



Differences in the grade placements of arithmetic concepts, in the methods employed to teach the concepts, and the achievement attained by students in French and in American elementary schools
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Abstract:

The problem was to determine what differences, if any, existed in the grade placements of arithmetic concepts, in the methods used to teach the concepts and in the achievements of students in the first five grades of the French and of the American public schools.

Arithmetic, textbook series of current use in the schools of both countries were examined in view of comparing the grade placements of main arithmetic concepts, the techniques used to present the concepts, and the relative stress, placed on all the concepts relating to major topics.

The comparison of arithmetic achievements of French and of American pupils was made by comparing results of an American standard achievement test, the Iowa Test of Basic Skills -Part A-Arithmetic, which was administered to a group of 59 French fifth graders and to a group of 59 American fifth graders, matched by sex and mental age. The arithmetic achievement of a group of 121 French fifth graders was also compared to the arithmetic achievement of a large American sample, as evidenced by norms of achievement for the United States, Hull hypotheses were formulated concerning grade placements, methods of teaching, and achievements of pupils.

The findings of the comparison of arithmetic programs were (1) the grade placement of the concepts of most arithmetic topics in the French arithmetic textbook series differ significantly (at the 1 per cent level) from. the grade placement of these same concepts in the American textbook series, these, concepts being placed, on the average, 1.2 grades sooner in the French series than in the American series; (2) few differences appear to exist, in the procedures, employed to present main arithmetic concepts, but (5.). the concepts presented in most of the textbook space of the French fourth and fifth grade texts are related to topics not covered, or only briefly covered in the American textbooks. Lessons on problems or problem-solving techniques occupy almost half (47.5 per cent) of the French fifth grade textbooks, whereas they occupy a smaller portion (17.5 per cent) of the American fifth grade textbooks.

The findings of the comparison of arithmetic achievements were (1) the arithmetic .achievement of the French fifth graders is significantly superior (at the 5 per cent level) to that of American fifth graders of the same sex and mental age; but (2) this superiority is caused by a higher average score on the second part of the test—arithmetic problem solving.

A comparison of ages of pupils revealed that French fifth grade classes had a greater number of older children, and a greater number of younger children, than American fifth grade classes. It was also found that, on the average, more time was spent on arithmetic in the French schools than in the American schools, the difference being from 3 to 15 .minutes a. day. These differences were considered "when evaluating the results of the investigation.

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THE ACHIEVEMENT ATTAINED BY STUDENTS IN FRENCH
AND IN AMERICAN ELEMENTARY SCHOOLS

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ABSTRACT

The problem was to determine what differences, if any, existed in the grade placements of arithmetic concepts, in the methods used to teach the concepts, and in the achievements of students in the first five grades of the French and of the American public schools.

Arithmetic textbook series of current use in the schools of both countries were examined in view of comparing the grade placements of main arithmetic concepts, the techniques used to present the concepts, and the relative stress placed on all the concepts relating to major topics.

The comparison of arithmetic achievements of French and of American pupils was made by comparing results of an American standard achievement test, the Iowa Test of Basic Skills--Part A--Arithmetic, which was administered to a group of 59 French fifth graders and to a group of 59 American fifth graders, matched by sex and mental age. The arithmetic achievement of a group of 121 French fifth graders was also compared to the arithmetic achievement of a large American sample, as evidenced by norms of achievement for the United States. Null hypotheses were formulated concerning grade placements, methods of teaching, and achievements of pupils.

The findings of the comparison of arithmetic programs were (1) the grade placement of the concepts of most arithmetic topics in the French arithmetic textbook series differ significantly (at the 1 per cent level) from the grade placement of these same concepts in the American textbook series, these concepts being placed, on the average, 1.2 grades sooner in the French series than in the American series; (2) few differences appear to exist in the procedures employed to present main arithmetic concepts, but (3) the concepts presented in most of the textbook space of the French fourth and fifth grade texts are related to topics not covered, or only briefly covered in the American textbooks. Lessons on problems or problem-solving techniques occupy almost half (47.5 per cent) of the French fifth grade textbooks, whereas they occupy a smaller portion (17.5 per cent) of the American fifth grade textbooks.

The findings of the comparison of arithmetic achievements were (1) the arithmetic achievement of the French fifth graders is significantly superior (at the 5 per cent level) to that of American fifth graders of the same sex and mental age; but (2) this superiority is caused by a higher average score on the second part of the test--arithmetic problem solving.

A comparison of ages of pupils revealed that French fifth grade classes had a greater number of older children, and a greater number of younger children, than American fifth grade classes. It was also found that, on the average, more time was spent on arithmetic in the French schools than in the American schools, the difference being from 3 to 15 minutes a day. These differences were considered when evaluating the results of the investigation.

CHAPTER I

INTRODUCTION

A survey of the educational literature of the last ten years reveals a renewed interest in comparative education. In the field of arithmetic, for instance, several studies compare programs and achievements of students in the schools of different countries to programs and achievements in American schools. Initial differences in the age of entrance to school in certain countries, such as Great Britain,¹ or in the length of the school year in other countries, such as the Netherlands,² were contributing factors in the differences observed. There is no evidence of studies comparing either French and American arithmetic programs, or arithmetic achievements of French and of American students. The writer felt that such a study would be of special interest because the length of the school year, as well as the age of entrance of the pupils, are the same in the American schools and in the French schools.

There are many similarities between the French and the American school systems, but also important differences which must be considered before making any comparison of programs.

¹G. T. Bushwell, "A Comparison of Achievement in Arithmetic in England and Central California," The Arithmetic Teacher, LVIII (February, 1958), 1-9.

²K. Kramer, "Arithmetic Achievement in Iowa and in the Netherlands," Elementary School Journal, LIX (February, 1959), 258-263.

The French and the American School-Systems

School is compulsory and free from age six to age sixteen, and the length of the school year is about 180 days in France as well as in the United States. The public schools of both countries accept all children regardless of social class or creed; however, there is only one type of school and one program for all elementary school pupils in France.¹

Statements found in recent French official documents reveal similarities of French and of American objectives in education.² They show a stress on preparation to life and to citizenship as well as a knowledge of the national cultural heritage. Other aims mentioned are helping the child to acquire a critical mind and helping him to realize himself. Similar statements of aims can be found in a document published by the National Educational Association.³

There are, however, important differences in the policies and in some of the objectives of the two school-systems. The French elementary school has only five grades, and at the end of the fifth grade, the pupils are placed in one of three different types of public schools according to their scholastic abilities. The most able students go to college preparatory schools, the less able go to short-term general study schools, and the least able go to schools offering a review of basic subjects and

¹L. Leterrier, Programmes, Instructions, Repartitions Mensuelles et Hebdomadaires (Paris: Hachette, 1960), p. 21.

²Ibid., pp. 21-34.

³National Education Association, Educational Policies Commission. The Purposes of Education in American Democracy. Washington, D. C., N.E.A., 1938.

apprenticeship training. A special committee of school officials makes the decision as to which type of school each pupil attends, state examinations are only given to pupils coming from a private school. In the United States, students are kept together in the same type of school through the twelfth grade, in most parts of the country. Differences in abilities and preferences of the students are taken care of by grouping and electives.

Other differences in school policies are that the practice of letting a pupil skip a grade, or that of retaining a pupil in the same grade, are much more frequent in the French schools than in the American schools. This results in less homogeneous classes, as far as chronological ages are concerned. The number of French pupils having repeated either the fifth grade, or any previous grade, was 51 per cent of the total French fifth grade population in 1960-1961.¹

These differences reflect differences in some of the objectives of French and of American educations. The standards of achievement are quite rigid in each grade of the French schools and pupils are placed in those grades only if they meet such standards. The number of repeaters shows that many pupils need more than five years to finish the elementary grade program. The investigator found very few statements in the French documents consulted concerning the adaptation of the child to other pupils or to society. The social life of the pupil and his relationship to others seems to be a great concern to American educators, and this aim of education is one of the major aims listed in many American statements of

¹ France, Ministère de l'Education Nationale, Informations Statistiques 38 (Mars, 1962), pp. 77-85.

objectives of education. These factors should be taken into consideration when comparing specific aspects of the programs of each country.

Trends in Arithmetic Teaching

As science and mathematics become increasingly important in the modern world, man needs an ever-broader knowledge of mathematics for understanding of his cultural heritage as well as for effective communication. It is evident in practically every phase of modern life that mathematical symbols are an essential aspect of present-day language usage, and that skills in mathematics are now necessary in man's solving even simple quantitative problems of daily living.

Many professions, which in the past did not require a knowledge of advanced mathematics, now require an ability to handle complicated computations or, at least, training in advanced mathematical studies. For example, in such professions as chemistry, medicine, geology, psychology, social science, and physics, mathematical knowledge is essential.

Even the very survival of a nation might well depend upon its scientific and its technical advancement. The need for mathematicians and scientists of any nation to keep pace with those other world powers is indicated daily in reports from both government and industry. The fact that the United States, for instance, is aware of this crucial need for more and better scientists and mathematicians is evidenced by the government's desire to give financial aid to researchers in all related areas of science and mathematics. Also, the establishment of special programs

designed by educators and industrial leaders to discover and train the gifted student, is another of the many indications that this nation is keenly aware of its increasing need for more better-trained persons.

In recognizing the importance of mathematics in all phases of modern life, many educators advocated a heavier emphasis on mathematics in the elementary-school curriculum, as well as in the secondary-school curriculum. James B. Conant,¹ for instance, recommended in 1959, that four years of mathematics be required of all academically talented high school students. William Brownell,² another educator concerned with the importance of mathematics on the elementary-school level, suggested as early as 1945, and in many recent articles,³ that a complete reorganization be undertaken. The subject matter, as well as the method of teaching, would be changed and a revised program would be put into effect in the elementary grades to adapt the elementary mathematics program to the demands of modern living.

In many foreign countries, as well as in the United States, educators are continually trying to discover new ways to raise the level of achievement in arithmetic of elementary-school pupils. The Association for Supervision and Curriculum Development, a department of the National Education Association, acknowledged in 1952 the importance of the "meaning theory" in arithmetic, which was "beginning to have a significant effect on

¹James B. Conant, The American High School Today (New York: McGraw-Hill Co., 1959), p. 57.

²William Brownell, "When Is Arithmetic Meaningful?" Journal of Educational Research, XXXVIII (March, 1945), 481-498.

³William Brownell, "Arithmetic in 1970," National Elementary Principal, XXXIX (October, 1959), 42-45.

classroom practices." This theory "conceives of arithmetic as a closely knit system of understandable ideas, principles and processes." Learning arithmetic meaningfully is believed to provide for more effective teaching by facilitating learning and retaining, and by strengthening skills.¹ Many authors of recent arithmetic textbook series are stressing meaning, formation of concepts, and more pupil participation in discovering arithmetic processes instead of being told about them. Some of these authors, such as H. F. Spitzer,² believe that greater efficiency can be attained with these methods without any radical changes in the arithmetic curriculum, while others, such as the authors of the Greater Cleveland Mathematics Program (GCMP), believe that the contents of the arithmetic curriculum should also be changed because "advanced mathematical concepts can be successfully introduced much earlier than had previously been thought possible or practical."³

Current trends in arithmetic in schools of the United States are toward a more advanced and more challenging program. Experimental programs, such as the ones sponsored by Stanford University and by the University of Illinois, have been attempted recently. These programs offer a new approach to arithmetic and present some arithmetic concepts to the students at an earlier age than were heretofore introduced. The educators involved

¹ Association for Supervision and Curriculum Development, What Research Says About Arithmetic? (Washington, D. C., Association for Supervision and Curriculum Development, 1952), pp. 12-15.

² Herbert F. Spitzer, The Teaching of Arithmetic (Boston: Houghton Mifflin Co., 1961), pp. 341-342.

³ Greater Cleveland Mathematics Program, Educational Council of Greater Cleveland, Press Conference (February 26, 1962), p. 1.

in the GCMP and in the School Mathematics Study Group (SMSG)¹ are currently working on a new series of textbooks which differ from traditional arithmetic textbooks in content and in the way in which the topics are presented to the students. The fourth grade SMSG textbook, for instance, has an extensive treatment of sets and of geometrical figures.

The writer's experience in making certain comparisons between the arithmetic program of French elementary schools and that of American elementary schools, and her deep feeling that some students can accept greater challenges at an earlier age than they are now offered, led to the desire to investigate to find out what differences, if any, existed between these two programs. Differences in grade placements of arithmetic concepts, differences in methods of teaching, and differences in the arithmetic achievements of students in the French and in the American elementary schools are to be investigated. The purpose and design of the investigation are presented in Chapter 2.

¹School of Mathematics Study Group, Mathematics for the Elementary School, Grade 4, Preliminary edition (Stanford, Calif.: Leland Stanford Junior University, 1961).

CHAPTER II

THE PURPOSE AND DESIGN OF THE INVESTIGATION

In most of the studies examined which compared the American arithmetic program with those of foreign countries, the researcher found that the main concern was with achievement made by students rather than with surveys of the arithmetic programs themselves. The chief purpose of such studies was to determine whether the foreign students or the American students achieve greater competency. The purpose of this investigation, on the other hand, was to present a thorough analysis of the French and of the American arithmetic curricula in an effort to reveal essential differences in grade placements of arithmetic concepts and in methods used to teach these concepts. Also, differences in achievements were investigated to discover whether there were indications that differences in grade placements and in methods corresponded to differences in achievements.

The Problem

The chief purpose of this investigation was to determine what differences, if any, existed between the arithmetic programs in the first five grades of the French and of the American elementary public schools. The following hypotheses were formulated:

1. The null hypothesis concerning grade placements was that there are no differences in grade placements of arithmetic concepts in the programs of the French and of the American elementary schools.
2. The null hypotheses concerning methods of teaching were: first, that the techniques used to present and explain the concepts

relating to main arithmetic topics in the French schools are similar to those used in the American schools; and second, that the stress on problems and problem-solving is the same in the schools of both countries.

3. The null hypothesis concerning the achievements of students was that the arithmetic achievement of French students by the end of the fifth grade does not differ from the arithmetic achievement of American students of the same grade, sex, and mental age.

Definitions of Terms

Arithmetic. Webster defines arithmetic as "science of numbers or the art of computation."¹ In this paper, however, the term is used in a broader sense, to designate what is taught in the elementary grades under the course-names of arithmetic, or numbers, or such similar titles. The term arithmetic, as used here, therefore includes concepts from other branches of mathematics such as geometry and algebra.

