 1.180, which were not large enough to be classified as significant at the 0.01 level of significance.

TABLE 12

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS IN LAIDLAW TEXTBOOKS AND IOWA TEST OF BASIC SKILLS

	Laidlaw Texts		Iowa Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	46	5.2	16	11.5	2.711**
Number Operations	433	49.0	41	29.5	4.246**
Measurements	106	12.0	21	15.1	.971
Geometry	40	4.5	3	2.2	1.180
Problem Solving	137	15.5	58	41.7	6.904**
General Review	123	13.8			

** 0.01 Level of Significance

Scott Foresman Textbooks and Iowa Test of Basic Skills

When the differences between proportions of textbook pages and test items were compared for the areas of Numeration and Notation, Measurements, and Geometry, they were found to yield critical ratios below the 2.57 necessary to indicate significance at the 0.01 level of significance.

As Table 13 indicates, the differences between textbook page and

test item percentages dealing with the areas of Number Operations and Problem Solving did yield z scores of sufficient size to be considered significant at the 0.01 level. These scores were 4.290 and 8.025, respectively. The first favored the Scott Foresman Textbooks; whereas, the latter favored the Iowa Test of Basic Skills.

TABLE 13

NUMBERS, PERCENTAGES, AND RESULTANT z SCORES FOR MAJOR MATHEMATICS AREAS IN SCOTT FORESMAN TEXTBOOKS AND IOWA TEST OF BASIC SKILLS

	Scott Foresman Texts		Iowa Test		z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	108	13.6	16	11.5	.651
Number Operations	391	49.3	41	29.5	4.290**
Measurements	94	11.8	21	15.1	1.054
Geometry	37	4.7	3	2.2	1.299
Problem Solving	101	13.1	58	41.7	8.025**
General Review	64	7.5			

** 0.01 Level of Significance

Silver Burdett Textbooks and Iowa Test of Basic Skills

Table 14 gives the figures obtained in comparing the percentages of textbook pages with the percentages of test items found between the Silver Burdett Textbooks and Iowa Test of Basic Skills. In the areas of Number Operations and Problem Solving, the critical ratios yielded were larger than required for significance at the 0.01 level. The Number Operations area received a score of 5.346 which favored the Silver Burdett Textbooks;

whereas, the area of Problem Solving obtained a score of 9.661 favoring the Iowa Test of Basic Skills.

For the remaining areas of Numeration and Notation, Measurements, and Geometry, the differences in percentages between pages and items did not obtain critical ratios that were significant at the 0.01 level of significance. The scores of .495, .372, and 2.367 all fell below the 2.57 requirement.

TABLE 14

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS IN SILVER BURDETT TEXTBOOKS AND IOWA TEST OF BASIC SKILLS

	Silver Burdett Texts		Iowa Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	85	10.6	16	11.5	.495
Number Operations	456	54.0	41	29.5	5.346**
Measurements	117	13.9	21	15.1	.372
Geometry	66	7.8	3	2.2	2.367
Problem Solving	85	10.1	58	41.7	9.661**
General Review	36	4.1			

** 0.01 Level of Significance

Addison-Wesley Textbooks and Metropolitan Achievement Test

In this comparison only one mathematical area had a difference in proportions of textbook pages and test items large enough to obtain a significant Z score. This was the area of Problem Solving and its score was 5.671. This greater proportion was found to exist in the Metropolitan

Achievement Test.

The other four areas each received Z scores which could not be classified as significant at the 0.01 level of significance. The areas and their scores were as follows: Numeration and Notation, .981; Number Operations, .074; Measurements, 1.336; and Geometry, 2.472.

TABLE 15

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS
IN ADDISON-WESLEY TEXTBOOKS AND METROPOLITAN ACHIEVEMENT TEST

	<u>Addison-Wesley Texts</u>		<u>Metropolitan Test</u>		Z
	<u>No. of</u> <u>Pages</u> <u>(X₁)</u>	<u>% of</u> <u>Pages</u> <u>(P₁)</u>	<u>No. of</u> <u>Items</u> <u>(X₂)</u>	<u>% of</u> <u>Items</u> <u>(P₂)</u>	
Numeration and Notation	75	7.8	18	10.1	.981
Number Operations	499	53.7	95	53.4	.074
Measurements	93	10.0	12	6.7	1.336
Geometry	80	8.6	0	0	2.472
Problem Solving	117	12.6	53	29.8	5.671**
General Review	66	7.3			

** 0.01 Level of Significance

American Book Company Textbooks and Metropolitan Achievement Test

Table 16 indicates the areas of Geometry and Problem Solving yielded large enough critical ratios to be significant when the difference in their proportions between textbook pages and achievement test items were computed. These critical ratios were 4.755 for Geometry and 9.216 for Problem Solving. The Geometry difference favored the American Book Company Textbooks. The Metropolitan Achievement Test contained the greater percentage in the

Problem Solving area.

When the areas of Numeration and Notation, Number Operations, and Measurements had their differences between percentages of textbook pages and test items compared, none of them obtained Z scores of sufficient magnitude to be considered statistically significant at the 0.01 level. The Numeration and Notation score was .657, the Number Operations score was .049, and the score for Measurements amounted to .395.

TABLE 16

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS IN AMERICAN BOOK COMPANY TEXTBOOKS AND METROPOLITAN ACHIEVEMENT TEST

	American Book Co. Texts		Metropolitan Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	118	11.9	18	10.1	.657
Number Operations	526	53.2	95	53.4	.050
Measurements	58	5.9	12	6.7	.395
Geometry	122	12.4	0	0	4.755**
Problem Solving	62	6.3	53	29.8	9.216**
General Review	104	10.4			

** 0.01 Level of Significance

Harcourt, Brace, and World Textbooks and

Metropolitan Achievement Test

The comparison of the contents in these two tools of education revealed that in four of the areas observed no significant difference exists between the percentages of textbook pages and test items.

Numeration and Notation, Number Operations, Measurements, and Geometry each obtained a Z score under the 2.57 required at the assigned level of significance for this study. These Z scores were .154, .198, .817, and 2.014 in the order of the areas previously listed.

The Metropolitan Achievement Test was observed to have the greater percentage of tallies in the Problem Solving area, and when the difference between the percentages of textbook pages and test items was computed obtained a Z score of 5.116. This score was sufficiently large and thus indicates a statistically significant difference. Table 17 gives a complete breakdown of these figures.

