



An Analysis of the Content of Six Third-Grade Arithmetics

F. T Spaulding


To cite this article: F. T Spaulding (1921) An Analysis of the Content of Six Third-Grade Arithmetics, *The Journal of Educational Research*, 4:5, 413-423, DOI: [10.1080/00220671.1921.10879221](https://doi.org/10.1080/00220671.1921.10879221)

To link to this article: <http://dx.doi.org/10.1080/00220671.1921.10879221>



Published online: 15 Dec 2014.



Submit your article to this journal 



View related articles 

AN ANALYSIS OF THE CONTENT OF SIX THIRD-GRADE ARITHMETICS

F. T. SPAULDING

Scarborough School, Scarborough, New York

Recent investigations of the content of the elementary-school course of study have centered attention on the utility and effectiveness of the subject-matter which the course of study includes. The Committee on Minimum Essentials and the Committee on Economy of Time in Education, as well as numerous individual investigators, have proposed more or less definite standards for each of the elementary-school subjects. The present study of six third-grade arithmetics was intended to determine the extent to which certain well-known primary texts approach these standards.

Specifically stated, the purpose of this study was twofold: first, to determine the exact nature of the arithmetical work presented; and second, to provide a basis for a judgment of the extent to which the textbooks studied make an appeal (a) to the immediate needs and interests and (b) to the probable future needs and interests of the pupils using them.

In selecting the textbooks for study an effort was made to choose those which are in wide use at the present time or which have been widely used in the past. The six books selected represent a period of fourteen years in the development of arithmetic texts. Listed according to recency of publication they are:

Stone, J. C., and Millis, J. F.: *New Stone-Millis Arithmetic*.

(Primary.) Benj. H. Sanborn & Co., 1920.

Chadsey, C. E., and Smith, J. H.: *Efficiency Arithmetic*.

(Primary.) Atkinson, Mentzer & Co., 1917.

Hoyt, F. S., and Peet, H. E.: *Everyday Arithmetic*. (Book I.)

Houghton Mifflin Co., 1915.

Walsh, J. H., and Suzzallo, H.: *Walsh-Suzzallo Arithmetics*.

(Third Year.) D. C. Heath & Co., 1914.

Wentworth, G., and Smith, D. E.: *Arithmetic*. (Book I.)

Ginn & Co., 1911.

Milne, W. J.: *Progressive Arithmetic*. (First Book.) American

Book Co., 1906.

The method pursued was substantially that used by Wise¹ and Monroe² in their studies of arithmetic problems. The third-grade material presented in each book was divided into two classes—(1) examples, i.e., drill and test work, in which the operations to be performed were indicated for the pupil; and (2) problems, or work in which the method of solution was not directly indicated. To make the results as nearly comparable as possible, each separate example or problem was counted as a unit, even though the author had included several such in a single task. Tables of numbers, from which the teacher or the pupil could form an almost limitless series of examples, were omitted in the classification.

Examples and problems were then classified separately as to the arithmetical operations or combinations of operations involved in each, including the use of fractions. Where fractional numbers were employed merely to indicate division (as $\frac{1}{2}$, $\frac{1}{4}$, etc.) the examples and problems were classified under "Division," classification as "Fractions" being restricted to examples and problems using fractions as such.

Problems were further classified (1) as to general subject-matter, according to a modification of the scheme adopted by Monroe, and (2) as to the use of measurements and the types of measurements employed.

The totals of examples and problems found in the six books, with the proportions of each, are presented in Table I. It is noteworthy that the totals vary from 1777 (Chadsey-Smith) to 3106 (Wentworth-Smith)—a range of nearly 1400. There has been little standardization, apparently, of the amount of material to be covered in this grade. Wide variation is also evident in the proportions of examples and problems presented. There would seem to be a tendency, however, toward a greater proportion of problems in the more recent books—a hopeful sign (assuming that the problems are of the right type), in view of the present emphasis on the need for making schoolwork vital and concrete, rather than abstract.

¹ Wise, C. T., "A survey of arithmetical problems arising in various occupations." *Elementary School Journal*, 20: 118-36, October, 1919.