Arithmetic concepts. The term arithmetic concept has been defined as an "elaboration from sensory data . . . tying together common sensory or perceptual quality in a sensation . . . such as the concept of 5."² There has been much discussion concerning the differences between concepts and skills, and the order in which they should be taught.³ To avoid the distinction between concepts and skills and to facilitate references to

¹ Webster's Universal Dictionary of the English Language (Cleveland, Ohio: World Book Company, 1940), p. 95.

² National Council of Teachers of Mathematics. The Learning of Mathematics, Its History and Practice. Twenty-First Yearbook (Washington, D. C.: The National Council of Teachers of Mathematics, 1953), pp. 82-83.

³ Ibid., pp. 340-341.

them, the investigator is calling an arithmetic concept any mental elaboration, any process or skill involved in the learning of arithmetic. This seems to be the position taken by the authors of the Iowa Tests of Basic Skills as they refer to counting, making change, place value of numbers, and so on, as "concepts."¹

Arithmetic major topics. The term arithmetic major topics is used in this paper to designate general subjects within the field of arithmetic such as addition of whole numbers or decimal numbers.

Relative emphasis. The relative emphasis on certain concepts in a textbook refers to the proportion of textbook-space allotted to these concepts in relation to the total amount of textbook-space.

Procedures

The procedures employed to test the three main hypotheses concerning grade placements, methods of teaching, and achievements are explained here for each part of the investigation.

Differences in Grade Placements of Arithmetic Concepts

To test the hypothesis of no difference in the grade placements of arithmetic concepts of the same difficulty in the French and in the American schools, the investigator made a grade-by-grade comparison of current textbook series used in both countries and proceeded with the following

¹Manual for Administrators, Supervisors, and Counselors. Iowa Tests of Basic Skills (Boston: Houghton Mifflin Company, 1956), pp. 69-70.

steps: (1) A list of current arithmetic textbook series most extensively used in the French and in the American elementary public schools was drawn up, after consulting publishers, textbook representatives and other qualified persons; the list of American textbooks was further tested by sending it to the superintendents of the fifteen states having the largest population; (2) The main arithmetic concepts presented in the textbooks were grouped within fourteen main arithmetic topics after an examination of the classification used in the titles of lessons and the tables of contents of the textbooks investigated; (3) The concepts grouped by major topics, such as the concepts relating to addition of whole numbers, for example, were then classified according to upper level of difficulty and grade placement; addition with sums to six, for instance, was the most difficult addition concept found in a first grade textbook and it would have a grade placement of 1 for this textbook series; the same procedure was followed for the textbooks of each grade and, then, for all the other arithmetic topics; and finally (4) the grade placement of these arithmetic concepts in the French texts was compared with that found in the American texts. This was done first by comparing the concepts presented in each grade of the French and of the American textbook series, and then determining the mean difference between the grade placement of each concept in the French text and the grade placement of the same concept in the American texts, and testing the significance of the difference between these means with the Wilcoxon matched-pairs signed-rank test.

Differences in the Methods Used to Present the Concepts of the Major Arithmetic Topics

The investigation, which was conducted to determine if any differences existed in the methods employed to present the main arithmetic concepts of the major arithmetic topics, was carried out by investigating the methods as revealed in the style presented in the American and the French textbook series previously mentioned, and not by observing classroom teaching. Procedures and devices used to present and explain these concepts were first compared, then the relative emphases devoted to all the concepts of each topic were compared for the French and for the American textbooks.

Procedures and devices employed. The main procedures and devices employed in the French and in the American texts were investigated by analyzing the charts, drawings, and other materials and methods to discover any outstandingly original methods of presenting and explaining arithmetic concepts, which were used in the textbooks of one country and not in the textbooks of the other.

Relative emphases given to the concepts of each topic. The relative emphases devoted to the concepts of each topic were investigated by determining first the number of pages devoted to the concepts relating to each topic in each grade of the French textbook series and in each grade of the American textbook series, second, by converting these numbers of pages into percentages of the total number of pages of either the French or the American texts of each grade, and finally by comparing these percentage figures. The main purpose of this portion of the investigation was to determine whether the concepts relating to certain topics, for instance geometry

concepts, were stressed more in certain grades of the textbook series of one country than in those of the other country.

A final aspect of this investigation of differences in methods was an analysis and a comparison of the relative extents of textbook-space devoted to lessons on problems and on problem-solving techniques in the French and in the American textbook series. This investigation was also done by counting pages and converting the numbers of pages into percentages of total number of pages of the textbook series of each grade.

Achievement Differences Between the French Pupils and the American Pupils

The purpose of the investigation of achievement differences between the French pupils and the American pupils was: (1) to find how the arithmetic achievement of a group of French fifth graders compared to the arithmetic achievement of American fifth, sixth, and seventh graders, as evidenced by norms of achievement for the United States, and (2) how the arithmetic achievement of a group of French fifth graders compared to the arithmetic achievement of a group of American pupils of the same grade, sex, and mental age.

Comparison of the achievement of French fifth graders with that of American fifth, sixth, and seventh graders. The first part of the comparison of achievements involved the following steps: (1) The American achievement test to be used was translated into French; a literal translation was possible, for the most part, although some changes had to be made in the phrasing of certain questions, for example when the price of objects mentioned in the problems was changed from dollars to francs; (2) The

translation of the fifth, sixth, and seventh grade test was administered to a group of French fifth graders; and (3) the results were compared to determine how the arithmetic achievement of the French pupils ranked in comparison with the average achievement of American pupils of the normative sample, as evidenced by tables of percentile norms. This part of the study was a descriptive comparison rather than a statistical analysis.

Comparison of the achievements of French and American fifth graders matched by grade, sex, and mental age. The second part of the comparison involved the following steps: (1) The correlation between the IQ scores of the French intelligence test administered to the French pupils and the American IQ test given to the American pupils was established, and regression line equations to predict one score from the other were calculated; (2) American fifth graders were chosen from a large sample of pupils arranged by alphabetical order and by sex, the first pupil of the same sex having the closest mental age, then also the closest chronological age, was chosen to match each French pupil; and finally results of the achievement test were compared by determining the differences between the mean achievement of the French sample and the mean achievement of the American sample for each of the two parts of the test (Arithmetic concepts and Arithmetic problem-solving) as well as for the total arithmetic test. The standard deviation of each test was computed and a test of significance was used to accept or reject the hypothesis of no difference at the 5 per cent level.

To be able to interpret the results of the investigations of differences in grade placements, in methods of instruction, and in achievements, the researcher investigated the ages of French and of American fifth

graders, and also the lengths of school-time allotted to arithmetic in France and in the United States. The purpose of this investigation was to see whether a grade-by-grade comparison was meaningful.

Age differences were investigated as follows: (1) The frequency distribution of the French sample used in the achievement investigation was figured out and this age distribution was compared to the age distribution of a sample of American fifth graders; (2) the significance of the differences between the means of the two distributions was tested.

Differences in the lengths of time spent on arithmetic in the French and in the American elementary schools were investigated by comparing the average amount of time spent by a French pupil by the end of the fifth grade to the average amount of time spent by an American pupil at the end of the fifth grade. The official schedule of the French Ministry of Education was consulted for the French schools, and researches in the field were consulted for the American schools.

Limitations of the Study

The basic assumption of this study was that most elementary-grade teachers tend to follow closely their arithmetic textbooks, and that the program taught, and most of the methods of instruction employed, do not differ essentially from the programs and methods presented in the textbooks. The program followed by the majority of elementary public schools in the United States was the only one considered. Experimental programs in public schools such as those followed in Palo Alto, California, or in

St. Louis, Missouri, programs in nongraded schools, in parochial or in other private schools were not investigated.

CHAPTER III

DIFFERENCES IN THE GRADE PLACEMENTS OF ARITHMETIC CONCEPTS IN FRENCH AND IN AMERICAN ARITHMETICS OF GRADES ONE TO FIVE

The initial step in this investigation of differences between the French and the American arithmetic programs in the first five grades of the elementary schools was an examination of differences in grade placements of the main arithmetic concepts, as evidenced by their placements in current arithmetic series.

Method of Selection of the Textbook Series

The first problem for the researcher was to select for investigation the textbook series most extensively used in the French and in the American elementary public schools.

The French textbook series. It was a simple matter to determine which were the most commonly used, current series in France, for there are only six main textbook publishers in France, some of whom do not publish arithmetic textbooks. In consulting these six publishers, as well as the managers of the largest book stores in Paris, the investigator found that only two textbook series were used extensively in the French schools. Each of the series has been assigned a code number to simplify future references to it throughout the paper. These series are:

F1. The Hachette Series. L. Vassort and M. Vassort, Le Nouveau Calcul Vivant (Paris: Hachette, 1961). This is the most widely used series.

F2. The Armand Colin Series. A. Adam, E. Ochsenbein, and

T. Gouzou, Arithmetique (Paris: Armand Colin, 1961). Grades Two to Five only. The Hachette series, grade one, is used most of the time in schools using the Armand Colin series grade Two to Five.

The American textbook series. The investigator found that it was much more complicated to determine the most widely used arithmetic series in the American elementary public schools, not only because of the great number of textbooks published in the United States, but also because of the difficulty in obtaining information concerning the estimated number of textbooks sold by the main arithmetic publishers. Such information is regarded as confidential by the publishers, being released to only such persons as authors and editors, who are immediately involved with the works published.

Consequently, the investigator consulted textbook representatives from seven well known publishing companies, together with professors from three of the largest teachers' colleges in the United States. From these sources, she compiled a list of ten titles of the arithmetic textbook series most widely used in the United States. There appeared to be no way to reduce the number of titles in this list, for their order of importance seemed to vary according to the authority consulted. The list of ten arithmetic series, which were the selections agreed upon by all the sources mentioned above, became the test-list for this study. It appears below:

- T1. American Book Series. C. B. Upton and K. G. Fuller, First Days with Numbers (Grades 1-2), American Arithmetic (Grades 3-5), (New York: American Book Company, 1960).
- T2. Ginn Series. G. T. Bushwell, W. A. Brownell, and I. Sauble, Numbers We Need (Grades 1-2), Arithmetic We Need (Grades 3-5), (Boston: Ginn and Company, 1959-1961).

- T3. Harcourt, Brace, & World Series. J. R. Clark, and others. One by One (Grade 1), Two by Two (Grade 2), Growth in Arithmetic (Grades 3-5), Discovery edition (New York: Harcourt, Brace, and World, Inc., 1962).
- T4. Heath Series. J. W. Wrightsone and others, Learning To Use Arithmetic (Boston: Heath and Company, 1962).
- T5. Laidlaw Series. E. T. McSwain, L. E. Ulrich, and R. J. Cooke, Arithmetic (Grades 1-2), Understanding Arithmetic (Grades 3-5) (River Forest, Illinois: Laidlaw Bros., Inc., 1959-1962).
- T6. Merrill Series. T. J. Durell, A. P. Hagaman, and J. H. Smith, Arithmetic for Today (Columbus, Ohio: Charles E. Merrill Books, Inc., 1962).
- T7. Scott, Foresman Series. M. L. Harting, H. Van Engen, and L. Knowles, Our New Number Workshop (Grades 1-2); Seeing Through Arithmetic (Grades 3-5), (Chicago: Scott, Foresman and Company, 1957-1960).
- T8. Silver Burdett Series. R. T. Morton and M. Gray, Making Sure of Arithmetic (Morristown, N. J.: Silver Burdett Company, 1958).
- T9. Webster Series. J. Osborn, A. Riefling, and H. F. Spitzer, Exploring Arithmetic (St. Louis, Missouri: Webster Publishing Company, 1961-1962).
- T10. Winston Series. L. J. Brueckner, E. L. Merton, and F. E. Grossnickle, Ready To Begin Numbers (Grade 1); Using More Numbers (Grade 2); Making Number Discovery (Grade 3); Reaching Number Goals (Grade 4); Using Number Ideas (Grade 5), (New York: Winston--Division of Holt, Rinehart, and Winston, Inc., 1960-1961).

The next step in this investigation was to test this list further by sending it, with a questionnaire, to state superintendents of public instruction, in the fifteen states of the United States having the largest populations.¹ These states represented a total population of about 110,000,000. Each superintendent was asked to indicate whether the titles

¹Appendix D.

of the most widely used arithmetic series in the schools of his state were included in this list of ten titles. If not included in the list, he was requested to list and to return titles with the completed questionnaire.

There were no responses from the superintendents of public instruction of two of these fifteen states, and from three other states, the replies indicated that the necessary information was not available because there was no statewide textbook-adoption policy, therefore, no record kept of textbook distribution in these states. Superintendents from ten of the fifteen states responded with helpful information.¹ These ten states, incidentally, represented a total population of almost eighty million people; thus, they served as a representative segment of the population for this study. According to the responses, the investigator found that the most widely used arithmetic textbook series were among those included in her list of ten series.

For this study, the investigator used the most recent editions available of these ten series, or in such instances that newer editions were published, she made certain the changes were only minor ones before settling upon the editions which she actually used for this investigation.² Editions in process of publication at the time this study was begun were not used.

¹The ten states from which responses to the questionnaire came were: California, Pennsylvania, Illinois, Texas, Michigan, New Jersey, North Carolina, Tennessee, Georgia, and Florida. The superintendent from Pennsylvania mentioned several other textbooks which were growing in popularity in his state.

²The investigator received letters from the publishers stating that a 1961 or a 1962 edition had been printed but was almost identical to the previous one.

Classification of Arithmetic Concepts
Under Topic Headings

All of the main arithmetic concepts presented in the two French series and in the ten American series were then classified under specific topic headings. It was found that all of the concepts taught could be grouped in the following categories:

1. Number System
2. Addition of Whole Numbers
3. Subtraction of Whole Numbers
4. Multiplication of Whole Numbers
5. Division of Whole Numbers
6. Fractions
7. Decimal Numbers
8. Geometry and Geometrical Measurements
9. Measures
10. Graphs
11. Ratio
12. Per Cent
13. Scale Drawing
14. Terms and Other Topics

The investigator has used the nomenclature that most authors of arithmetic textbooks employ in their tables of contents and in their titles of lessons. The concepts related to each one of these topics were examined in turn, to determine what level was attained in every area of arithmetic considered, and this procedure gave an over-all survey of the arithmetic program presented in the textbooks examined.

Grade Placements of Arithmetic Concepts in the French
and in the American Arithmetic Textbooks

A grade-by-grade investigation of the arithmetic concepts presented in the French and in the American arithmetic textbooks was made to determine the differences in the challenges offered to the French and to the

American students are each grade-level.