TABLE 17

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS
IN HARCOURT, BRACE, AND WORLD TEXTBOOKS AND
METROPOLITAN ACHIEVEMENT TEST

	Harcourt, Brace, and World Textbooks		Metropolitan Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	61	6.6	18	10.1	.154
Number Operations	487	52.6	95	53.4	.198
Measurements	80	8.7	12	6.7	.817
Geometry	25	2.7	0	0	2.014
Problem Solving	123	13.3	53	29.8	5.116**
General Review	149	16.1			

** 0.01 Level of Significance

Holt, Rinehart, and Winston Textbooks and
Metropolitan Achievement Test

The comparison of contents in this textbook series and achievement test revealed, according to Table 18, that in three of the major mathematical areas there was no significant difference. The differences in the proportions of textbook pages and achievement test items found in the areas of Numeration and Notation, Number Operations, and Measurements did not produce large enough critical ratios to be classified as statistically significant. Scores for these three areas were .396, 2.244, and .434, respectively.

In the areas of Geometry and Problem Solving, there were found differences between these percentages of pages and items great enough to produce significant Z scores. The area of Geometry had a score of 3.479 which favored the Winston Textbooks. The Problem Solving area obtained a Z score of 4.033, which is above that required at the 0.01 level of significance. The difference in proportions in this area favored the Metropolitan Achievement Test.

TABLE 18

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS
IN HOLT, RINEHART, AND WINSTON TEXTBOOKS AND
METROPOLITAN ACHIEVEMENT TEST

	Holt, Rinehart, and Winston Textbooks		Metropolitan Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	94	9.1	18	10.1	.396
Number Operations	460	44.2	95	53.4	2.244
Measurements	80	7.7	12	6.7	.434
Geometry	75	7.3	0	0	3.479**
Problem Solving	170	16.3	53	29.8	4.033**
General Review	159	15.4			

** 0.01 Level of Significance

Laidlaw Textbooks and Metropolitan Achievement Test

The comparison made in this section of the study, as indicated in Table 19, pointed out two mathematical areas in which there exists differences between the proportions of textbook pages and achievement test items large enough to yield critical ratios of significant nature. The area of Geometry obtained a Z score of 2.690 which is large enough to indicate a difference of significance at the assigned level. This difference favored the lessons in the Laidlaw Textbooks. The other area was Problem Solving which received a Z score of 4.292. This was well above the required 2.57 at the 0.01 level of significance. This greater proportion of observations was found in the Metropolitan Achievement Test.

The areas of Numeration and Notation, Number Operations, and Measurements had the differences between textbook page and test item percentages computed and received the following Z scores: 2.336, .849, and 1.922, respectively. None of these equal or surpass that score necessary to indicate significance in this study.

TABLE 19

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS IN LAIDLAW TEXTBOOKS AND METROPOLITAN ACHIEVEMENT TEST

	Laidlaw Textbooks		Metropolitan Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	46	5.2	18	10.1	2.336
Number Operations	433	49.0	95	53.4	.849
Measurements	106	12.0	12	6.7	1.922
Geometry	40	4.5	0	0	2.690**
Problem Solving	137	15.5	53	29.8	4.292**
General Review	123	13.8			

** 0.01 Level of Significance

Scott Foresman Textbooks and Metropolitan Achievement Test

Observations of the pages in the Scott Foresman Textbooks and the items in the Metropolitan Achievement Test produced proportions whose differences yielded critical ratios in three mathematical areas which could not be classified as significant for this study. The area of Numeration and Notation received a score of 1.215, the Number Operations area obtained a score of .986, and the Measurements area had a Z score of 1.914.

The tabulations in Table 20 point out that the two remaining mathematical areas (Geometry and Problem Solving) both had differences between percentages of pages and test items large enough to obtain Z scores indicating significance at the 0.01 level as assigned to this study. The score for the area of Geometry was 2.861 and the difference in percentages favored the Scott Foresman Textbooks. The area of Problem Solving showed a greater proportion of observations in the Metropolitan Achievement Test and received a Z score of 5.335.

TABLE 20

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS IN SCOTT FORESMAN TEXTBOOKS AND METROPOLITAN ACHIEVEMENT TEST

	Scott Foresman Textbooks		Metropolitan Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	108	13.6	18	10.1	1.215
Number Operations	391	49.3	95	53.4	.986
Measurements	94	11.8	12	6.7	1.914
Geometry	37	4.7	0	0	2.861**
Problem Solving	101	13.1	53	29.8	5.335**
General Review	64	7.5			

** 0.01 Level of Significance

Silver Burdett Textbooks and Metropolitan Achievement Test

The areas of Numeration and Notation and Number Operations as compared in this part of the study and recorded in Table 21 obtained Z scores indicating there was no significant difference between the proportion of

lessons in the Silver Burdett Textbooks and the items in the Metropolitan Achievement Test. The Z score obtained for the area of Numeration and Notation was .198, while that computed for Number Operations was .146.

The differences between percentages of textbook pages and achievement test items in the areas of Measurements and Geometry yielded critical ratios of 2.594 and 3.807, respectively. These two ratios exceed 2.57 and, therefore, are considered statistically significant for this study. The greater proportion of tallies in these areas was obtained by the Silver Burdett Texts.

For the other area, Problem Solving, the difference between proportions of pages and items yielded a critical ratio of 6.878, indicating a significant difference for this study. This difference in proportions favored the Metropolitan Achievement Test.

TABLE 21

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS
IN SILVER BURDETT TEXTBOOKS AND METROPOLITAN ACHIEVEMENT TEST

	Silver Burdett Texts		Metropolitan Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	85	10.6	18	10.1	.198
Number Operations	456	54.0	95	53.4	.146
Measurements	117	13.9	12	6.7	2.595**
Geometry	66	7.8	0	0	3.807**
Problem Solving	85	10.1	53	29.8	6.878**
General Review	36	4.1			

** 0.01 Level of Significance

Addison-Wesley Textbooks and S. R. A. Achievement Test

The S. R. A. Achievement Test Battery (Arithmetic Section) which was used in this study is a multi-level edition. It has color coding systems by which a selection of the exercises to be given to certain grade levels can be made. The sections herein compared are those designated in the Test Coordinators Manual as the Blue and Green Levels.¹

The areas of Numeration and Notation, Number Operations, and Measurements in this comparison had differences between the proportions of the textbook pages and achievement test items which produced critical ratios below the 2.57 level necessary to indicate significance at the 0.01 level. These scores were .091, 1.911, and .699, respectively, for each of the named areas.

As shown by Table 22, the area of Geometry obtained a Z score of 2.908, which was above the established level of significance. This would indicate a significant difference between the percentage of textbook pages for Addison-Wesley and the S. R. A. Achievement Test items in this area. The higher proportion of observations was from the Addison-Wesley Textbooks.

The last area compared in these two educational tools was the area of Problem Solving. This area yielded a Z score of 6.614 when the difference between percentages of textbook pages and test items was compared. This score is indicative of a significant difference at the 0.01 level of significance. This difference favors the S. R. A. Achievement Test, which was observed to have the higher percentage in this area.

¹S. R. A. Achievement Series, Test Coordinator's Manual for Forms C. and D., (Chicago: Science Research Associates, Inc., 259 East Erie Street, 1964), p. 13.