² Monroe, W. S., "A preliminary report of an investigation of the economy of time in arithmetic." *Sixteenth Yearbook of the National Society for the Study of Education, Part I*, chapter 7.

TABLE I. NUMBERS AND PROPORTIONS OF PROBLEMS AND EXAMPLES CONTAINED IN SIX THIRD-GRADE ARITHMETICS

TEXTS	NUMBER			PERCENT	
	Examples	Problems	Total	Examples	Problems
Stone-Millis (1920).....	1,526	751	2277	67.0	33.0
Chadsey-Smith (1917).....	1,334	443	1777	75.1	24.9
Hoyt & Peet (1915).....	1,887	667	2554	73.9	26.1
Walsh-Suzzallo (1914).....	2,513	582	3095	81.2	18.8
Wentworth-Smith (1911).....	2,344	762	3106	75.5	24.5
Milne (1906).....	2,059	442	2501	82.3	17.7
Average.....	1,944	608	2552	76.2	23.8

Table II shows the distribution of examples according to the types of operations involved. With the exception of Milne, the books are practically agreed in requiring the use of a single one of the four fundamental operations in the solution of over 90 percent of the examples and of more than 85 percent of the problems—a practice supported by the findings of Wise in his study of problems taken from everyday experience. But in the relative amount of space devoted to each of the four single operations the books vary widely—so widely that the median is of little value as an indication of general practice. Here again practice has apparently been determined in each case by the arbitrary judgment of the textbook maker, rather than by reference to any sort of objective standard.

The variation in proportionate emphasis on the fundamentals between examples and problems within the same book is as worthy

TABLE II. PERCENTS OF EXAMPLES AND PROBLEMS INVOLVING THE VARIOUS OPERATIONS

Combinations	STONE-MILLS			CHADSEY-SMITH			HOYT & PEET			WALSH-SOZZALLO			WENTWORTH-SMITH			MILNE			MEDIANS			
	Examples	Problems	Total	Examples	Problems	Total	Examples	Problems	Total	Examples	Problems	Total	Examples	Problems	Total	Examples	Problems	Total	Examples	Problems	Total	
Addition.....	26.7	20.5	24.7	22.0	26.5	23.1	44.4	4.21	3.38	4.22	3.21	1.22	1.32	5.19	7.29	3.12	0.5	4.10	8.24	5.20	8.23	9
Subtraction.....	15.1	12.9	14.4	13.0	10.8	12.5	29.3	19.8	26.7	13.5	17.7	14.3	27.3	21.5	25.9	10.8	7.2	10.2	14.3	15.3	14.4	
Multiplication.....	28.2	36.6	31.0	25.4	18.5	23.6	10.7	21.4	13.5	29.4	32.0	29.9	13.2	30.6	17.6	21.9	27.0	22.8	23.7	28.8	23.2	
Division.....	28.4	27.6	28.1	36.3	32.5	35.3	15.6	23.8	17.7	29.7	22.7	28.4	18.8	8.20	5.19	2.33	0.12	7.29	4.29	1.23	3.28	3
Addition and Subtraction.....	0.3	0.1	.....	0.5	0.1	.....	5.5	1.5	0.1	.....	0.5	0.1	0.4	0.1	0.4	2.7	0.8	0	0.5	0.1	0	
Addition and Multiplication.....	1.5	0.1	1.1	.....	1.1	0.3	.....	4.0	1.0	.....	0.5	0.1	5.5	2.5	4.8	3.1	8.1	4.0	0.8	1.8	1.1	
Addition and Division.....	0.1	.....	.....	.....	.....	.....	1.4	0.4	.....	0.7	0.1	1.8	0.2	1.4	.....	.....	.....	.....	0	0.4	0.1	
Addition, Subtraction & Multiplication.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0	0	
Addition, Subtraction and Division.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Addition, Multiplication and Division.....	.....	0.1	.....	.....	1.8	0.5	.....	.....	.....	.....	.....	.....	0.1	.....	.....	.....	.....	.....	.....	0	0.1	0
Subtraction and Multiplication.....	.....	0.3	0.1	.....	.....	.....	.....	2.1	0.6	.....	.....	0.7	0.1	.....	.....	0.7	7.0	1.8	0	0.5	0.1	
Subtraction and Division.....	0.1	.....	.....	.....	.....	.....	.....	0.5	0.2	.....	.....	0.3	0.1	.....	.....	.....	.....	.....	0	0	0	
Subtraction, Multiplication and Division.....	.....	1.5	0.5	.....	0.5	0.1	.....	0.2	.....	.....	.....	0.2	.....	.....	.....	.....	.....	.....	.....	0	0.4	0.1
All Operations.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Fractions.....	.....	.....	3.3	.....	7.9	4.5	.....	.....	.....	5.0	4.1	4.9	0.9	4.5	1.7	18.1	18.6	18.2	2.1	4.3	3.1	