The researcher examined each arithmetic series, from grade one to grade five of the French series--F1 and F2, and each of the American series--T1 to T10--to discover the most difficult concept presented, or, in other words, the most advanced level reached in each category, beginning with the Number System. The examination revealed that the different levels attained for the Number System varied, from the understanding of numbers from one to one-hundred, in some of the first-grade arithmetic textbooks, to the understanding of numbers to the twelfth-place, in two fifth-grade arithmetic textbooks. The same procedure was followed to determine the levels attained for all of the other categories. The results are presented in Appendix A, wherein the grade-placement of each level has been tabulated for every textbook series investigated for this study.

The investigator found the grade placements of arithmetic concepts in the two French series to be almost identical; this finding was to be expected, however, for all textbooks used in the French public schools follow the official program, which is planned in detail by the French government. The grade placements of arithmetic concepts in the ten American series showed some variations, but no series showed a consistently higher or a consistently lower grade placement. The difference in grade-placement was never more than one grade, with the exception of two concepts--the concept of sub-group in multiplication and division, and the introduction to geometry, where greater differences were observed between the American series. For this reason, the investigator only considered the prominent grade-placement of the major arithmetic concepts in the American series

in the descriptive part of the study. The level of difficulty attained in the French texts of a certain grade was compared to the level of difficulty attained in most of the American texts of the same grade, as represented by a level attained in at least sixty per cent of these textbooks. The second part of the grade-placement comparison, however, was made from the standpoint of the grade placement of each concept representing an upper level of difficulty attained in a textbook, and every American text was considered for this part of the comparison. The null hypothesis was tested at this time.

Results of the investigation of grade placement of main arithmetic concepts in the French and in the American series are set forth in the following section. The concepts presented in each grade, representing the level attained in the arithmetic texts, are presented and compared first; then, the average grade placement of the concepts representing upper levels of difficulty are given and compared for the French series and for the American series. This is the procedure followed for each of the fourteen topics: the number system, the addition of whole numbers, the subtraction of whole numbers, the multiplication of whole numbers, the division of whole numbers, fractions and mixed numbers, decimal numbers, measures, graphs, ratio, per cent, scale-drawing, terms, and other topics.

The Number System

The number-system concepts presented in each grade were as follows:

Grade One. The French and the American first-grade arithmetics present sequential counting, reading, writing, and understanding of numbers from one to one hundred.

Grade Two. The American arithmetic textbook series cover these same concepts to two hundred; whereas, the French arithmetic textbook series include numbers to 9,999, with meaning of place-value of hundreds and thousands.

Grade Three. Three digit numbers are studied in the American arithmetic textbooks; whereas, the French texts cover seven-digit numbers.

Grade Four. The American arithmetic textbooks present six-digit numbers; whereas, the French arithmetic texts present nine-digit numbers.

Grade Five. Nine-digit numbers are presented in the American arithmetic textbooks; twelve-digit numbers are presented in the French texts.

Differences in the levels of number concepts presented in each grade of the French and of the American arithmetic series. It was found that although there are no differences in the level of number-concepts presented in the first-grade arithmetic textbooks in France and in the level of number-concepts presented in the first-grade textbooks in the United States, there is a difference of over one figure in the numbers studied in the second-grade. Also, there is a difference of three to four figures in the numbers studied in the other grades, the French arithmetic textbooks presenting the larger numbers in the other grades. With the exception of the concepts presented in the first-grade, the concepts presented in any one grade of the French arithmetic program are not presented until one year later (for grade four), or until over a year later (for grades two and three) in the American textbook series. The differences between the French and the American grade placements are illustrated in Figure 1, in which the ordinate represents the level of the number-concept presented (in number of digits in number studied), and the abscissa represents the grade considered.

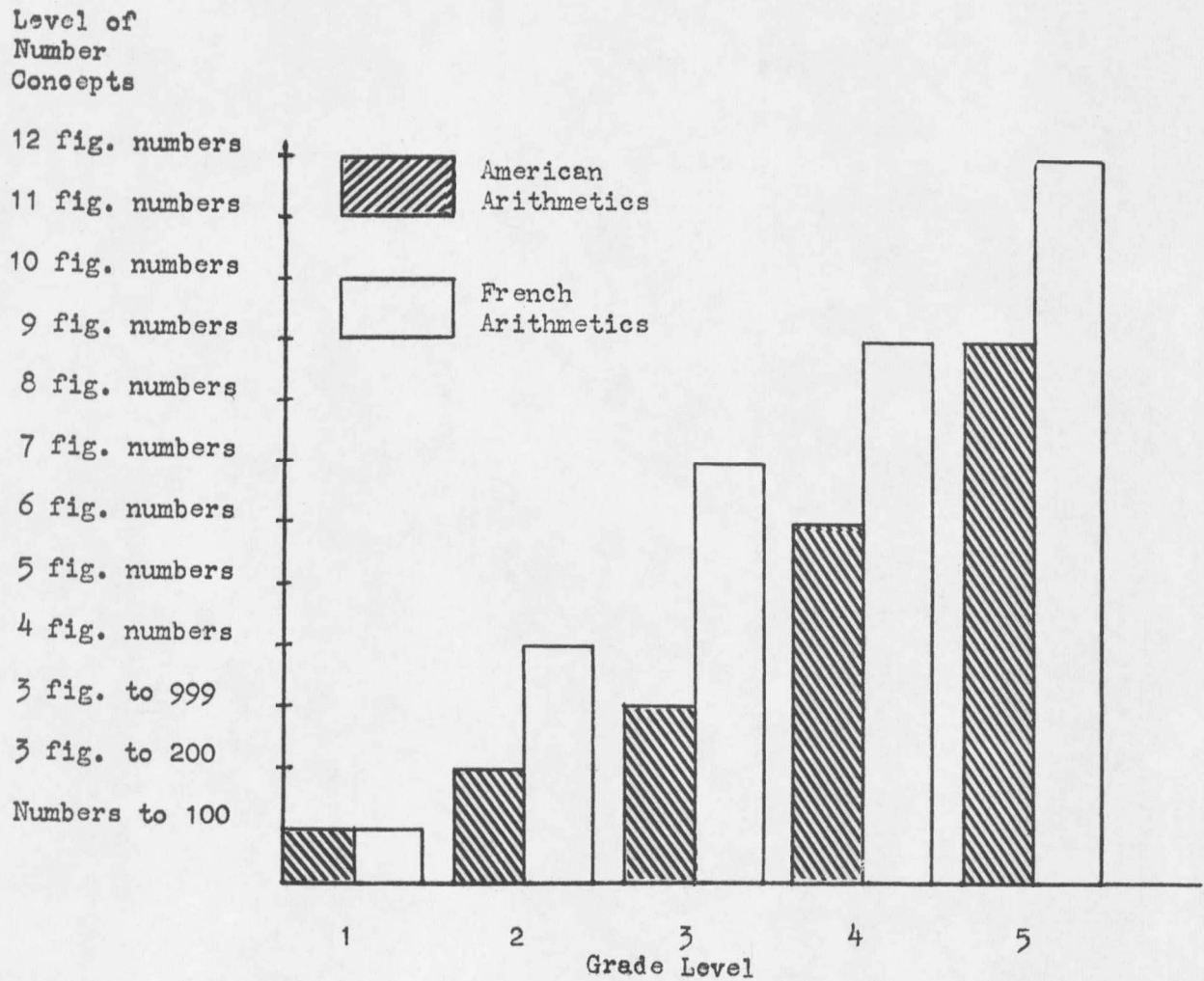


Figure 1. Differences in the Grade Placement of the Number System Concepts in the French and in the American Arithmetic Textbook Series

Differences between the average grade placements of number concepts in the French and the American arithmetic texts. The grade placement of each concept representing an upper level of difficulty is shown in Appendix A, together with the average American grade placement and the average French grade placement for this concept and the difference between these two averages. Only grade placements of concepts presented in all of the American textbooks and in the French textbooks could be compared in this manner, grade placements of concepts presented in the French texts but not yet presented in the American fifth grade texts could not be compared. The average grade-placement difference for number concepts between the French and the American textbooks was + .9 grade, the plus sign indicating a positive difference when the French mean grade placement was subtracted from the American mean grade placement.

Addition of Whole Numbers

The main concepts related to the addition of whole numbers covered in the first five grades of the French and the American textbook series are as follows:

Grade One. All of the arithmetic textbooks concerned cover the meaning of addition, the + sign, and some of the addition-facts, but the American arithmetic textbooks present the addition-facts (or sums of single-figures to 9 or 10); whereas, the French textbooks present all of the facts (to 18), and additions of two-digit numbers with carrying.

Grade Two. The American arithmetic textbooks present the addition-facts and the additions of two-digit numbers without carrying; the French textbooks, on the other hand, cover additions of four-digit numbers with carrying.

Grade Three. Additions of three-digit numbers with carrying twice

are presented in the American texts, addition of six-digit numbers with carrying several times are covered in French texts.

Grade Four. The American arithmetics include additions of two or more four-digit numbers, the French arithmetics include two or more nine-digit numbers.

Grade Five. Five-digit number additions are presented in the American texts, twelve-digit number additions in the French texts.

Differences in the levels of addition of whole number concepts in each grade. The investigator considered next the differences in grade placement for the concepts of the addition of whole numbers, presented in the first five grades of the French and the American arithmetic textbook series. She found that the addition-concepts presented in French first-grade textbooks were more difficult than the addition-concepts presented in the American first-grade texts, and that the concepts presented in the French second-grade textbooks were comparable with those presented in the American fourth-grade arithmetic textbooks.

Noticeable differences were also found in the third-grade arithmetic textbooks of each country. The level of addition-concepts presented in the French third-grade texts was not yet reached in the American fifth-grade arithmetic textbooks. These differences in the grade placement of the addition of whole-number concepts are illustrated in Figure 2, in which the level of difficulty of the addition has been plotted on the ordinate, and the grade investigated has been plotted on the abscissa.

Differences between the average grade placements of concepts of addition of whole numbers in the French and in the American texts. The mean difference between the grade placements of concepts of addition of whole numbers in all of the French texts and the grade placements of the

same concepts in all of the American texts was +1.1 grades.

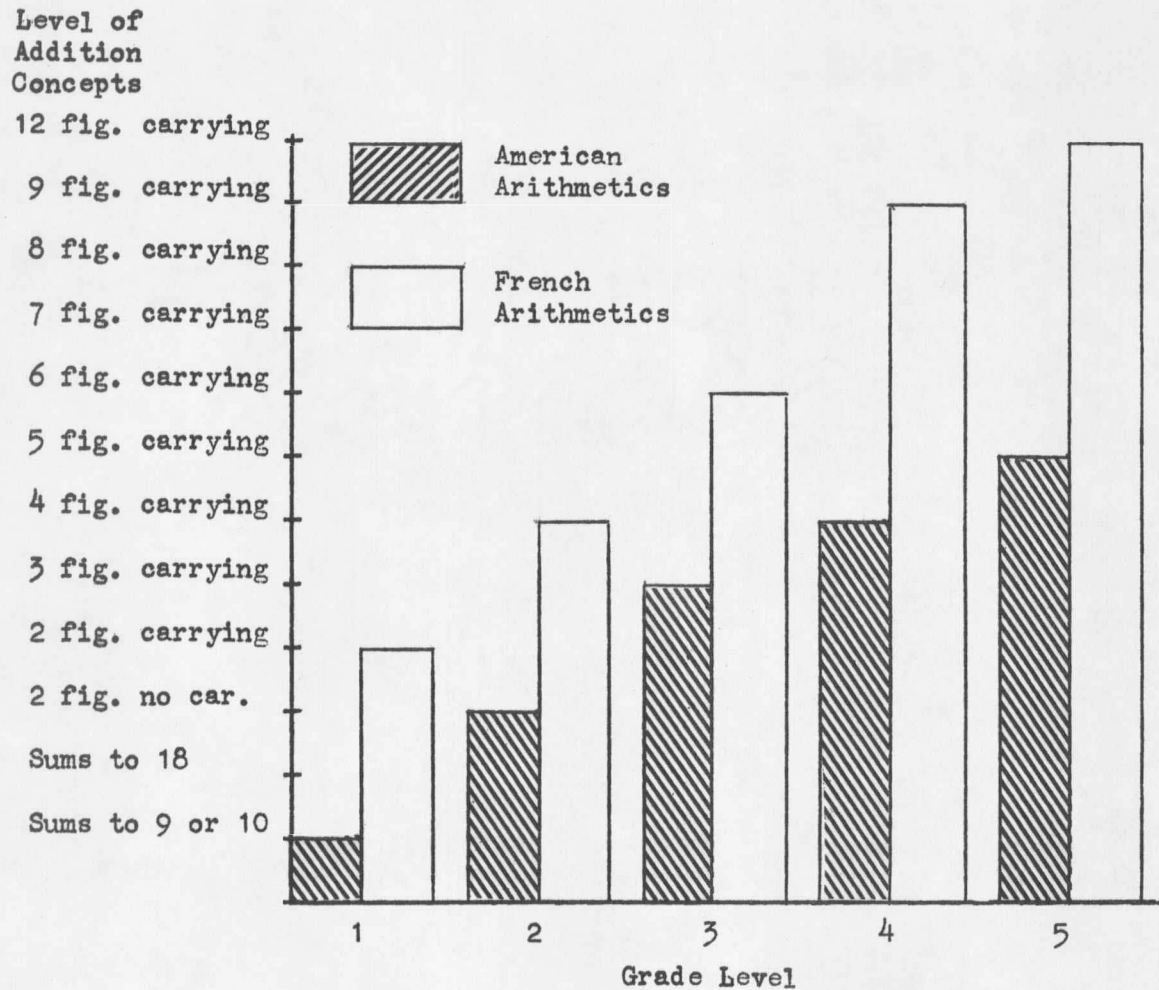


Figure 2. Differences in the Grade Placement of the Addition of Whole Number Concepts in the French and in the American Textbook Series

Subtraction of Whole Numbers

The concepts related to the subtraction of whole numbers were the next factor considered by the researcher. The differences in the challenges offered to the French and to the American students at each grade level for the subtraction of whole numbers are very similar to those found for the addition of whole numbers. They are as follows:

Grade One. The American arithmetic textbooks cover the meaning of subtraction, the minus sign, and subtraction facts up to a minuend of 10. The French arithmetic texts cover all subtraction-facts and the subtractions of two-digit numbers with borrowing.