TABLE 22

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS
IN ADDISON-WESLEY TEXTBOOKS AND S. R. A. ACHIEVEMENT TEST

	Addison-Wesley Texts		S. R. A. Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	75	7.8	15	7.6	.091
Number Operations	499	53.7	91	46.2	1.911
Measurements	93	10.0	23	11.7	.699
Geometry	80	8.6	5	2.5	2.908**
Problem Solving	117	12.6	63	32.0	6.614**
General Review	66	7.3			

** 0.01 Level of Significance

American Book Company Textbooks and S. R. A. Achievement Test

Of the five major areas used in this comparison, only two were observed to have differences between percentages of textbook pages and test items which could not be classified as significant. The areas of Numeration and Notation and Number Operations received Z scores of 1.674 and 1.801, respectively.

The differences between textbook page and test item percentages for the three remaining areas produced critical ratios which exceed the 2.57 requirement for statistical significance at the 0.01 level. The area of Measurements yielded a score of 2.831, the area of Problem Solving a score of 10.239, and the area of Geometry a score of 3.913. The first two of these areas had the higher percentages favoring the S. R. A.

Achievement Test; whereas, the last one, as shown in Table 23, favors the American Book Company Textbooks.

TABLE 23

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS IN AMERICAN BOOK COMPANY TEXTBOOKS AND S. R. A. ACHIEVEMENT TEST

	American Book Company Textbooks		S. R. A. Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	118	11.9	15	7.6	1.674
Number Operations	526	53.2	91	46.2	1.801
Measurements	58	5.9	23	11.7	2.831**
Geometry	122	12.4	5	2.5	3.913**
Problem Solving	62	6.3	63	32.0	10.239**
General Review	104	10.4			

** 0.01 Level of Significance

Harcourt, Brace, and World Textbooks and S. R. A. Achievement Test

Table 24 shows that only one area considered in this phase of the study had sufficient difference between the percentages of textbook pages and test items to yield a critical ratio which could be classified as statistically significant. This area was Problem Solving and its score was 5.973. The S. R. A. Achievement Test was observed to have the higher percentage of tallies in this area.

Numeration and Notation, Number Operations, Measurements, and Geometry are areas which yielded critical ratios of .471, 1.636, 1.225, and

.149, respectively, indicating these differences between proportions of pages and items were not statistically significant at the 0.01 level of significance.

TABLE 24

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS IN HARCOURT, BRACE, AND WORLD TEXTBOOKS AND S. R. A. ACHIEVEMENT TEST

	Harcourt, Brace and World Texts		S. R. A. Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	61	6.6	15	7.6	.471
Number Operations	487	52.6	91	46.2	1.636
Measurements	80	8.7	23	11.7	1.225
Geometry	25	2.7	5	2.5	.149
Problem Solving	123	13.3	63	32.0	5.973**
General Review	149	16.1			

** 0.01 Level of Significance

Holt, Rinehart, and Winston Textbooks and S. R. A. Achievement Test

The areas of Numeration and Notation, Number Operations, Measurements, and Geometry obtained Z scores which were indicative of no significant differences between the proportions of pages in the Holt, Rinehart, and Winston Textbooks and the proportion of items in the S. R. A. Achievement Test for these particular areas. The Z scores received were .634, .510, 1.738, and 2.343, all of which are below the 2.57 required for significance at the 0.01 level of significance.

The one area indicating a significant difference between the percentages of textbook pages and achievement test items was Problem Solving. It yielded a critical ratio of 4.846 and the higher proportion of tallies for this area was given to the S. R. A. Achievement Test. The data for this comparison is summarized in Table 25.

TABLE 25

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS IN HOLT, RINEHART, AND WINSTON TEXTBOOKS AND S. R. A. ACHIEVEMENT TEST

	<u>Winston Textbooks</u>		<u>S. R. A. Test</u>		Z
	<u>No. of Pages (X₁)</u>	<u>% of Pages (P₁)</u>	<u>No. of Items (X₂)</u>	<u>% of Items (P₂)</u>	
Numeration and Notation	94	9.1	15	7.6	.634
Number Operations	460	44.2	91	46.2	.510
Measurements	80	7.7	23	11.7	1.738
Geometry	75	7.3	5	2.5	2.343
Problem Solving	170	16.3	63	32.0	4.846**
General Review	159	15.4			

** 0.01 Level of Significance

Laidlaw Textbooks and S. R. A. Achievement Test

The comparison of the contents found in the S. R. A. Achievement Test and the Laidlaw Textbooks (Table 26) reveals that only in the area of Problem Solving was there a difference between percentages of textbook pages and test items which could be classified as significant. In this area the difference yielded a Z score of 5.093, which is well above the score needed to indicate significance at the 0.01 level. This difference

favors the S. R. A. Achievement Test.

The other major mathematical areas compared at this time; namely, Numeration and Notation, Number Operations, Measurements, and Geometry received Z scores of 1.247, .704, .110, and 1.195, respectively, and these would indicate differences of non-significant nature between the proportion of textbook pages and test items.

TABLE 26

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS
IN LAIDLAW TEXTBOOKS AND S. R. A. ACHIEVEMENT TEST

	Laidlaw Texts		S. R. A. Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	46	5.2	15	7.6	1.247
Number Operations	433	49.0	91	46.2	.704
Measurements	106	12.0	23	11.7	.110
Geometry	40	4.5	5	2.5	1.195
Problem Solving	137	15.5	63	32.0	5.093**
General Review	123	13.8			

** 0.01 Level of Significance

Scott Foresman Textbooks and S. R. A. Achievement Test

Data used in the comparison of the Scott Foresman Textbooks and S. R. A. Achievement Test is given in Table 27. These data indicate only one area, Problem Solving, where the difference between the percentage of textbook pages and achievement test items was large enough to produce a critical ratio (6.197) which could be considered statistically significant.

In this area, the greater proportion of tallies favored the S. R. A. Achievement Test.

For the other areas, Numeration and Notation, Number Operations, Measurements, and Geometry, the differences in proportions of pages and items did not yield critical ratios that were significant at the 0.01 level of significance. These obtained critical ratios were 2.221, .775, .038, and 1.339, respectively.

TABLE 27

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS IN SCOTT FORESMAN TEXTBOOKS AND S. R. A. ACHIEVEMENT TEST

	Scott Foresman Texts		S. R. A. Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	108	13.6	15	7.6	2.221
Number Operations	391	49.3	91	46.2	.775
Measurements	94	11.8	23	11.7	.038
Geometry	37	4.7	5	2.5	1.339
Problem Solving	101	13.1	63	32.0	6.197**
General Review	64	7.5			

** 0.01 Level of Significance

Silver Burdett Textbooks and S. R. A. Achievement Test

Table 28 includes the data used in the comparison of the Silver Burdett Textbooks and the S. R. A. Achievement Test. These data indicate that in the areas of Geometry and Problem Solving the differences between the percentages of textbook pages and test items were large enough to yield

critical ratios of statistical significance. The ratio for Geometry was 2.617 and that for Problem Solving was 7.791. In the case of the Geometry area, the greater proportion of tallies favored the Silver Burdett Textbooks; whereas, the area of Problem Solving had the larger percentage of tallies from the S. R. A. Achievement Test.