of note as the variation between books. Leaving out of consideration a fairly uniform preponderance of addition examples over addition problems (due partly to the use of addition in demonstrating subtraction and multiplication), the tables show in some cases a greater proportion, in others a less, of examples than of problems. Hoyt & Peet, for instance, devote 29 percent of their examples and only 19 percent of their problems to subtraction; whereas 8 percent more problems than examples are devoted to division. In the *Walsh-Suzzallo Arithmetics* the differences are in the opposite direction. Part of the discrepancy is obviously due to the fact that considerably more problems than examples are distributed in the double and triple-operation groups; but this would provide only for smaller proportions of problems than of examples. Lack of a clear conception of the functions of problems and of examples and of the amount of practice desirable in each is responsible for most of the variation.

A hopeful sign is apparent in the partial or the complete elimination of fractions in the later books. Milne devotes 18.2 percent of his examples and problems to fractions as such; Stone & Millis and Hoyt & Peet postpone the study of fractions (except fractions with unit-numerators, used to indicate simple division) to a later grade. In his study of common problems from everyday life, Wise found the use of fractions to be restricted very largely to that of fractions with simple numerators and denominators—a fact which would argue for much less attention to the more complex fractions than has been given by the older arithmetics.

From the point of view of the textbook maker such investigations as that of Wise must serve to indicate the nature of the material which should be included in a course of study, rather than the relative stress which each phase of such material should receive. For it is obvious that the practice necessary to master an operation of arithmetic may be out of proportion, so far as the time element is concerned, to the degree to which the pupil may expect to use this operation in ordinary life; and yet the fact that it is necessary in ordinary life requires its mastery in school. It is dangerous, therefore, to draw conclusions from such figures as we have at hand as to the exact amount of time which should be devoted to each of the several phases of arithmetic-teaching. In so far as the textbooks studied center their attention on practice in the fundamentals they are in accord with the general

principles established by Wise's study. Their weakness is in pedagogical method, rather than in aim; they show no evidence of established standards as to the amount of practice needed to master the fundamentals.

In the classification of the subject-matter of the problems (Tables III, IV, and V), we find a basis for determining the extent to which the texts meet the present and the future needs and interests of the pupils who use them. Here again a very wide diversity is apparent. Of particular significance is the variation in the proportion of problems which relate to no human activity—such problems as, "How many feet have 16 birds?" or "A book cost $\$1\frac{3}{4}$. How much more than $\$1\frac{1}{4}$ is that?" The Hoyt & Peet *Everyday Arithmetic* is the only one which has a clean slate in this respect; the Walsh-Suzzallo text is the worst offender, with 4.1 percent of its problems (24 in all) of this worthless type. The tabulation shows an encouraging tendency, however, toward the elimination of this sort of work from the later books.

There is a much larger group of problems (49.6 percent of those in the Wentworth-Smith book) which give valuable practice to the pupil and are of a sort which he will frequently meet, but which as presented can be identified with no particular activity. Of this type are such problems as, "How many pecks are there in 8 bushels?" or, "What is the perimeter of a lot 180 feet square?" In their lack of appeal to the pupil and their lack of connection with concrete activity, they are of much less value, of course, than problems which possess definite significance. As with the problems relating to no activity, the proportion of such problems seems to be decreasing in the more recently published books.