Grade Two. All subtraction-facts of single numbers and subtractions of two-digit numbers are covered in the American texts; whereas, subtractions of three-digit numbers with borrowing are presented in the French arithmetic texts.

Grade Three. American arithmetic texts include subtractions of three-digit numbers with borrowing. French arithmetic texts cover subtractions of six-digit numbers.

Grade Four. Four-digit subtractions with borrowing are presented in the American arithmetic textbooks; whereas, nine-digit subtractions are presented in the French textbooks.

Grade Five. Whereas the American arithmetic texts present five-digit subtractions, the French texts present twelve-digit subtractions in this grade.

Differences in the level of subtraction of whole number concepts in each grade. Differences in the challenges offered to the French students and to the American students at each grade-level for the subtraction of whole numbers, as evidenced by the grade placement of the subtraction-concepts, are similar to those found for the addition of whole numbers because these two topics are, of course, related. It is significant to point out, however, that the subtraction-concepts presented in the French first-grade

arithmetic textbooks are more difficult than are the subtraction-concepts presented in the second-grade American arithmetic textbooks, and that the subtraction-concepts presented in the French third-grade texts are more difficult than are those presented in the American fifth-grade texts. These differences in the grade placement of the concepts are illustrated in Figure 3.

**Level of
Subtraction
Concepts**

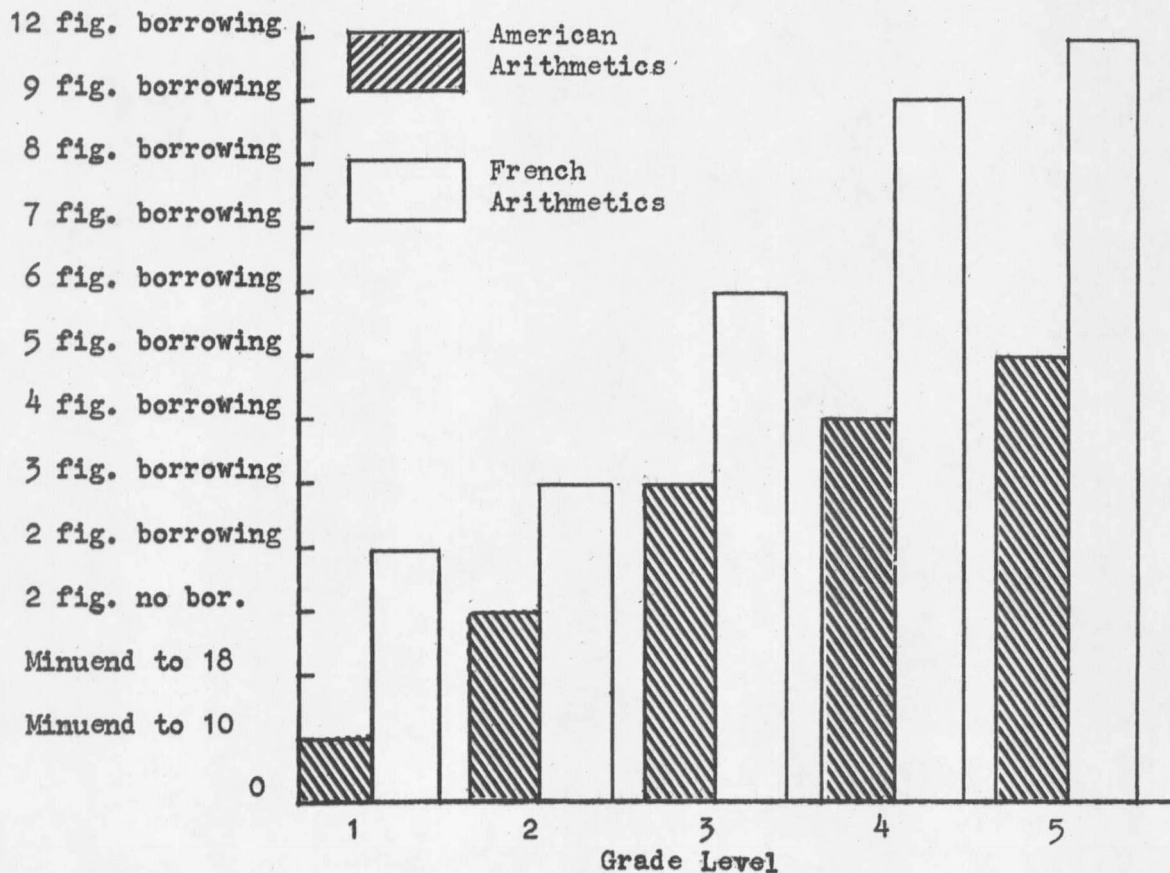


Figure 3. Differences in the Grade Placement of the Subtraction of Whole Number Concepts in the French and in the American Textbook Series

Differences between the average grade-placements of concepts of subtraction of whole numbers in the French and in the American texts. The mean difference between the grade placements of concepts of subtraction of whole numbers in the French texts and the grade placements of the same concepts in the American texts was + 1.0.

In the following two sections of this paper, the researcher records the results of the grade-placement investigation of concepts related to the multiplication of whole numbers, and of concepts related to the division of whole numbers.

Multiplication of Whole Numbers

The concepts concerning the multiplication of whole numbers, which are presented in each of the texts for the five grades in the French and in the American arithmetic programs, are as follows:

Grade One. Multiplication is not taught in the American first-grade; therefore, not presented in the American textbook series. The only concept taught, which is somewhat related to multiplication, is counting by 2 and by 5. The French arithmetic textbooks, on the other hand, present the multiplication-facts of single numbers by 2, 3, 5, and 10, as well as multiplication with carrying of any two-digit number by 2, 3, 5, and 10.

Grade Two. At this grade level, the American arithmetic texts introduce multiplication by showing in only a very general manner how many equal subgroups some single-place numbers might have--the number "6," for instance, being composed of three groups of 2's. The French textbooks present multiplication-facts of all single numbers and of 10, as well as multiplication of two-digit or three-digit numbers by two-digit numbers with carrying.

Grade Three. In the American arithmetic texts, some of the multiplication-facts of single numbers are covered (either

multiplication by 1, 2, 3, and 4, or multiplication of all single numbers up to a product of 30, 36, or 38). Also covered in the American texts is multiplication of three-digit numbers by one figure involving the facts studied, with carrying. The French arithmetic texts present multiplication of six-digit numbers by two-digit numbers with carrying several times.

Grade Four. The American arithmetic textbook series present multiplication of two-digit numbers by two-digit numbers; whereas, the French arithmetic texts present four-digit numbers multiplied by four-digit numbers.

Grade Five. Multiplication of four-digit numbers by two-digit numbers are covered in the American arithmetic texts for the fifth-grade. The French arithmetic texts, on the other hand, present multiplication of four-digit numbers by six-digit numbers.

Differences in the levels of multiplication of whole numbers concepts for each grade. Differences in grade placements of concepts related to the multiplication of whole numbers in the French and the American textbook series are greater than the differences found for the other arithmetic topics considered thus far. Whereas the American arithmetic texts present no multiplication concepts whatsoever in the series for the first grade, and only an introduction to multiplication in the second-grade series, the French second-grade arithmetic texts cover multiplication concepts similar to those presented in the American fourth grade. The multiplication concepts presented in the French arithmetic textbooks are already more advanced by the end of the third grade than the multiplication concepts presented in the American fifth-grade arithmetic textbook series. An important factor to understand, however, is that some of the concepts which are presented in the first- and second-grade French arithmetic textbooks--those concepts showing related facts between the four operations of addition, subtraction, multiplication, and division--cannot be introduced in the American arithmetic texts for the first and second grade because

the American arithmetics texts for the these grades do not provide the presentation of multiplication and division concepts until later on in the elementary grades. The grade-placement differences which have just been presented are illustrated in Figure 4.

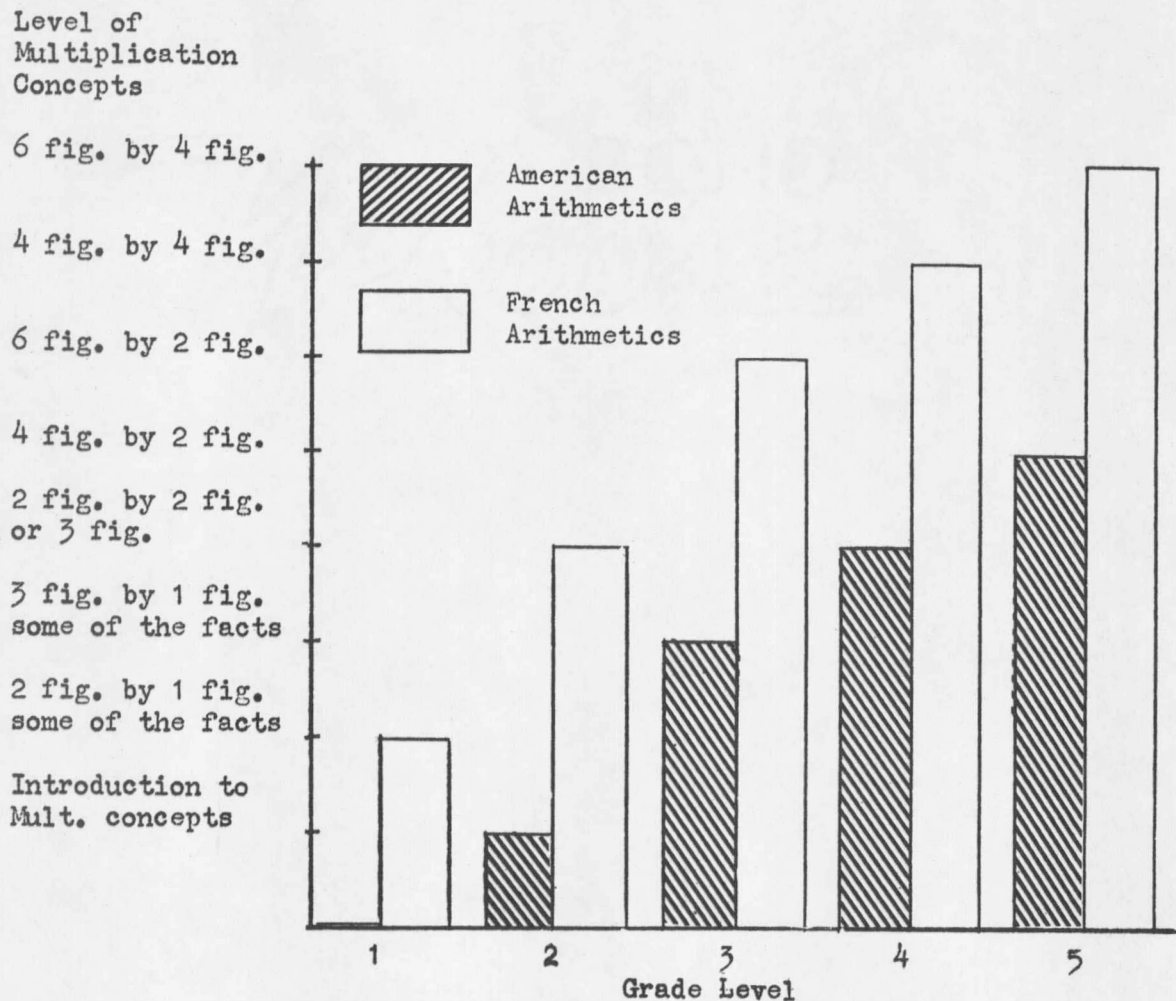


Figure 4. Differences in the Grade Placement of the Multiplication of Whole Number-Concepts in the French and in the American Arithmetic Textbook Series

Differences between the average grade-placement of concepts of multiplication of whole numbers in the French and in the American texts.

The mean difference between the grade placements of concepts of multiplication of whole numbers in the French texts and the grade placements of the same concepts in the American texts was + 1.9 gradeq.

Division of Whole Numbers

The concepts relating to the division of whole numbers, presented in the first five grades of the French arithmetic textbook series and the first five grades of the American arithmetic textbook series, are as follows:

Grade One. The American arithmetic texts do not introduce division at this grade-level, but the French arithmetic texts do cover some of the division-facts (by 2, 5, and 10), and the division of two-place numbers by 2, 5, and 10, with remainder.

Grade Two. Divisions are introduced, in the American arithmetic series for this grade, only as a search for equal subgroups. In the French arithmetic texts, divisions are presented--to three figures by one figure, with a three-figure quotient, borrowing and remainder.

Grade Three. The American arithmetic textbook series for this grade level present divisions of three figures by 1, 2, or 3 (or other figures with a dividend not larger than 38), with no borrowing and no remainder. The French texts present divisions of six-digit numbers by two-digit numbers with borrowing and remainder.

Grade Four. Division of three or four-digit numbers by any one-place number with borrowing and remainder are presented in the American arithmetic texts; whereas, the French arithmetic texts present divisions of seven or eight figures by two to five-digit numbers.

Grade Five. The American arithmetic series for this grade level present division of four or five-digit numbers by two-digit numbers. The French arithmetic texts for this level review the concepts which were to have been learned in the fourth-grade.

Differences in the levels of division of whole number concepts in each grade. Differences in the grade placements of the concepts related to the division of whole numbers in the French and in the American textbook series are comparable to the differences found for the multiplication of whole numbers because these two areas of arithmetic are taught in similar ways. By the end of the second-grade in American schools, the texts have presented an introduction to division; whereas, at the same grade level in France, the texts have advanced in their presentations to the more difficult concepts in division, such as the borrowing and the remainder-concepts. The division concepts presented in the French arithmetic texts for the third grade are more advanced than the division concepts presented even in the fifth-grade American textbooks. These grade-placement differences are shown in Figure 5.