The other areas of Numeration and Notation, Number Operations, and Measurements did not produce differences in proportions of pages and items large enough to yield significant critical ratios at the 0.01 level of significance. These critical ratios were 1.057, 1.975, and .803, respectively.

TABLE 28

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS IN SILVER BURDETT TEXTBOOKS AND S. R. A. ACHIEVEMENT TEST

	<u>Silver Burdett Texts</u>		<u>S. R. A. Test</u>		Z
	<u>No. of</u> <u>Pages</u> (X_1)	<u>% of</u> <u>Pages</u> (P_1)	<u>No. of</u> <u>Items</u> (X_2)	<u>% of</u> <u>Items</u> (P_2)	
Numeration and Notation	85	10.6	15	7.6	1.057
Number Operations	456	54.0	91	46.2	1.975
Measurements	117	13.9	23	11.7	.803
Geometry	66	7.8	5	2.5	2.617**
Problem Solving	85	10.1	63	32.0	7.791**
General Review	36	4.1			

** 0.01 Level of Significance

Addison-Wesley Textbooks and Stanford Achievement Test

The Addison-Wesley Textbooks and Stanford Achievement Test were examined and the pages and items classified as falling into one of five

major mathematical areas. The comparison was made for each area by taking the difference in the percentage of textbook pages and the percentage of test items and calculating a critical ratio for each area. As shown in Table 29, two of these scores in the areas of Number Operations and Measurements were of such nature as to be classified as non-significant at the 0.01 level of significance since they fell below the required 2.57.

The areas of Numeration and Notation, Geometry, and Problem Solving obtained Z scores which were indicative of significant differences between the proportion of pages in the Addison-Wesley Textbooks and the proportion of items in the Stanford Achievement Test. These Z scores were 2.746, 3.556, and 4.690, respectively.

TABLE 29

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS IN ADDISON-WESLEY TEXTBOOKS AND STANFORD ACHIEVEMENT TEST

	Addison-Wesley Texts		Stanford Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	75	7.8	30	14.0	2.746**
Number Operations	499	53.7	112	52.4	.345
Measurements	93	10.0	14	6.5	1.535
Geometry	80	8.6	3	1.4	3.556**
Problem Solving	117	12.6	55	25.7	4.690**
General Review	66	7.3			

** 0.01 Level of Significance

American Book Company Textbooks and Stanford Achievement Test

The difference in the percentages of textbook pages and test items as found in the American Book Company Textbooks and Stanford Achievement Test yielded statistically significant critical ratios in only two of the five mathematical areas. As indicated in Table 30, these areas were Geometry and Problem Solving and their respective critical ratios were 4.568 and 8.273. The difference in the Geometry area favored the American Book Company Textbooks, but the Problem Solving area had a greater proportion of tallies favoring the Stanford Achievement Test.

For the other areas of Numeration and Notation, Number Operations, and Measurements, the difference in proportion of pages and items did not produce a critical ratio which was significant at the 0.01 level of significance. These ratios were .811, .213, and .321, respectively.

TABLE 30

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS
IN AMERICAN BOOK COMPANY TEXTBOOKS AND STANFORD ACHIEVEMENT TEST

	<u>American Book Co. Texts</u>		<u>Stanford Test</u>		z
	<u>No. of Pages (X₁)</u>	<u>% of Pages (P₁)</u>	<u>No. of Items (X₂)</u>	<u>% of Items (P₂)</u>	
Numeration and Notation	118	11.9	30	14.0	.811
Number Operations	526	53.2	112	52.4	.213
Measurements	58	5.9	14	6.5	.321
Geometry	122	12.4	3	1.4	4.568**
Problem Solving	62	6.3	55	25.7	8.273**
General Review	104	10.4			

** 0.01 Level of Significance

Harcourt, Brace, and World Textbooks and Stanford Achievement Test

This comparison, as noted in Table 31, revealed that three of the major areas did not yield statistically significant critical ratios when the differences between percentages of textbook pages and test items were calculated. The area of Number Operations received a score of .053, Measurements a score of .974, and Geometry a score of 1.028. Each of these scores fell below the 2.57 required at the 0.01 level of significance.

The area of Numeration and Notation achieved a Z score of 3.342 indicating a statistically significant difference between the percentages of textbook pages and test items in favor of the Stanford Achievement Test.

The remaining area showing a statistically significant difference between percentages of pages and items was that of Problem Solving. Its critical ratio of 4.203 was in favor of the Stanford Achievement Test.

TABLE 31

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS
IN HARCOURT, BRACE, AND WORLD TEXTBOOKS AND STANFORD ACHIEVEMENT TEST

	Harcourt, Brace and World Texts		Stanford Test		Z
	No. of Pages (X ₁)	% of Pages (P ₁)	No. of Items (X ₂)	% of Items (P ₂)	
Numeration and Notation	61	6.6	30	14.0	3.342**
Number Operations	487	52.6	112	52.4	.053
Measurements	80	8.7	14	6.5	.974
Geometry	25	2.7	3	1.4	1.028
Problem Solving	123	13.3	55	25.7	4.203**
General Review	149	16.1			

** 0.01 Level of Significance

Holt, Rinehart, and Winston Textbooks and Stanford Achievement Test

The area of Numeration and Notation received a critical ratio of 2.035 when the difference in the percentages of textbook pages and test items were compared. Two other areas yielded critical ratios which were not statistically significant when the difference in the proportion of textbook pages and test items were compared. The areas of Number Operations and Measurements received scores of 2.161 and .566, respectively.

The difference between proportions of textbook pages and achievement test items for the areas of Geometry and Problem Solving produced z scores of 3.027 and 3.066, respectively. The Holt, Rinehart, and Winston Textbooks obtained the higher proportion of tallies in Geometry and Stanford Achievement Test in Problem Solving.

TABLE 32

NUMBERS, PERCENTAGES, AND RESULTANT z SCORES FOR MAJOR MATHEMATICS AREAS IN HOLT, RINEHART, AND WINSTON TEXTBOOKS AND STANFORD ACHIEVEMENT TEST

	<u>Winston Textbooks</u>		<u>Stanford Test</u>		z
	<u>No. of Pages (X_1)</u>	<u>% of Pages (P_1)</u>	<u>No. of Items (X_2)</u>	<u>% of Items (P_2)</u>	
Numeration and Notation	94	9.1	30	14.0	2.035
Number Operations	460	44.2	112	52.4	2.161
Measurements	80	7.7	14	6.5	.566
Geometry	75	7.3	3	1.4	3.027**
Problem Solving	170	16.3	55	25.7	3.066**
General Review	159	15.4			

** 0.01 Level of Significance

Laidlaw Textbooks and Stanford Achievement Test

Three of the five areas in the Laidlaw Textbooks showed no significant difference between percentages of textbook pages and test items.