With the exception of Wentworth-Smith the books are fairly agreed in devoting about half their problems to Home Activities, Personal Activities, and the Activities of Children. Five books out of the six agree in relating about 10 percent of their problems to Home Activities; in the other two classifications just mentioned there is considerable divergence. Within all of these fields the quality of the problems presented counts for so much that without a more exact classification than that of the present study, and without more definite standards of evaluation than have yet been developed, we can draw no worth-while conclusions as to present tendencies and limitations.

For the distribution of problems dealing with occupations we have standards of a sort. If we consider these problems in the

TABLE III. DISTRIBUTION OF PROBLEMS ACCORDING TO SUBJECT-MATTER

TEXTS	1. OCCUPATIONS												2. HOME ACTIVITIES		3. PERSONAL ACTIVITIES		4. ACTIVITIES OF CHILDREN		5. RELATING TO NO ACTIVITY		6. INCAPABLE OF IDENTIFICATION			
	1. ALL OCCUPATIONS		A. AGRICULTURE		B. TRADE		C. TRANSPORTATION		D. PUBLIC SERVICE		E. INDUSTRY		F. OTHERS											
	No.	Per- cent	No.	Per- cent	No.	Per- cent	No.	Per- cent	No.	Per- cent	No.	Per- cent	No.	Per- cent	No.	Per- cent	No.	Per- cent	No.	Per- cent	No.	Per- cent		
Stone-Mills	240	31.8	97	12.9	113	15.0	8	1.1	10	1.3	1	0.1	11	1.4	83	11.1	56	7.5	249	33.2	5	0.7	118	15.7
Charlsey-Smith	59	13.3	18	4.1	10	2.3	13	2.9	8	1.8	1	0.2	9	2.0	40	9.0	57	12.9	185	41.8	1	0.2	101	22.8
Hoyt & Peet	195	29.5	41	6.1	81	12.2	29	4.4	27	4.2	10	1.5	7	1.1	75	11.2	151	22.6	191	28.5	0	0	55	8.2
Walsh-Suzallo	140	24.1	61	10.5	62	10.7	10	1.7	1	0.2	6	1.0	0	0	72	12.4	103	17.7	141	24.2	24	4.1	102	17.5
Wentworth-Smith	74	9.6	17	2.2	46	6.0	4	0.5	4	0.5	0	0	3	0.4	82	10.8	125	16.4	79	10.4	24	3.2	378	49.6
Milne	89	20.2	11	2.5	50	11.3	10	2.3	4	0.9	0	0	14	3.2	77	17.4	51	11.5	80	18.1	7	1.6	138	31.2
Average	1321	21.4	41	6.4	60	9.6	12	2.2	9	1.5	3	0.5	7	1.2	72	12.0	91	14.8	154	26.0	10	1.6	149	24.2

light not merely of the pupils' present needs, but of their future interests and of the possibility of vocational and civic enlightenment through the work in arithmetic, we find not only much variation in individual texts, but a considerable difference in treatment between the earlier and the later books. The subject-matter in the problems in the earlier books appears to have been selected almost entirely because of its adaptability to the textbook maker's purposes in providing practice in the fundamentals, rather than because of any consideration of the value of the subject-matter itself. The grouping of problems is for the most part heterogeneous and pointless, so far as their subject-matter is concerned. In the later arithmetics it has been the avowed purpose of the authors, attested not merely by their introductory statements but by the arrangement and selection of problems as well, to provide subject-matter which shall make definite appeal to the needs and interests of the pupils. In these later books we find, therefore, first, a distribution of problems over a wider field of interests and activities, and second, a more thoughtful apportionment of problems to the various occupational groups. The first characteristic becomes apparent when we consider the percents of problems represented in each group. The three last published books afford problems under all six occupational headings, whereas the earlier texts tend seriously to neglect various fields—