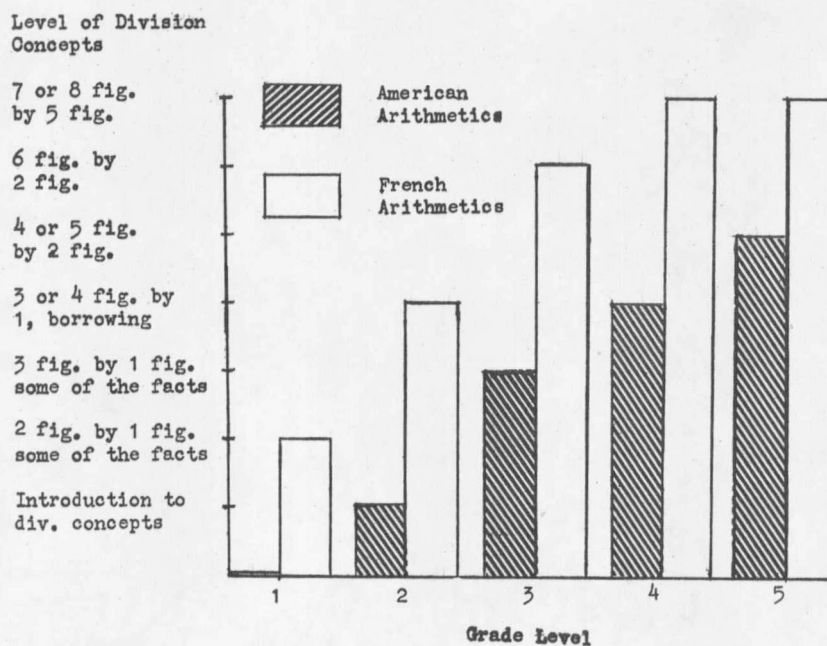


Figure 5. Differences in the Grade Placement of the Division of Whole-Number-Concepts in the French and in the American Arithmetic Textbook Series

Differences between the average grade-placement of concepts of division of whole numbers in the French and in the American texts. The mean difference between the grade placements of concepts of division of whole numbers in the French texts and the grade placements of the same concepts in the American texts was exactly the same as the difference found for multiplication of whole number concepts: +1.9 grades.

Upon completing the grade-placement investigation of concepts related to addition, subtraction, multiplication, and division of whole numbers, the researcher turned to the problem of investigating the concepts related to fractions. The section which follows immediately is a report on her findings concerning these concepts and their differences in grade-placement in the French and in the American arithmetic textbook series.

Fractions

The concepts related to fractions are presented in the French and in the American arithmetic textbook series as follows:

Grade One. The only fraction-concept presented in the American textbooks, as well as in the French texts, is understanding and writing the fraction--one-half.

Grade Two. The American and the French textbooks cover the fractions, one-half and one-fourth.

Grade Three. The American arithmetic texts review the fractions, one-half, one-fourth, and they introduce one-third. The French textbooks, on the other hand, cover all single-unit fractions to one-ninth.

Grade Four. All single-unit fractions and multiple-unit fractions (three-fifths, four-fifths, and so on) are presented in the American arithmetic texts, as well as the comparison of fractions as an introduction to the addition and subtraction of like fractions. At this grade-level, the French texts cover the

addition and the subtraction of any two like fractions.

Grade Five. At this grade-level, the American and the French textbooks cover comparable matter--the addition and the subtraction of like and unlike fractions, the mixed numbers, the reduction to a common denominator, and the fractional quotient in division

Differences in the level of fraction concepts in each grade. The grade-placements of concepts relating to fractions in the French and in the American arithmetic textbook series differ less than the grade placements of concepts relating to the four preceding topics. No differences were found for the fraction concepts presented in the first and second grades. The concepts presented in the French third and fourth grades were somewhat more difficult than were those presented in the corresponding grades in American schools, but the same degree of difficulty was again attained in French and in American textbooks at the fifth-grade level. These differences are illustrated in Figure 6.

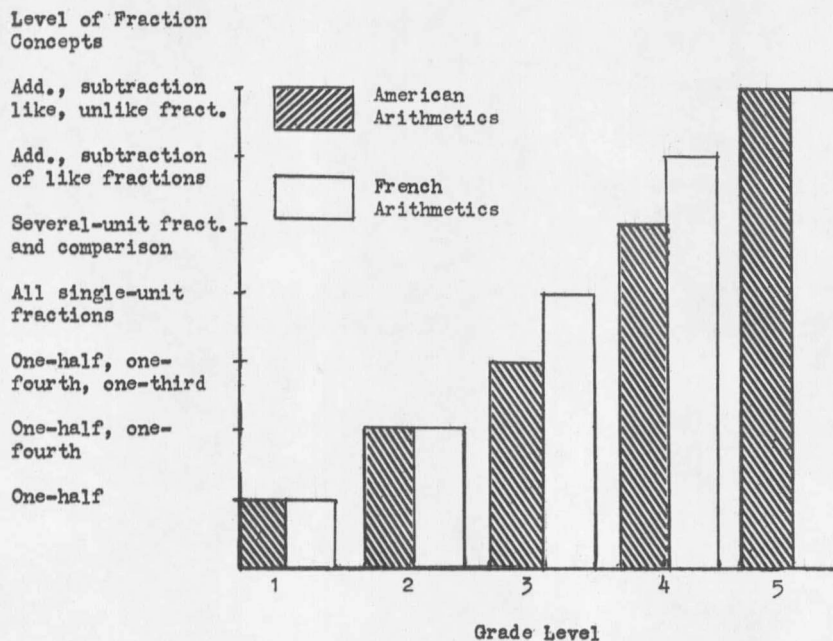


Figure 6. Differences in the Grade-Placement of Fraction Concepts in the French and in the American Arithmetic Textbook Series

Differences between the average grade-placement of concepts of fraction in the French and in the American texts. As could be expected, the mean differences between the grade placements of fraction concepts in the French texts and the grade placement of those concepts in the American texts was very small; it was only +.25 grade.

After having completed her investigation of the concepts relating to fractions, the researcher began a similar examination of the concepts relating to decimal numbers.

Decimal Numbers

Decimal-number concepts are not introduced in the American arithmetic textbook series until the third-grade texts, but are not presented in the French textbook series until the fourth-grade. Here is an interesting variation in the grade-placement of an arithmetic concept. As it has been shown in the preceding pages, the arithmetic concepts considered were generally presented at an earlier grade level in the French textbook series than they were in the American series, but in the case of the decimal numbers, the American textbooks introduce the relative concepts a grade-level earlier. The concepts examined were as follows:

Grade Three. The American arithmetic textbooks cover decimal money-numbers and the four operations with money-numbers. The French arithmetic texts do not introduce decimal numbers on the third-grade level.

Grade Four. The study of money-decimals and their four operations is continued in the American arithmetic texts for the fourth-grade. The French arithmetic texts present a complete coverage of all decimal numbers to the thousandths, involving numbers smaller than 1, decimal quotient of whole numbers, multiplication and division of decimal numbers by 10 to 10,000.

Grade Five. The American arithmetic textbooks for this level cover decimals other than money-numbers, the changing of a fraction to a decimal, the addition and the subtraction of decimals to hundredths, with numbers not smaller than one. The French texts introduce no new concepts at this grade-level, but review the concepts presented in the fourth-grade.

Differences in the levels of decimal number concepts for each grade.

Although the decimal-number concepts are presented in the American arithmetic textbook series at a grade-level earlier than the same concepts are presented in the French arithmetic texts, much more difficult concepts are presented in the French series at the fourth and fifth-grade levels than in the American texts for comparable levels. These differences are illustrated in Figure 7.

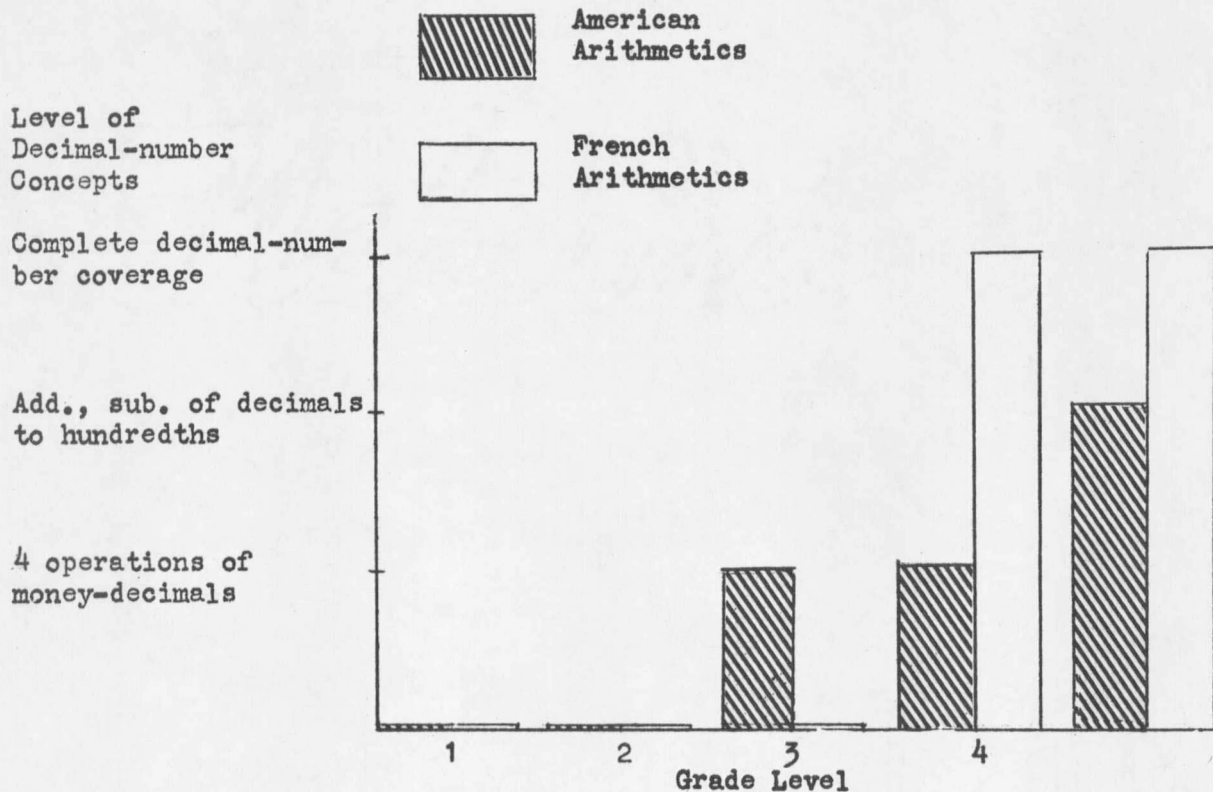


Figure 7. Differences in the Grade-Placement of Decimal Number Concepts in the French and in the American Arithmetic Textbook Series

Differences between the average grade placement of decimal number concepts in the French and in the American texts. Only one level the easiest level of difficulty for decimal numbers: money decimals, could be compared for grade placement differences because it was the only concept presented in all of the American textbook series as well as in the French series. For this concept the mean difference between the grade placement in the French texts and the grade placement in the American texts was -2.1 grades, the American series presenting it sooner than the French series. The more difficult concepts, which were presented in the French fifth grade were not presented in some of the American fifth grade texts, so the difference could not be figured out.

Geometry and Geometrical Measurements

The differences in the challenges offered in the French and in the American arithmetic texts for geometry and geometrical measurements are greater than for any other topic thus far considered. The concepts relating to geometry, in the American arithmetic textbook series, are of an introductory nature, up to the text for the fifth-grade; whereas, geometrical concepts are presented in a gradual sequence, made progressively more difficult, from the first-grade texts on, in the French arithmetic series. The specific differences found are as follows:

Grade One. Five out of the ten American texts present an introduction to basic geometrical shapes such as the circle, the square, the triangle and the rectangle. The French arithmetic text presents these same concepts. The other five American texts do not present any geometrical concepts. This is the only case where there was no prominent grade placement in the American series, and the level for this grade has been plotted in Figure 8 half-way between the first and the second level.

Grade Two. At this grade level the American texts do not present geometric concepts. The French texts cover the definition and the basic properties of lines and angles, as well as the review of the basic shapes presented in the previous text. The properties of the circle, the perimeter of the square, of the rectangle and of the triangle are also presented.

Grade Three. The American arithmetic series present an introduction to basic shapes, at this grade-level; whereas, the French textbooks present the perimeter of the circle and the area of the square, of the rectangle and of the cube. The volume of the cube is also introduced.

Grade Four. The American arithmetic series continue with the presentation of basic shapes; whereas, the French texts cover the area of the circle and the rectangular prism, and the volume of the cube and rectangular prism.

Grade Five. The perimeter and the area of the square and the rectangle are presented at this level in the American texts. More advanced geometrical concepts are presented at this level, however, in the French-texts--concepts of plane and solid figures, such as the volume of the right prism and the cylinder.

Differences in the levels of concepts of geometry and geometrical measurements for each grade. The grade placements of concepts relating to geometry and geometrical measurements in the French and in the American texts differ from the first-grade on. The American arithmetic series do not advance beyond an introductory level, even by the end of the text for the fourth-grade; whereas, the French arithmetic textbook series present geometrical concepts in a gradual sequence of difficulty from the first-grade on. The geometrical concepts presented in the American fifth-grade texts are not any more difficult than those presented in the French third-grade texts. These differences in grade placement are illustrated in Figure 8.

Differences between the average grade-placement of concepts of geometry and geometrical measurements in the French and in the American

texts. The mean difference between the grade-placements of the concepts of geometry and geometrical measurements in the French texts, and the grade-placements of these same concepts in the American texts was greater than for any topic considered so far, as it could be expected; it was +2.1 grades.