Table 33 lists critical ratios for Number Operations (.887), Measurements (2.174), and Geometry (1.961) all below the 2.57 score required for significance at the 0.01 level.

The two remaining areas obtained critical ratios larger than that necessary for significance. The area of Numeration and Notation received a ratio of 4.295. This significant difference between proportions of pages and items was in favor of the Stanford Achievement Test. The Problem Solving area gained a critical ratio of 3.327, which is statistically significant. This difference between percentages of textbook pages and test items was also in favor of the Stanford Achievement Test.

TABLE 33

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS
IN LAIDLAW TEXTBOOKS AND STANFORD ACHIEVEMENT TEST

	Laidlaw Texts		Stanford Test		Z
	No. of Pages (X_1)	% of Pages (P_1)	No. of Items (X_2)	% of Items (P_2)	
Numeration and Notation	46	5.2	30	14.0	4.295**
Number Operations	433	49.0	112	52.4	.887
Measurements	106	12.0	14	6.5	2.174
Geometry	40	4.5	3	1.4	1.961
Problem Solving	137	15.5	55	25.7	3.327**
General Review	123	13.8			

** 0.01 Level of Significance

Scott Foresman Textbooks and Stanford Achievement Test

This comparison revealed that in only one area was there a difference between textbook pages and achievement test items that could be classified as statistically significant. This was in the area of Problem Solving, which obtained a critical ratio of 4.373. The Stanford Achievement Test was observed to have the higher proportion in this area.

Comparing the Scott Foresman Textbooks and Stanford Achievement Test in the other four areas revealed a difference between proportions of pages and items of non-significant nature in each area. The tabulation of Table 34 shows Numeration and Notation obtained a Z score of .146; Number Operations, .800; Measurements, a Z score of 2.146; and the area of Geometry 2.130. All of these scores are less than that required for significance at the 0.01 level.

TABLE 34

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS
IN SCOTT FORESMAN TEXTBOOKS AND STANFORD ACHIEVEMENT TEST

	Scott Foresman Texts		Stanford Test		Z
	No. of Pages (X ₁)	% of Pages (P ₁)	No. of Items (X ₂)	% of Items (P ₂)	
Numeration and Notation	108	13.6	30	14.0	.146
Number Operations	391	49.3	112	52.4	.800
Measurements	94	11.8	14	6.5	2.146
Geometry	37	4.7	3	1.4	2.130
Problem Solving	101	13.1	55	25.7	4.373**
General Review	64	7.5			

** 0.01 Level of Significance

Silver Burdett Textbooks and Stanford Achievement Test

Two of the mathematical areas in the comparison of Silver Burdett Textbooks and the Stanford Achievement Test obtained critical ratios which were classified as not significant. The differences between the percentage of pages in these textbooks and the percentage of items in this test yielded critical ratios of 1.620 for Numeration and Notation and .420 for the area of Number Operations.

Table 35 indicates the three remaining areas of Measurements, Geometry, and Problem Solving all have statistically significant differences between the proportions of textbook pages and test items when they yielded critical ratios of 2.902, 3.326, and 5.938, respectively. The first two of these areas favored the Silver Burdett Textbooks, while the last one favored the Stanford Achievement Test.

TABLE 35

NUMBERS, PERCENTAGES, AND RESULTANT Z SCORES FOR MAJOR MATHEMATICS AREAS
IN SILVER BURDETT TEXTBOOKS AND STANFORD ACHIEVEMENT TEST

	<u>Silver Burdett Texts</u>		<u>Stanford Test</u>		Z
	<u>No. of Pages (X₁)</u>	<u>% of Pages (P₁)</u>	<u>No. of Items (X₂)</u>	<u>% of Items (P₂)</u>	
Numeration and Notation	85	10.6	30	14.0	1.620
Number Operations	456	54.0	112	52.4	.420
Measurements	117	13.9	14	6.5	2.902**
Geometry	66	7.8	3	1.4	3.326**
Problem Solving	85	10.1	55	25.7	5.938**
General Review	36	4.1			

** 0.01 Level of Significance

Table 36 is a summary table indicating the percentages of pages for the major mathematics areas in all the state adopted arithmetic textbook series for fourth, fifth, and sixth grades in the States of Oklahoma and Texas.

TABLE 36

PERCENTAGES FOR MAJOR MATHEMATICS AREAS IN STATE ADOPTED ARITHMETIC
TEXTBOOK SERIES FOR FOURTH, FIFTH, AND SIXTH GRADES

	Numeration and Notation	Number Operations	Measurements	Geometry	Problem Solving
Addison- Wesley Texts (N=930) ^a	7.8%	53.7%	10.0%	8.6%	12.6%
American Book Company Texts (N=990) ^a	11.9%	53.2%	5.9%	12.4%	6.3%
Harcourt, Brace, and World Texts (N=925) ^a	6.6%	52.6%	8.7%	2.7%	13.3%
Holt, Rinehart, and Winston Texts (N=1038) ^a	9.1%	44.2%	7.7%	7.3%	16.3%
Laidlaw Texts (N=885) ^a	5.2%	49.0%	12.0%	4.5%	15.5%
Scott Foresman Texts (N=795) ^a	13.6%	49.3%	11.8%	4.7%	13.1%
Silver Burdett Texts N=(845) ^a	10.6%	54.0%	13.9%	7.8%	10.1%

a = Total Number of Pages

Table 37 is a summary table showing the percentage of items for each major mathematical area as found in the five selected achievement test batteries.

TABLE 37
PERCENTAGES FOR MAJOR MATHEMATICS AREAS
IN SELECTED ACHIEVEMENT TESTS

	Numeration and Notation	Number Operations	Measurements	Geometry	Problem Solving
California Achievement Test (N=125) ^a	12.8%	68.8%	6.4%	0	12.0%
Iowa Test of Basic Skills (N=139) ^a	11.5%	29.5%	15.1%	2.2%	41.7%
Metropolitan Achievement Test (N=178) ^a	10.1%	53.4%	6.7%	0	29.8%
S. R. A. Achievement Test (N=197) ^a	7.6%	46.2%	11.7%	2.5%	32.0%
Stanford Achievement Test (N=214) ^a	14.0%	52.4%	6.5%	1.4%	25.7%

a = Total Number of Items

CHAPTER V

SUMMARY, FINDINGS, RECOMMENDATIONS, AND IMPLICATIONS

Summary

This study involved a content comparison between items in the Arithmetic Sections of the five most widely used achievement test batteries in Oklahoma and Texas and the officially adopted arithmetic textbooks for the fourth, fifth, and sixth grades in these states. Both the items in the achievement tests and the pages in the books were examined and classified as pertaining basically to one of five major areas of mathematics. These areas were: (1) Numeration and Notation, (2) Number Operations, Properties, and Computational Procedures, (3) Measurements, (4) Geometry, and (5) Problem Solving.