TABLE IV. A COMPARISON OF THE DISTRIBUTION OF PROBLEMS
ACCORDING TO OCCUPATIONS, WITH THE DISTRIBUTION OF
THE WORKING POPULATION OF THE UNITED STATES

	All Occupations	A. Agriculture	B. Trade	C. Transportation	D. Public Service	E. Industry	F. Others
<i>Census of 1910</i>	100.0	33.2	9.5	6.9	1.2	27.9	21.3
Stone-Millis.....	100.0	40.4	47.1	3.3	4.2	0.4	4.6
Chadsey-Smith.....	100.0	30.5	17.0	22.0	13.6	1.7	15.2
Hoyt & Peet.....	100.0	21.0	41.5	14.9	13.9	5.1	3.6
Walsh-Suzzallo.....	100.0	43.6	44.3	7.1	0.7	4.3	
Wentworth-Smith.....	100.0	23.0	62.2	5.4	5.4		4.0
Milne.....	100.0	12.4	56.2	11.2	4.5		15.7

TIME	Per- cent
40	18.8
22	26.5
99	64.3
44	31.6
37	22.0
41	35.3
41	29.1

notably Agriculture and Industry (Wentworth-Smith and Milne), Transportation (Wentworth-Smith), and Public Service (Walsh-Suzzallo and Wentworth-Smith). The second point is confirmed by an inspection of Table IV, in which the percents of occupational problems belonging to each group are presented for comparison with the distribution of workers by vocations according to the census of 1910 (adapted from Monroe). Though the distribution of problems diverges to a considerable extent from that of the industrial population, there is yet evident in the later books some degree of approach to this standard distribution. The over-emphasis on trade is not a serious defect, since this is an occupation with which every adult (and nearly every child) has more or less to do. The most serious neglect appears in the field of industry, which, though claiming nearly 28 percent of the nation's workers, is represented at most by but 5 percent of the problems.

Our final analysis is concerned with the number of measurement problems and with the types of measurement involved (Table V). With but one exception (Chadsey-Smith), the six textbooks are fairly agreed in devoting about one-fourth of their problems to some type of measurement. Beyond this point agreement ceases. There is a tendency in the later books to postpone study of certain forms of measurement (notably square and cubic measure), taken up in detail in the earlier published texts; but in the amount of space devoted to the remaining forms of measurement (linear, dry, liquid, weight, and time) the books are very widely at variance. There is here very evident need of standardization of the course of study on the basis both of pedagogical and of utilitarian values.

SUMMARY

The very limited number of texts involved in the present study makes the drawing of general conclusions a dangerous proceeding. Until such time as a more extensive investigation is possible, however, the following conclusions are advanced for what they are worth.

1. There is much need for standardization of third-grade arithmetic texts: (a) as to the nature and amount of material presented for study in the course of the year; (b) as to the emphasis placed on each of the fundamental operations; and (c) as to the subject-matter of the problems presented for solution.

2. Present practice in textbook writing apparently tends toward a concentration of attention in the third grade on the fundamental operations of arithmetic, with a postponement of the study of fractions to the upper grades—a tendency the value of which is supported by the findings of Wise and of others with respect to the utility of these phases of arithmetic in practical experience.

3. There is evident also a tendency toward greater emphasis on problem-solving, in contrast to the simple “doing examples” of the earlier books.

4. A study of the subject-matter of problems shows an increasing elimination of those which relate to no human activity, or which can be identified with no activity—and, as a corollary, an increase in the proportion of worth-while, intelligible problems.

5. Textbook makers are apparently coming to appreciate the need for making their problems representative of the fields of activity in which pupils are likely to be engaged.

6. Movement in all these directions toward better third-grade teaching material is as yet, however, ill defined and irregular, resting on no firm basis of educational theory. The pressing need of the present time is for a pedagogically sound definition of arithmetic material (a) in terms of the amount needed to accomplish most economically the desired results, and (b) in terms of subject-matter looking not alone to efficient mastery of the fundamentals but to the proper development of the whole child. Until we have such a definition, the making of textbooks in arithmetic must be (as it has been in the past) guesswork, pure and simple.