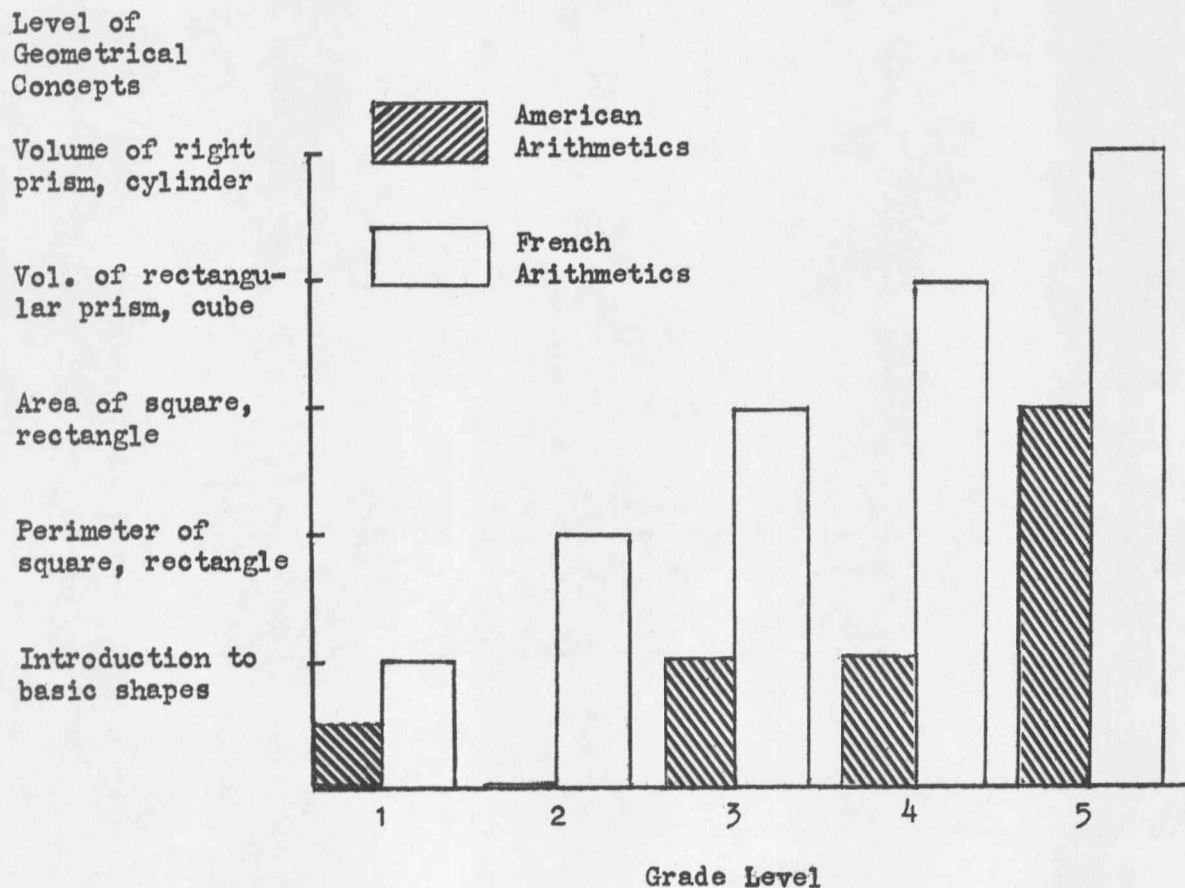


Figure 8. Differences in the Grade Placement of Concepts of Geometry and Geometrical Measurements in the French and in the American Arithmetic Textbook Series

In the following pages of this chapter, the six remaining arithmetic concepts are discussed, but only very briefly, either because they are not introduced until the upper grade-levels, as this was the case for four topics, or because the comparison was complicated by cultural differences between France and the United States, as this was the case for two topics. The six subjects are: measures, graphs, ratio, per cents, scale-drawing, terms, and other topics.

Measures

The researcher did not attempt a detailed investigation of the differences in grade placement of concepts related to measures in the French and in the American arithmetic textbook series because of the difficulty involved in comparing the decimal-system measures used in France and the system of measures used in the United States. Common measures are presented in the French and in the American texts for the first-grade through the fifth-grade. Linear measures, such as the inch and the centimeter, the pound and the kilogram, are introduced in the first-grade and the second-grade texts; whereas, in the third-grade texts, larger and smaller units of measurement are introduced. The French arithmetic texts present the very small and the very large units, such as one-thousandth of a liter and one-thousand liters, but the differences may be caused by the differences in the measuring systems. It is probably relatively easy for the French student to learn a great range of decimal units of measurement, once he has mastered the decimal system, so the comparison might not have been fair to the American student.

Graphs

There are no really noticeable difference in the grade placement of the concepts relating to the graph in the French and in the American arithmetic textbook series. The graph is not introduced until the fourth-grade. Grade-placement concepts are as follows:

Grade Four. Charts, bar-graphs, and line-graphs are not introduced in the American arithmetic texts for this grade-level, but all three concepts are presented in the French texts for this grade-level.

Grade Five. Charts, bar-graphs, and line-graphs are presented in the American arithmetic texts for this grade-level, and are reviewed and continued in the French text for this level.

Thus, it is seen that the French texts introduce the study of graphs one grade-level earlier than do the American texts, but the texts of both countries present the same concepts at the fifth-grade level because no new concepts are introduced in the French fifth-grade.

The mean difference between the grade placements of the two levels of difficulty considered in the French texts and the grade placements of these same levels in the American texts was + .8.

Ratio

The concepts related to ratio are not presented in the American arithmetic textbook series until the fifth grade, and then only in conjunction with problems of distance, time and rate, or with problems of work, time and rate. In the French arithmetic texts, ratio is presented, at a comparable level of difficulty, as early as the third grade. In the fourth-grade French texts, there is an extensive coverage of ratio, rate,

and proportion.

Differences between the average grade-placement of concepts related to ratio in the French texts and the average grade-placement in the American texts could not be established because one American textbook series did not present any concept related to ratio in the first five grades, and only one American arithmetic series presented more advanced concepts (in the fifth grade), as shown in Appendix A. If such concepts were assumed to be presented in the sixth grade, in the case of series not presenting them by the fifth grade, the mean difference between grade placements in the French texts and those in the American texts would have been + 1.9 grades. This figure was not considered when the final test of significance was made to compare the mean difference for all concepts presented in the French texts with the mean difference for all the concepts presented in the American texts, because sixth grade textbooks had not been investigated.

Per Cents

Concepts related to per cents were introduced in only one of the American arithmetic textbooks investigated, this one textbook being the fifth grade text of the Scott Foresman series. Per cents were dealt with extensively in the French fourth-grade and fifth grade texts in which concepts such as determining the percentage of a number, changing decimal numbers into percentages, and handling problems of discount, were presented.

The mean difference between the grade placements of concepts related to per cents in the French texts and the grade placements in the American texts could not be calculated because the situation was the same as for

ratio. If the grade placement of the American arithmetics, except for the Scott Foresman fifth grade text, was assumed to be 6, the mean difference between the French grade placement and the American grade placement would be close to + 2.0 grade.

Scale Drawing

The researcher found that concepts related to scale-maps and scale drawing were introduced one grade earlier in the French texts than in the American texts, being presented in the French fourth grade but in the American fifth grade for all series except one. By the fifth grade, however, the levels were the same, as the French texts reviewed the concepts of the fourth grade.

The mean difference between the grade placements of concepts related to scale drawing in the French texts and the grade placement of these concepts in the American texts was + .9.

Terms and Other Topics

The final category in this part of the investigation to be considered, terms and other topics, could not be analyzed for grade-placement differences in the French and in the American arithmetic series because of the vocabulary and the cultural differences. The concepts classified in this topic were almost exclusively pages on arithmetic vocabulary words to be learned in the first five grades of the French and of the American series. In the American fifth grade these concepts included pages on arithmetic vocabulary words but also a few pages on topics such as "How to

save money," or "How to fill out a check," whereas in the French fifth grade texts they were mostly on a few notions of business arithmetic, on intervals and on notions of physics, concepts which did not fit in any of the other thirteen topics, and which, with the exclusion of vocabulary words, were presented only in the textbooks of one country and not in those of the other.

Significance of the Grade Placement Differences for All Topics

The comparison of the levels of difficulty presented in the French arithmetic textbooks of each grade and in the American arithmetic textbooks of the corresponding grades has shown that, the concepts presented in the French first grade texts were more difficult than those presented in at least 60 per cent of the American texts for all topics except the number system decimal numbers and fractions, and excluding also the topics of measures and terms which could not be investigated for grade-placement differences. By the end of the fifth grade, the difficulty of the concepts is greater in the French texts than in the American texts for all topics considered except for scale drawing, graphs, and fractions, wherein the difficulty is the same. Another interesting fact is that the concepts related to addition, subtraction, multiplication, and division of whole numbers and those related to geometry are as difficult or more difficult in the French third grade than they are in the American fifth grade.

The comparison of grade-placement differences for the concepts of each topic presented in the French and in the American texts has shown mean

differences varying from -2.1 grade for decimal numbers, when the concepts investigated were presented earlier in the American texts, to + 2.1 grades for geometry, when the concepts investigated were presented earlier in the French texts. An hypothesis of no difference between the mean grade placement of each arithmetic concept in the French arithmetic textbook series and the mean grade placement of the same arithmetic concept in the American arithmetic textbook series was formulated. The alternative hypothesis was that the grade placement in the French text was lower than the grade placement in the American texts. The Wilcoxon Matched-Pairs Signed-Rank Test was used to test these hypotheses.¹

There were 71 concepts, representing an upper level of difficulty attained in some textbooks, for which the difference between the mean grade placement in the French arithmetic series, and the mean grade placement in the French series had been calculated, as shown in Appendix A. Six of these differences were zero and were eliminated from the total number of differences, leaving a sum of $N=65$, being the total number of differences having a sign. Each difference was then assigned a rank and a sign, the sign being a plus sign if the concept was placed earlier in the French textbook series, and a minus sign if the concept was placed earlier in the American textbook series. The sum of the minus ranks was found to be: $T=61.5$, and the null hypothesis that the mean grade placements were the same at the one per cent level was formulated. The standard normal

¹Sidney Siegel, Nonparametric Statistics for Behavioral Sciences (New York: McGraw-Hill Book Company, 1956), pp. 75-83.

variable was calculated by the following formula:

$$z = \frac{T - \frac{N(N+1)}{4}}{\sqrt{\frac{N(N+1)(2N+1)}{24}}}$$

It was found to be -6.61 which was significant at the one per cent level for a two-tailed probability. It was indeed significant way beyond this level. The null hypothesis was rejected and the alternative hypothesis leading to a one-tail test was accepted: The arithmetic concepts investigated are placed significantly earlier in the French texts than in the American texts. The mean difference was 1.2 grade, which shows that arithmetic concepts of the same difficulty are presented over a year earlier in the French textbook series than in the American textbook series. It was assumed earlier that the arithmetic program taught to French and to American elementary grade students did not differ greatly from the program presented in the arithmetic textbooks; if this is so, the same challenges in arithmetic are presented to French students, on the average, over a grade earlier than they are presented to American students.

In this section of the study, the investigator was concerned only with differences in the grade placement of certain arithmetic concepts presented in the French and in the American textbook series, and not with differences in methods employed to present these concepts, or with differences in the emphases placed on the concepts of each topic. The results of the investigation of these differences in methods and emphases are discussed in Chapter 4.

CHAPTER IV

DIFFERENCES IN THE METHODS USED TO PRESENT THE CONCEPTS OF MAJOR ARITHMETIC TOPICS AND DIFFERENCES IN THE EMPHASES PLACED ON THESE CONCEPTS IN THE FRENCH AND IN THE AMERICAN SERIES

The purpose of this portion of the investigation was two-fold: (1) to see if there were differences in the methods used to introduce, explain and develop the major arithmetic concepts related to each topic; and (2) to determine differences in the emphases placed on all of the concepts of each topic, as evidenced by the proportion of total textbook space devoted to these concepts in each grade of the French and of the American arithmetic series. The investigator wanted to learn, for instance, whether there appeared to be important differences in the ways the number system, addition of whole numbers, and so on, were explained to the French and to the American students, and whether the French arithmetic textbooks devoted more space or less space than the American textbooks to the number system, addition of whole numbers or other topics in relation to the total arithmetic program of each grade.

Results of the topic by topic investigation of differences in methods and in emphases are reported in this paper in the following manner:

1. The main procedures or techniques employed to present and explain the major concepts of each topic in the French and in the American arithmetic textbooks are given. Similarities and differences between the texts of both countries are then indicated.
2. The proportion of textbook-space occupied by the concepts of every topic in each of the five grades of the French and of the American series is given. This proportion of textbook-space is expressed in terms of the percentage of the total number of pages in the textbooks. To obtain, for instance, the percentage of textbook-space on the number system in the ten

first-grade American textbooks, the investigator counted the total number of pages of these textbooks, then the total number of pages on the number system and established the proportion. The proportion of textbook space on each topic for the first five grades was also calculated.

3. Differences in procedures employed and in emphases placed on the concepts of every topic presented in the French and in the American arithmetic programs of the first five grades are then summarized.
4. The proportions of textbook space devoted to problems and to problem-solving in each grade of the French and of the American arithmetic textbook series are presented and compared. This section has been added because the investigation of procedures had showed that problem-solving was stressed more in the French arithmetics than in the American arithmetics. The investigator wanted to see whether this stress would also be evidenced by significant differences in the space allotted to problems and problem-solving techniques. This report is presented after the reports on procedures and emphases because it does not pertain to problems on each topic, but to problems on any part of the arithmetic program.

Procedures Employed to Present the Concepts of Each Topic and Emphases Placed on These Topics in the French and in the American Arithmetics

The procedures employed to present major arithmetic concepts and the emphasis given these concepts are presented in this section of the paper for each of the fourteen topics: the number system, the addition of whole numbers, the subtraction of whole numbers, the multiplication of whole numbers, fractions, decimal numbers, geometry and geometrical measurements, ratio, per cents, graphs, scale drawing, measures, and terms and other topics. Procedures and emphases found in the ten American arithmetic series and those found in the two French arithmetic series are discussed and compared for the first five grades. Results on some of the topics are reported together because of similarities in procedures and emphases.

The Number System

Procedures used. The procedures used in the French and in the American arithmetic textbook series to introduce and to explain the number system concepts are as follows:

1. The techniques and devices used in the French textbooks are dots, pictures of objects and other concrete examples to teach counting and one to one correspondence. The place value of numbers is explained with the help of packages of ten sticks and with coins. All these methods are also used in most of the American textbooks.
2. The American arithmetic textbooks of the first two grades are workbooks with many pictures, especially the first grade workbook which is composed mainly of pictures and blanks left for the pupil to circle or check the right answer; for instance under a picture of four children, the question: "How many children are there?" would be asked, with the numbers 2, 3, and 4 under it. The French first grade arithmetics are regular textbooks, like the ones of the other grades; they have many pictures but also pages on problems, and by the second grade, pictures do not occupy more than a third of the textbook space. The natures of the third, fourth and fifth-grade French and American textbooks are comparable.

The concepts related to the number system are thus presented in very much the same manner in the French arithmetic textbooks than they are in the American textbooks, except for a different approach caused by differences in the natures of the textbooks of the first two grades.

Emphases placed on number concepts. The French arithmetic textbooks of the first grade devote 16.5 per cent of their total number of pages to concepts related to the number system. The American first grade arithmetic textbooks devote 38 per cent of their total number of pages to number system concepts. These concepts are thus stressed more in the American first grade arithmetics--21.5 per cent more--than they are in the French first grade arithmetics. The differences in emphases in the other

grades are much smaller; the percentage of American textbook space varying from 2.5 per cent more to 2.75 less than the percentage of textbook space occupied by number concepts in the French arithmetics of the corresponding grades, the difference between the proportion of total textbook-space on the number system in the first five grades in the French texts and the same proportion in the American texts is +4.5 per cent, as shown in Table 1.