The number of observations in each category were then converted to percentages of the total for that test or textbook and these proportions compared with one another. Each test was compared with each textbook series regarding the proportion of observations found in the five areas. The statistical instrument used to make the comparison was the normal standardized deviate or Z score. The level of significance selected for the study was the 0.01 level.

The statistical comparison of the percentage of textbook pages and percentage of achievement test items was made and at the same time an

outline of the content for each book on the three levels examined (fourth, fifth, and sixth) was made. These summaries used the same five major mathematical areas to segregate the types of lessons contained and then enumerated the various concepts, understandings, facts, and operations which basically fall in each area. The achievement tests also had their items summarized as falling into one of the five major mathematical areas. These two operations were carried out to test the hypothesis that there is a significant difference between the content of presently used arithmetic textbooks in the fourth, fifth, and sixth grades and the arithmetic achievement tests used by students at the same grade levels.

Findings

Some of the findings of this study are directly related to the procedures and operational design of the study and only indirectly related to the hypothesis tested.

It was found that not all pages in the textbooks could be classified as pertaining solely to one mathematical area. This was caused by some pages being used by the authors for review or evaluation lessons and containing exercises from two or more of the major areas of mathematics. The percentage of textbook pages devoted to general review for each series is noted in each table under the heading "General Review" but is not used in the comparative phase of the study.

The area of Problem Solving was restricted to items or pages in which the principal objectives required the student to read and understand the words of the problem, analyze the numerical data given, decide on the computational processes to be used, and finally, compute the answer to the problem. Many of these problems were of a multi-step nature involving two or more different computational procedures. This area also includes those

pages from the textbooks whose primary aim is to explain or develop initial knowledge in one or more of these skills.

The format of the five arithmetic achievement tests is basically the same. Three out of the five had three sections dealing specifically with items designed to evaluate arithmetical concepts, operational computations, and problem solving. The other two tests had only two sections but these included items involving the same basic areas as handled in the other tests.

The findings most directly involved in testing the hypothesis of this study are several in number.

1. One hundred seventy five critical ratios were computed and yielded 70 significant differences to 105 not significant differences.
2. The mathematical area of Numeration and Notation obtained 30 critical ratios which were small enough to indicate no significant difference between proportions of pages and items. This left five critical ratios classified as significant at the 0.01 level of significance. By definition, the 0.01 level of significance would indicate that a given Z score would occur one time out of 100 by chance alone. In the area of Numeration and Notation, this would seem to say there were five critical ratios, each one which would be classified significant one time out of 100 by chance. Using Wilkinson's tables developed by expanding the binomial we find that instead of five separate critical ratios each one significant one out of 100 times, there is probably one ratio which would be significant by chance alone .002 times out of 100. In other words, the difference in percentages of textbook pages and test items for the area of Numeration and

Notation is probably even less significant than would be indicated by the 30 and 5 figures.¹

3. Number Operations, Properties, and Computational Procedures obtained 21 critical ratios falling below the required 2.57 at the 0.01 level of significance and, therefore, indicating no statistically significant differences between percentages of textbook pages and achievement test items. The remaining 14 scores were of such magnitude as to exceed the requirement and thus indicated significance.
4. The Measurements area obtained the same ratio of critical ratios as mentioned for the Numeration and Notation area, 30 to 5, with the large proportion coming in the non-significant category. By definition, the 0.01 level of significance would indicate that a given Z score would occur one time out of 100 by chance alone. In the area of Measurements, this would seem to say there were five critical ratios, each one which would be classified significant one time out of 100 by chance. Using Wilkinson's tables developed by expanding the binomial, we find that instead of five separate critical ratios each one significant one out of 100 times, there is probably one ratio which would be significant by chance alone .002 times out of 100. In other words, the difference in percentages of textbook pages and test items for the area of Measurements is probably even less significant than would be indicated by the 30 and 5 figures.²

¹Bryan Wilkinson, "A Statistical Consideration in Psychological Research," Psychological Bulletin, 48 (1951), p. 157.

²Ibid

5. The area of Geometry received the most nearly even distribution of critical ratios showing significant and not significant differences. This area yielded 18 critical ratios indicating no significant difference and 17 indicating significant differences between percentages of textbook pages and achievement test items.
6. The area of Problem Solving reversed the trend of the other four mathematical areas. It yielded 29 critical ratios sufficiently large as to exceed the 0.01 level requirement and thus indicate differences of a significant nature. Of the total 35 scores for this area, this left only six which indicate no statistically significant difference. Using Wilkinson's table again, it would seem that the area of Problem Solving definitely shows significant differences between the percentage of textbook pages devoted to it and the percentage of test items classified under this heading.³
7. Two of the achievement tests examined, the California and Metropolitan, received no tallies for items which could be classified in the area of Geometry. The remaining three tests had percentages in this area ranging from 1.4% to 2.59% of their total items.
8. The Number Operations area in all individual textbooks, textbook series, and in all but one achievement test, received the largest number of tallies. The Iowa Test of Basic Skills was the one achievement test which did not receive a larger proportion of tallies in this area. The percentages in the textbook

³ Ibid

series ranged from 44% to 54% in this area. The percentages found in the achievement tests for the Number Operations area ran from 29% to 68%.

9. Contents of all achievement tests and textbook series cover the whole number operations of addition, subtraction, multiplication and division. The textbooks cover the basic laws and properties of number operations, but no test items evaluate these topics directly.
10. Operations on rational numbers in the form of common fractions are covered in all textbook series examined. The concepts and operational procedures for adding, subtracting, multiplying, and dividing common fractions are presented. Decimal fraction operations are also included in the content of these arithmetic textbooks using the four basic computations. The topic of percent and its basic relationship to other forms of rational numbers is presented in all textbook series examined.
11. The study of Measurements as covered by the seven textbook series is substantially the same. All series deal with the basic units of measure; adding, subtracting, multiplying, and dividing these units; and the principles of conversion. A notable addition to the units of measures included is the metric system which is covered by five series--Addison-Wesley, American Book Company, Holt, Rinehart, and Winston, Laidlaw, and Scott Foresman. The use and development of charts, graphs, tables, and scale drawings are substantially covered by all textbook series.
12. The five achievement tests examined contained items covering the basic units of measures. No test included items covering

the metric system, with the exception of the S. R. A. Test, which had one problem using the Kilowatt hour measure of electricity.

13. The area of Geometry as covered by the seven textbook series showed the greatest difference content-wise as compared to the achievement tests. All but one of the textbook series extensively covered the topics of points, rays, lines, line segments, angles, and planes. Only one test has these topics included in any way. Volume of closed figures such as cubes, prisms, cylinders, and cones is covered by all the textbook series. Only one test item out of all five tests is concerned with volume.
14. The types of exercises and items classified in the Problem Solving area were comparable in both textbooks and achievement tests. Both used single and multi-step problems using different types of numbers and operations.
15. All achievement tests examined, except the California Test, showed significant differences in the Problem Solving area when compared with the textbooks. The California Achievement Test was the only battery which did not have a specific section devoted to Problem Solving with no other types of concepts included.
16. When the proportion of test items classified as falling in the Numeration and Notation area was compared with the proportion of textbook pages devoted to this area, the critical ratios obtained overwhelmingly indicated no significant difference (30 - 5). When the topics of content covered in this area are considered, there are some basic differences. The topic of sets,

set notations, and set operations were covered in four of the seven textbook series. None of the achievement tests cover this topic. The topic of numbers from base systems other than ten are covered in five of the textbook series, but the tests do not have any items evaluating this area. Negative integers are presented in three of the textbook series and the S. R. A. and Stanford Tests contain one item each involving this concept. Symbols used to indicate mathematical meanings of greater than, less than, is not equal to, and unknowns in number equations are presented in five textbook series and the S. R. A. Test is the only one using items on these concepts. Place value concepts, reading and writing numbers, Roman numerals, and number sequence principles are covered equally well by textbook series and achievement tests.

17. The Metropolitan Achievement Test, despite its early (1959) copyright date, seems to have adequate coverage of whole number operations, common fraction operations, and decimal fraction operations. The percentage of items covering all areas of Geometry, number bases other than ten, sets, percent, negative integers, number properties, and mathematical symbols is extremely low or lacking.
18. The California Achievement Test includes ample items to cover the areas of Number Operations of whole numbers, common fractions, and decimal fractions. Its coverage of whole number place value, Roman numerals, standard units of measure and the operations on these units seems adequate. The number of items evaluating topics of sets and their notation, all aspects of Geometry, use of

tables, graphs and charts, negative integers, number bases other than ten, metric system of measures, and number properties is either non-existent or small.

19. With approximately half the comparisons in the area of Geometry receiving critical ratios indicating significant differences and with the differences noted in the lists of topics covered in the tests and textbooks, there would seem to be strong indications that test items covering more geometric concepts should be developed for all test batteries examined in this study. When the fourth, fifth, and sixth grade materials for one of the major experimental programs (School Mathematics Study Group) is examined, it is found to have some 23% of its content devoted to the several topics of Geometry. This amount is nearly double that contained in any of the seven textbook series and ten times the amount found in the achievement test containing the highest proportion of items in this area.
20. The topic of sets, set notation, and operations with sets is significantly covered by a majority of the textbook series at this level. Two of the series that do not have fourth, fifth, or sixth grade lessons pertaining to these topics have used them in previous levels. There would seem to be substantial need for additional items in all five tests to cover these topics.
21. Five of the seven textbook series include lessons involving number bases other than ten in all the tests of this study.
22. The area of Number Operations obtained 14 $\bar{z}$ scores out of 35 which indicated statistically significant differences between the proportions of items in the achievement tests and the

proportion of pages in the textbook series. Some of the significance of this observation can be reduced by taking into account that many of the pages in each textbook which were classified as General Review did have exercises involving Number Operations. This would appear to indicate that the contents of the tests and textbook series with regard to Number Operations are fairly close.

23. The basic laws and properties involved with Number Operations (associative, commutative, distributive, and identity element) are included in the textbooks but not in the tests. The importance of these concepts would seem to indicate need for more direct coverage of these topics by the achievement tests.

Recommendations

The following recommendations are made as a result of the data obtained in this study.

1. More teachers and school administrators should evaluate the contents of their arithmetic textbooks and the arithmetic sections of the achievement tests they use to determine whether the test items adequately parallel the subject matter presented in the textbooks.
2. A standardized achievement test cannot possibly contain all the different types of work included in a textbook series, but it should cover in a substantial manner the major areas of curriculum content.
3. A careful examination of chapter or unit headings, index topics, and scope and sequence charts for most arithmetic textbooks can usually give sufficient data to indicate what type item coverage

is required from a particular achievement test for adequate evaluating. This type scrutiny is neither too expensive time-wise, nor too technical from an operational standpoint when considering proper achievement test selection.

4. The period of transition dealing with any area of curriculum change tends to create a wider than usual gap between achievement test content and textbook content. Schools in the States of Oklahoma and Texas which are using the state adopted arithmetic textbooks for fourth, fifth, and sixth grades can, with limited reservations, use the standardized achievement test batteries examined in this study and expect to attain valid evaluation of their arithmetic programs.

Implications

This study emphasizes the continued need for scientific examinations of the proficiency level at which tools of education are used. Continual research in the operational use by teachers of specific tools of learning is necessary to maintain any satisfactory growth in teaching techniques and processes.

Long-range research is still needed to help determine the proper grade level placement for given topics in curriculum areas such as mathematics.

Research concerning the proper place textbooks should hold in a given curriculum area is vital to the development of good operational procedures in the classroom.

Additional research is called for in helping determine to what extent standardized achievement tests are of more value to the educational process than other types of evaluational instruments that might be used.

Does the value derived justify the expense and time involved?

An implication for further study would be that research be carried out to determine how closely the content of standardized achievement tests must parallel textbook contents in order for the maximum amount of good to be gained from their use.

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APPENDIX A

RAW DATA

RAW DATA^a

ADDISON-WESLEY TEXTBOOKS

MAJOR MATHEMATICAL AREAS	4TH GRADE	5TH GRADE	6TH GRADE	TOTALS
Numeration and Notation	28	23	23	75
Number Operations Total	172	170	157	499
A. Whole Number Addition and Subtraction	36	24	20	80
B. Whole Number Multipli- cation and Division	81	60	40	181
C. Rational Numbers, Common Fractions, Decimals, Ratio, Percent	55	86	97	238
Measurements	36	31	26	93
Geometry	18	23	39	80
Problem Solving	38	35	44	117

^a = Number of Textbook Pages Devoted to Mathematical Areas

RAW DATA^a

AMERICAN BOOK COMPANY TEXTBOOKS

MAJOR MATHEMATICAL AREAS	4TH GRADE	5TH GRADE	6TH GRADE	TOTALS
Numeration and Notation	46	33	39	118
Number Operations Totals	173	173	180	526
A. Whole Numbers Addition and Subtraction	48	23	30	101
B. Whole Numbers Multipli- cation and Division	71	42	38	151
C. Rational Numbers, Common Fractions, Decimals, Ratio, Percent	54	108	112	274
Measurements	13	21	24	58
Geometry	50	41	31	122
Problem Solving	25	15	22	62