TABLE 1. PERCENTAGE OF TEXTBOOK SPACE ON THE NUMBER SYSTEM IN THE FRENCH AND IN THE AMERICAN ARITHMETIC TEXTBOOKS

Grade	American textbooks	French textbooks	Difference
1	38	16.5	+21.5
2	16	18.5	- 2.5
3	6.25	9	- 2.75
4	5	3	+ 2.0
5	4.5	2	+ 2.5
1 to 5	10.5	6	+ 4.5

The reason that American arithmetic texts for the first grade place greater emphasis on number concepts is that other topics such as multiplication and division of whole numbers and geometry are not introduced at this grade level, whereas they are presented in the French first grade textbooks. The difference of +21.5 per cent of textbook space in the first grade corresponds, on the average, to from 32 to 52 textbook pages, while the difference of +4.5 per cent for all grades corresponds, on the average,

to from 7 to 11 pages. Although no test of significance was used to test the significance of this difference, the writer feels that any difference in textbook-space above 10 per cent, or on the average more than 15 pages of French text, written in smaller print, or 24 pages of American texts starts to indicate a greater stress on the concepts of a topic because it corresponds to enough lessons to indicate a difference in the French and in the American arithmetic programs.

Addition and Subtraction of Whole Numbers

The procedures employed to present the concepts of addition and of subtraction of whole numbers, as well as the emphases given to these concepts, were so similar that the results are discussed together.

Procedures used. The techniques employed in the French and in the American textbook series to explain addition and subtraction of whole numbers are as follows:

1. The French arithmetic textbooks use dots, pictures and dominoes to present addition and subtraction facts in the first grade; these same devices are also used in the American textbooks; however the French second grade texts employ fewer concrete devices with pictures occupying only a small part of the pages on addition and subtraction. The American second-grade arithmetic textbooks, on the other hand, still use many pictures to present these facts.
2. The French textbooks for the first-grade present word-problems without the help of pictures, and very few drills on addition and subtraction, whereas the American arithmetic texts for this same grade, and some of the second-grade texts, present either picture-problems or drills, but no word-problems.
3. There are few differences in the other grades either in the manner the addition or subtraction concepts are explained, or in the type of problems given, except for the differences in difficulty presented in Chapter 3: though more difficult

problems and concepts are presented sooner in the French arithmetic series, similar techniques or presentation are used.

To summarize then, the investigator found that there are no apparent differences between the French and the American series in the methods employed to explain the concepts of the addition or the subtraction of whole numbers, with the possible exception of the fewer concrete devices in the texts for the lower grade levels and the different types of problems presented in the French textbooks.

Emphases placed on the concepts of addition and subtraction of whole numbers. The percentages of textbook-space occupied by the concepts of addition and of subtraction of whole numbers in the French and in the American arithmetic textbooks are comparable in the first grade, but from the second grade on those percentages are much greater in the American texts than they are in the French texts. There is a difference of +49.5 per cent in the second grade, +37.5 per cent in the third, and +20.5 per cent in the fourth grade. The difference between the percentage of textbook space occupied by concepts relating to addition and subtraction of whole numbers in the French series of the first five grades and that occupied by the American series of the same grade is large: +24.5, as shown in Table 2.

The reason for the smaller emphasis in the French second, third and fourth grade is probably that most of the significant concepts related to addition and subtraction of whole numbers have already been introduced in the French first grade and are simply extended to larger numbers, or are developed through presenting more difficult problems in the following grades.

TABLE 2. PERCENTAGE OF TEXTBOOK-SPACE ON THE CONCEPTS OF ADDITION AND SUBTRACTION OF WHOLE NUMBERS IN THE FRENCH AND IN THE AMERICAN ARITHMETIC TEXTBOOKS

Grade	American textbooks	French textbooks	Difference
1	44.5	43	+ 1.5
2	66	16.5	+ 49.5
3	53	14.5	+ 37.5
4	27	6.5	+ 20.5
5	16.5	6	+ 10.5
1 to 5	37.5	13	+ 24.5

Multiplication and Division of Whole Numbers

The comparison of teaching methods and of emphases relating to the concepts of multiplication and of division of whole numbers are discussed together because of their similarities.

Procedures used. The French and the American textbooks employ the following techniques to teach multiplication and division of whole numbers:

1. The French and the American arithmetic textbooks present multiplication and division concepts by relating them to addition and subtraction of whole numbers. Tables, concrete examples and devices such as multiplication and division "wheels" are used in some of the textbooks of both countries.
2. The concepts of carrying and borrowing in multiplication and in division are presented as a unit in relation to carrying in addition and subtraction in the French texts, and as successive units, in relation to each operation, in the American texts.
3. The French first grade arithmetic texts present verbal problems requiring the choice of the process of addition, subtraction, multiplication or division to find the solution, such problems are only presented in the American third or fourth grade texts.

The American textbooks series present many multiplication and division drills, whereas the French textbooks series present few of them.

In summary, the French and the American arithmetic textbook series do not appear to differ in the devices or techniques used to explain the multiplication and the division of whole numbers facts. The French arithmetics, however, present problems, sooner, than is the case for the American arithmetics.

Emphases placed on the concepts of multiplication and of division of whole numbers. The American arithmetic textbooks only introduce the concepts of multiplication and division of whole numbers in the second grade, so the emphases on these concepts are very small (1.5 per cent), while it consists of 32 per cent of the French second grade textbooks. On the average the difference between the emphasis on multiplication and division concepts in the French texts and that emphasis in the American texts is +6.5, as shown in Table 3.

TABLE 3. PERCENTAGE OF TEXTBOOK-SPACE ON THE CONCEPTS OF MULTIPLICATION AND DIVISION OF WHOLE NUMBERS IN THE FRENCH AND IN THE AMERICAN ARITHMETIC TEXTBOOKS

Grade	American textbooks	French textbooks	Difference
1	0	11	- 11
2	1.5	32	- 30.5
3	24	27	- 3
4	44.5	13	+ 31.5
5	31.5	14.5	+ 17
1 to 5	25.5	19	+ 6.5

In the French and in the American third-grade texts, comparable space is occupied by multiplication and division concepts, but in the fourth and fifth grade texts, less space is devoted to these concepts in the French textbooks. The French series show a most extensive coverage in the second and third grade. The most extensive coverage in the American textbooks, on the other hand, is in the fourth and in the fifth grade. The indication here is that, since most of the important multiplication and division concepts are presented by the French third grade, there is an opportunity for other arithmetic concepts to be introduced in the fourth and fifth grades.

Fractions

In the grade-placement investigation, it was found that the concepts related to fractions were presented at a comparable level of difficulty in the French and in the American arithmetic texts for the first grade, as well as in the texts for the fifth grade.¹ This was not the case for the topics discussed so far, and the comparison between the procedures used and the emphases given to concepts related to fractions also differs from the comparisons made for the other topics.

Procedures used. The procedures employed to present the concepts relating to fractions in the French and in the American arithmetic textbooks are as follows:

1. Shaded parts of a figure, such as portion of a picture of a pie or of a circle, and number-lines with segments corresponding to

¹See pp. 36-38.

fractions of units, are used to introduce fractions in the French and in the American texts.

2. More problems involving fractions are presented in the American textbooks than in the French textbooks. In fact, most of the problems presented in the American fourth and fifth-grade textbooks are problems using fractions.

In summary, the researcher found no apparent differences in the techniques used to present the concepts of fractions in the French and in the American arithmetic textbooks, but in the American texts, these concepts are developed more extensively through problem-solving than in the French arithmetics.

Emphases placed on the concepts of fractions. Fractions are not presented extensively in the first three grades of either the French or the American arithmetic textbook series; concepts relating to fractions only occupy from one to two per cent of textbook-space, as shown in Table 4.

TABLE 4. PERCENTAGE OF TEXTBOOK-SPACE ON FRACTIONS IN THE FRENCH AND IN THE AMERICAN ARITHMETIC TEXTBOOKS

Grade	American textbooks	French textbooks	Difference
1	1	1	0
2	2	1	+ 1
3	2	1	+ 1
4	7	8	- 1
5	23	7	+16
1 to 5	8.5	4.5	+ 4

Concepts relating to fractions are occupying more space in the fourth grade of the French and of the American textbook series--8 per cent and 7 per cent--but the portions of space are comparable. In the fifth grade, however, the space occupied by concepts relating to fractions is much larger in the American arithmetics, almost one fourth of the textbooks whereas it is 7 per cent in the French arithmetics. The reason for the stronger emphasis on fractions in the American textbooks is probably that fractional units of measurement are widely used in the United States.

Decimal Numbers

Most of the French units of measurements are expressed in decimal units rather than in fractional units, this caused differences in the procedures employed to present decimal number concepts and in the emphases on these concepts in the French and in the American textbooks.

Procedures used. The procedures employed to present decimal number concepts are as follows:

1. Decimal numbers are presented in the American arithmetics together with money-numbers up to the end of the fourth grade, students are shown that each place-value corresponds to cents, dimes, and dollars. In the fifth grade all the American textbooks make use of the speedometer as a device to introduce decimals other than money-numbers.
2. The French fourth and fifth grade arithmetics present a complete coverage of decimals, using different units of measurement; they also present many varied exercises and problems on decimals other than money decimals whereas the American textbooks problems are money-number problems.

The French and the American arithmetic series use different techniques to present decimal numbers, this being the result of cultural differences between the two countries.

Emphases placed on decimal number concepts. Decimal numbers are not presented until the third grade, and then only in 3 per cent of the textbook-space of the American series. The textbook-space devoted to decimal number concepts in the French fourth grade, on the other hand, is greater than that devoted to these concepts in the American textbooks of the same grade: 10.5 per cent instead of 4 per cent. By the fifth grade, however, American textbooks devote 7 per cent of their total number of pages to decimal numbers and the French texts, 4 per cent. The difference in emphases for the over-all programs of the first five grades, however, differ very little, as shown in Table 5.

TABLE 5. PERCENTAGE OF TEXTBOOK-SPACE ON DECIMAL NUMBERS IN THE FRENCH AND IN THE AMERICAN ARITHMETIC TEXTBOOKS

Grade	American textbooks	French textbooks	Difference
1	0	0	0
2	0	0	0
3	3	0	+ 3
4	4	10.5	- 6.5
5	7	4	+ 3
1 to 5	3.5	4	- 1

These emphases figures correspond to the findings of the grade placement investigation which has shown that decimal numbers are fully covered in the French fourth grade. The space devoted to decimal numbers

in the fifth grade of the French series is occupied by lessons on decimal units of measurement or by decimal problems.

Geometry and Geometrical Measurements

The topic of geometry and geometrical measurements is the topic for which the greatest differences between grade placements in the French and in the American textbook series were found. Investigation of the methods of teaching geometrical concepts and the emphasis given to these concepts was important because geometry is a subject where measurement formulas may be presented without stress on understanding of the processes involved.

Procedures used. Methods of teaching could only be compared to the introduction to the area of the square, as it is the most difficult concept presented in the American arithmetics. The procedures used in the textbooks of both countries were as follows:

1. The French and the American textbooks explain geometrical figures with concrete examples, checkerboards and paper folding. The methods used to teach perimeter and area are also similar: concrete examples are presented, where the student can visualize the number of inches, for instance, of each side of the square or the rectangle, or the number of square inches of the area.
2. The French arithmetics present many problems on perimeter and area, whereas only three of the American arithmetic series have such problems. Even in the case problems were presented, their number was very small.

The methods used in the French and in the American textbooks do not differ by the devices or techniques employed, but differ by the development of these concepts through problem-solving.

Emphasis placed on geometrical concepts. The space occupied by concepts in the first four grades of the American arithmetics is very

small, it is not over one per cent of the total textbook space. It is still only 3 per cent of the total textbook-space of the fifth grade American texts. Geometry concepts, on the other hand, occupy from 5.5 per cent to 28 per cent of the French textbook-space of each grade, as shown in Table 6.

TABLE 6. PERCENTAGE OF TEXTBOOK-SPACE ON GEOMETRY AND GEOMETRICAL MEASUREMENTS IN THE FRENCH AND IN THE AMERICAN ARITHMETIC TEXTBOOKS

Grade	American textbooks	French textbooks	Difference
1	1	5.5	- 4.5
2	.5	10	- 9.5
3	.25	19	+ 18.75
4	.25	24	- 23.75
5	3	28	- 25
1 to 5	1.25	20.5	- 19.25

Geometrical concepts are stressed considerably more in the French arithmetics than in the American arithmetics. Problems occupy the greatest proportion of the textbook space devoted to geometry and to geometrical measurements in the French textbooks. Typical problems of the first grade and of the fifth grade of the French textbooks are as follows:

Grade Two: Dad has a square garden with a 32 meter-side. He fences it with four rows of wire. What is the perimeter of the garden? What length of wire will be needed?

Grade Five: On a scale model of a public square with a scale of $1/2,500$, the rectangular public square is 12 mm long and 9.6 mm wide. A round flower bed with a diameter of 8 m is reserved in

the center. A fine gravel is poured on the rest of the surface 2 cm thick. Calculate: (1) the real dimensions of the public square; (2) the surface without the circle; (3) the volume of the gravel.

Most of the problems on perimeter or area, which were presented in the American arithmetics, even in the fifth grade, were direct questions such as: "What is the perimeter of a square that is 18 inches on each side?" or "The dimensions of a rectangular picture are 18 inches and 16 inches. Find the area of the picture."

The next topic to be discussed is the topic of ratio, where important differences were also found in the French and in the American textbooks concerning problem-solving skills relating to ratio.

Ratio

Ratio is not presented as a problem-solving concept in the American textbook series, except for the Scott, Foresman series in which complete coverage is given in the fifth grade text, stressing its importance as a mathematical device to solving problems. Authors of the book use ratio in an equation-form, such as $\frac{10}{3} = \frac{n}{6}$, the first term of the equation showing the rate (for example 3 candy bars for 10 cents); and the second term, the ratio to be found (number of cents to be paid for 6 candy bars). French arithmetic texts emphasize ratio as also a problem-solving device, not expressed, however, as an equation, but rather as the method of "unitary analysis," which is a somewhat similar technique.¹ The equation

¹The problem would be resolved in the following way with the method of unitary analysis: 3 candy bars cost 10 cents so one candy bar costs $\frac{10}{3}$ cents and 6 candy bars: $\frac{10}{3} \times 6$ cents.

technique or the unitary analysis technique are processes used in solving two or three-step problems, or problems in which only one question is asked, but another question has to be answered before that one can be solved. Two-step problems such as the one that follows, are presented in even the second-grade French textbooks:

A store keeper bought baskets of fruit at 120 francs a basket. The fruit spoiled, however, and had to be sold for only 100 francs. How much does the store keeper lose on his twelve baskets of fruit?