^a = Number of Textbook Pages Devoted to Mathematical Areas

RAW DATA^a

HARCOURT, BRACE, AND WORLD TEXTBOOKS

MAJOR MATHEMATICAL AREAS	4TH GRADE	5TH GRADE	6TH GRADE	TOTALS
Numeration and Notation	19	17	25	61
Number Operations Totals	144	166	177	487
A. Whole Numbers Addition and Subtraction	24	20	8	52
B. Whole Numbers Multipli- cation and Division	103	68	41	212
C. Rational Numbers, Common Fractions, Decimals, Ratio, Percent	17	78	128	223
Measurements	28	30	22	80
Geometry	3	7	15	25
Problem Solving	53	37	33	123

a = Number of Textbook Pages Devoted to Mathematical Areas

RAW DATA^a

HOLT, RINEHART, AND WINSTON TEXTBOOKS

MAJOR MATHEMATICAL AREAS	4TH GRADE	5TH GRADE	6TH GRADE	TOTALS
Numeration and Notation	29	21	44	94
Number Operations Totals	214	153	155	522
A. Whole Number Addition and Subtraction	54	16	10	80
B. Whole Numbers Multipli- cation and Division	136	67	33	236
C. Rational Numbers, Common Fractions, Decimals, Ratio, Percent	24	70	112	206
Measurements	18	29	33	80
Geometry	15	25	22	62
Problem Solving	62	58	50	170

a = Number of Textbook Pages Devoted to Mathematical Areas

RAW DATA^a

LAIDLAW TEXTBOOKS

MAJOR MATHEMATICAL AREAS	4TH GRADE	5TH GRADE	6TH GRADE	TOTALS
Numeration and Notation	10	23	13	46
Number Operations Totals	163	131	139	433
A. Whole Number Addition and Subtraction	34	20	10	64
B. Whole Number Multipli- cation and Division	89	61	26	176
C. Rational Numbers, Common Fractions, Decimals, Ratio, Percent	40	50	103	193
Measurements	19	38	49	106
Geometry	7	15	18	40
Problem Solving	56	47	34	137

a = Number of Textbook Pages Devoted to Mathematical Areas

RAW DATA^a

SCOTT FORESMAN TEXTBOOKS

MAJOR MATHEMATICAL AREAS	4TH GRADE	5TH GRADE	6TH GRADE	TOTALS
Numeration and Notation	33	44	31	108
Number Operations Totals	126	121	144	391
A. Whole Number Addition and Subtraction	33	2	2	37
B. Whole Number Multipli- cation and Division	78	55	18	151
C. Rational Numbers, Common Fractions, Decimals, Ratio, Percent	15	64	124	203
Measurements	31	36	27	94
Geometry	3	8	26	37
Problem Solving	42	33	26	101

a = Number of Textbook Pages Devoted to Mathematical Areas

RAW DATA ^a

SILVER BURDETT TEXTBOOKS

MAJOR MATHEMATICAL AREAS	4TH GRADE	5TH GRADE	6TH GRADE	TOTALS
Numeration and Notation	29	29	27	85
Number Operations Totals	141	162	153	456
A. Whole Number Addition and Subtraction	25	22	6	53
B. Whole Number Multipli- cation and Division	89	60	28	177
C. Rational Numbers, Common Fractions, Decimals, Ratio, Percent	27	80	119	226
Measurements	39	42	36	117
Geometry	13	17	36	66
Problem Solving	43	21	21	85

a = Number of Textbook Pages Devoted to Mathematical Areas

RAW DATA^a

ACHIEVEMENT TESTS

MAJOR MATHEMATICAL AREAS	California Test	Iowa Test of Basic Skills	Metropolitan Test	S. R. A. Test	Stanford Test
Numeration and Notation	16	16	18	15	30
Number Operations	86	41	95	91	112
A. Whole Numbers: Addition and Sub- traction	20	6	37	9	24
B. Whole Numbers: Multipli- cation and Division	21	13	32	21	43
C. Rational Numbers: Common Fractions Decimals Ratio Percent	45	22	26	61	45
Measurements	8	21	12	23	14
Geometry	0	3	0	5	3
Problem Solving	15	58	53	63	55
TOTAL ITEMS	125	139	178	197	214

^a = Number of Achievement Test Items Devoted to Mathematical Areas

APPENDIX B

LETTERS REGARDING TESTS

TEXAS EDUCATIONAL AGENCY

State Board of Education
State Commissioner of Education
State Department of Education

Austin, Texas

78711

November 17, 1964

Mr. Lee A. Smith, Principal
Western Plateau School
4927 Shawnee Trail
Amarillo, Texas

Dear Mr. Smith:

I am under the impression that the most popular individual arithmetic tests used in the elementary grades are those provided by the textbook publisher. The most commonly used achievement batteries containing an arithmetic section are Stanford Achievement, Metropolitan Achievement, California Achievement, Science Research Associates Achievement, and Gray-Votaw-Rogers Achievement Tests. I hope this will give you the information you need, and if you have any additional questions, please do not hesitate to ask.

Very truly yours,

(signed) Julian Biggers, Program Director for Testing
Division of Guidance and Supervision

JB:cm

OKLAHOMA STATE UNIVERSITY - STILLWATER

Bureau of Tests & Measurements
Frontier 2-6211, Ext. 7251

74075

September 14, 1964

Mr. Lee A. Smith, Principal
Western Plateau School
Amarillo, Texas

Dear Mr. Smith:

I appreciate receiving your letter of September 10 in which you inquire about those Arithmetic Achievement Tests for grades four, five and six most widely used in the Bureau's work with the public schools. These tests are the arithmetic sections of the Stanford, the Metropolitan, and the California Achievement batteries.

I hope this information is of assistance to you.

Very sincerely yours,

(Signed) Dr. Harry K. Brobst, Director
Bureau of Tests and Measurements
Professor of Psychology

HKB:nw

THE UNIVERSITY OF OKLAHOMA

Norman . Oklahoma

November 17, 1964

Mr. Lee A. Smith, Principal
Western Plateau School
4927 Shawnee Trail
Amarillo, Texas

Dear Mr. Smith:

Reference: Your letter of November 13

For Grades 4, 5, and 6 we process more arithmetic tests from the California Achievement battery @ .25 per pupil and the Iowa Tests of Basic Skills @ .20. You will find short descriptions of these tests on pages 19 and 20 of our bulletin which you will receive in the near future.

Our service includes all materials necessary for administering the tests as well as complete scoring and reporting of results. We also furnish statistical data on groups of 35 or more.

We would welcome the opportunity to serve you. Order blanks are enclosed for your convenience.

Cordially,

(Signed) C. Mount
Mrs. Roy Mount, Jr.
Evaluation and Testing

CM
Enc.