Few two-step problems as difficult as this problem are to be found in the American textbooks, even in those used in the fifth grade, with the exception of a few problems involving work, time and rate, or distance, speed and rate, such as this one:

Mr. Cook traveled 65 miles in two hours in his car. At this rate, how far could he travel in 12 hours?

Problems involving more than two steps are not presented in the American arithmetic, but most problems presented in the French third, fourth and fifth grade textbooks have three or more steps.

Emphases placed on ratio concepts. The concepts of ratio are not presented in the American textbooks until the fifth grade, where the emphasis is 1.5 per cent of the total text-book space. Ratio concepts on the other hand, occupy respectively 1 per cent, 10 per cent and 6 per cent of the textbook-space of the third, fourth and fifth grade French textbooks, as shown in Table 7.

With the exception of the Scott, Foresman series, which raised the proportion of textbook-space on ratio in the American series, the American arithmetics devote less space to ratio concepts than the French arithmetic series do in the third, fourth and fifth grade. This difference in

emphases is large in the fourth grade,

TABLE 7. PERCENTAGE OF TEXTBOOK SPACE ON RATIO CONCEPTS IN THE FRENCH AND IN THE AMERICAN ARITHMETIC TEXTBOOKS

Grade	American textbooks	French textbooks	Difference
1	0	0	0
2	0	0	0
3	0	1	- 1
4	0	10	- 10
5	1.5	6	- 4.5
1 to 5	.5	4.5	- 4

Per Cents

The topic of per cents is related to that of ratio, and is not presented in the American arithmetic textbooks, except for the Scott, Foresman fifth-grade arithmetic. Methods of teaching could not be compared. The emphasis in the American arithmetic textbooks is .5 per cent of the total number of pages of the fifth grade arithmetics (because of the presentation in the Scott, Foresman arithmetic). The concepts relating to per cents occupy respectively 2 per cent and 3.5 per cent of the French fourth and fifth grade textbooks. This space is allotted mostly to problems of profit, discount and interest, or to lessons on problem-solving techniques to solve these problems.

Graphs

The methods used to present graphs are exactly the same in the French and in the American textbooks. The skills involved are reading and plotting the graphs, and several examples are given in the textbooks of both countries. Graphs are only presented in three American texts of the third grade with an emphasis of .5 per cent of the total number of pages of the American fourth grade texts, the corresponding percentage for the French fourth grade arithmetics is 1.5 per cent. In the fifth grade, the emphases in the French and in the American texts are respectively 1 per cent and 2 per cent. French arithmetics, therefore devote 1 per cent more space to graphs in the fourth grade but 1 per cent less in the fifth grade, than American arithmetics of the corresponding grades; and these differences are very small.

Scale Drawing

Scale drawing concepts are also presented in the same manner in the French and in the American arithmetic textbook series, as the skill involved is merely the reading of a scale drawing or of a scale map, with the translation of the measurements on the drawing or the map into actual measurements of objects or of distances. The French textbooks, however present more problems on this topic. Scale drawing is not presented until the fourth grade, and the emphases on concepts related to this topic in that grade are zero per cent of the textbook-space of the American series and 3 per cent of the textbook-space of the French series. In the fifth grade scale-drawing concepts occupy 1 per cent of the American

textbook-space and 2 per cent of the French textbook-space. These differences in emphases of scale-drawing concepts are quite small.

Measures

Procedures employed to present and explain concepts relating to measures could not be compared because the measures presented in the French textbooks are different measures than those presented in the American arithmetics, with the exception of measurements of time. The methods employed are different because French measures involve decimals, and the only American measures involving decimals are money computations.

Emphases placed on the concepts of measure. The concepts of measures were stressed about as much in the French and in the American arithmetics of the first grade--respectively 13 per cent and 10.5 per of the total textbook-space of the arithmetics of each country. From the second grade on, however, the emphasis is greater in the French textbooks than in the American textbooks. It is greater by 9 per cent in the second grade, by 14 per cent in the third grade, by 4.5 per cent in the fourth grade and by 7 per cent in the fifth grade, as shown in Table 8. The only large difference is in the third grade, and the over-all difference is not very large.

The reason for this greater emphasis in the French third grade texts than in the American texts is probably that the range of decimal units of measurement is greater in the French arithmetics, and also that the number of problems using measures is greater in the French texts than in the American texts.

TABLE 8. PERCENTAGE OF TEXTBOOK-SPACE ON MEASURES IN THE FRENCH AND IN THE AMERICAN ARITHMETIC TEXTBOOKS

Grade	American textbooks	French textbooks	Difference
1	10.5	13	- 3.5
2	13	22	- 9
3	10.5	24.5	- 14
4	10.5	14.5	- 4.5
5	8	15	- 7
1 to 5	10	18	- 8

Terms and Other Topics

The procedures used to present terms and other topics could not be compared because the vocabulary terms, as well as the other topics involved are different in the textbooks of both countries. The pages classified as pages under "terms and other topics" were, as it was mentioned earlier, mostly pages on arithmetic vocabulary words in the first four grades of the French and of the American series. Pages from the fifth grade texts of the French arithmetic series, however, were classified in this manner: When they were on intervals or on notions of physics which did not correspond to topics presented in the American textbooks. A few pages on budgeting and on saving-accounts in the French and in the American fourth and fifth grade texts were also classified under this heading.

A comparison of the emphases given to terms and other topics in the French and in the American arithmetics is not very meaningful because the

concepts involved are different. It seems worth-while, however, to determine what proportion of the textbooks of each country was occupied by concepts not connected with the other topics investigated. The proportion of textbook-space is small in every arithmetic text (not over 5 per cent) except in the French first grade and in the French fifth grade textbooks (respectively 10 and 11 per cent), as shown in Table 9.

TABLE 9. PERCENTAGE OF TEXTBOOK-SPACE ON TERMS AND OTHER TOPICS IN THE FRENCH AND IN THE AMERICAN ARITHMETIC TEXTBOOKS

Grade	American textbooks	French textbooks	Difference
1	5	10	- 5
2	1	.5	+ .5
3	1	4	- 3
4	1	4	- 3
5	1.5	11	- 9.5
1 to 5	1.5	8	- 7.5

Concepts relating to terms and other topics were the last concepts investigated in the comparison of methods and of emphases. A summary of the findings of this comparison for all topics presented in the French and in the American textbook series is given in the next section of this paper.

Summary of the Differences in Procedures and in Emphases
for All the Topics Presented in the French and
in the American Arithmetic Textbooks

The investigation of the procedures used to present arithmetic concepts in the French and in the American textbook series revealed mainly that the techniques employed to present and explain arithmetic concepts in the French and in the American textbooks appear to be very similar. Among the topics which could be compared, the only topic for which a difference in technique was found was decimal numbers. No original method of instruction, used exclusively in the French texts, such as a stress on understandings, or a better explanation of mathematical principles, could be found in the study. Such a method might have explained why more difficult concepts could be presented earlier in the French arithmetic series.

The only differences which were found in the procedures used to present arithmetic concepts were: (1) that the French texts appear to depart earlier from a concrete way of presenting and explaining certain concepts, the French texts using fewer pictures and other concrete devices in the first two grades than do the American texts; and (2) The French texts appear to give more stress to problems and problem-solving techniques than do the American texts. This greater stress was not necessarily in the original presentation of the concepts, as many of the American arithmetics also present many concepts as a process to be discovered instead of a fact to be learned, but the presentation of the concept is followed by a great number of problems but few computation drills in the French textbooks, whereas it is followed by fewer problems but many computation drills in the

American textbooks.

The main differences in the proportion of textbook-space devoted to the concepts of every topic in the French and in the American textbook series are the following:

1. The French textbook series devote more space than the American textbook series to multiplication and division in the first two grades, more space to geometry in all five grades, and more space to ratio in the third grade.
2. The American textbook series devote more space than the French textbook series to the number system in the first grade, to addition and subtraction in the second, third, fourth and fifth grade, to multiplication and division in the fourth and fifth grade, and to fractions in the fifth grade.

These differences, together with the findings of the grade placement investigation reported in Chapter 3, show that most of the concepts relating to addition, subtraction, multiplication and division of whole numbers are presented by the end of the third grade of the French arithmetic textbook series. This leaves an opportunity for the presentation of other topics such as geometry, decimal numbers, ratio, or per cents. A French fourth grade arithmetic textbook devotes almost half of its textbook-space to concepts relating to geometry, ratio and decimal numbers, whereas an American fourth grade arithmetic devotes, on the average, only 4.25 per cent of its textbook-space to these same concepts. The investigation of methods and emphases had shown that problems and lessons on problem-solving techniques appeared to be stressed more in the French textbooks than in the American textbooks. The aim of the following section of the study was to find how extensively problems and problem-solving techniques were emphasized in the French arithmetics in relation to the emphasis on problems and problem-solving in the American arithmetics.

Differences Between the Proportions of Textbook-Space
Devoted to Problems and Problem-Solving in the
French and in the American Arithmetic Series

The investigation of the proportion of textbook-space devoted to problems and to lessons on problem-solving in the French and in the American arithmetic series was conducted by counting the number of pages on problems or on problem-solving techniques in all of the French texts and in all of the American texts of each grade. These figures were then converted into percentages of the total number of pages of each grade of the French series or each grade of the American series.

To qualify as a problem an arithmetic question or exercise had to be: "...a situation stated in words and numerals which calls for a quantitative solution and involves a number relation new to the problem solver."¹ A question such as: "Six dolls and two dolls are _____dolls?" was not considered as a problem, but: "Bob gave Sue 4 cents. She had 6 cents. How much money did Sue have then?" was considered as a problem. Pages on how to solve problems, on how to estimate answers in problems and other similar subjects related to problem-solving techniques were also included. The topics or the processes involved in the problems were not considered.

The proportion of textbook-space devoted to problems and to problem-solving is low in the first and second grades of the American series (1.25 per cent and 6 per cent of the total American textbook-space of each of these grades). It is already high in the French second grade textbook (35 per cent of the French second grade textbook-space), as shown in

¹Cleata B. Thorpe, Teaching Elementary Arithmetic (New York: Harper and Bros., 1962), p. 30.

Table 10.

TABLE 10. PERCENTAGE OF TEXTBOOK-SPACE ON PROBLEMS AND PROBLEM-SOLVING IN THE FRENCH AND IN THE AMERICAN ARITHMETIC SERIES

Grade	American textbooks	French textbooks	Difference
1	1.25	8	- 6.75
2	6	35	- 29
3	15	33	- 18
4	17	38	- 21
5	17.5	47.5	- 30
1 to 5	13.5	38	- 24.5

The proportion of textbook-space devoted to problems and to problem-solving in the French arithmetic series is more than twice the proportion of textbook-space devoted to these same subjects in the American series for each of the five grades. The French texts devote, on the average, almost one fourth more of their textbook-space to problems and problem solving than do the American arithmetics for the texts of the first five grades. It was assumed earlier that the arithmetic program taught in the classrooms of the elementary grades of the French and of the American public schools did not differ greatly from the programs presented in the arithmetic textbooks used in these schools. The difference in stress was thus assumed to correspond to a greater number of lessons on problem-solving taught in class, and a greater number of problems done by pupils in

class or in study-periods in the French schools than in the American schools. Although no questionnaires have been sent to teachers, the answers to direct inquiries to French and American teachers appear to indicate that most of the problems of the textbooks are done either in class, with all the students working the problems together, or as individual assignments during study-periods.

The practice of giving assignments to be done at home by French pupils in the public elementary schools has been forbidden by a law of December 1956.¹ There was, therefore, no reason to believe that French pupils might do more arithmetic homework than American pupils. A survey of the American literature in the field failed to reveal any article giving the average amount of homework given in American elementary schools, many statements were found, however, which advised teachers to give a minimum of homework during the first five grades of the elementary schools.

The next part of the investigation, which is reported in Chapter 5, aimed to find what differences, if any, existed between the arithmetic achievement of French pupils and that of American pupils.

¹France, Ministère de l'Éducation Nationale, Horaires et Programmes de l'Enseignement du Premier Degré (Paris: Vuibert, 1960), p. 88.

CHAPTER V

DIFFERENCES BETWEEN THE ARITHMETIC ACHIEVEMENTS OF FRENCH AND OF AMERICAN FIFTH GRADERS

After completing the investigation of differences in the arithmetic programs of the French and of the American elementary schools, the researcher undertook the next step in this study--a comparison of the achievements in arithmetic of the French and of the American elementary school students. The investigator wished to determine whether a comparison of the arithmetic achievement of a group of French fifth graders with the arithmetic achievement of a group of American fifth graders would reveal differences which corresponded to differences found in the other steps of the investigation. The achievement of the French fifth graders was also compared to that of American sixth and seventh graders. The investigation in grade placements, in methods and in emphases had revealed the following information:

1. The major arithmetic concepts of most topics are presented on a comparable level of difficulty more than a year earlier in the French schools than they are in the American schools.
2. Major concepts related to specific topics are introduced to pupils by the end of the third grade in the French schools, thus providing an opportunity for additional problem applications and for other topics to be presented in the fourth and in the fifth grade.
3. Problems and lessons on problem-solving techniques are emphasized more in the French schools than in the American schools.

On the basis of these findings, then, the researcher proceeded with the following hypotheses (1) that by the end of the fifth grade, which is the last grade of the French elementary school, the achievement of French pupils in arithmetic does not differ significantly from that of the

American pupils of the same grade; and (2) that the achievement of French fifth graders for problem-solving skills does not differ significantly from the achievement of American fifth graders for the same skills.

In setting out to test these hypotheses, the researcher made a comparison of the achievement of a sample group of 59 French fifth graders with the arithmetic achievement of a sample group of American fifth graders to which they had been matched by sex and mental age. The achievement in arithmetic of a larger sample of 121 French fifth graders was also compared to the achievement of a large random sample of American fifth, sixth and seventh graders, as evidenced by norms of achievements for the United States.

The achievement investigation will be reported as follows:

1. Discussed first are the selection and the translation of the arithmetic achievement test to be administered to the French sample group, the nature of the French sample, the nature of the American sample, and the administration of the test to the samples.
2. Results of the sample of 121 French fifth graders are presented, and their average achievement is compared to norms of achievements for American fifth, sixth and seventh graders.
3. Results of the sample of 59 French fifth graders are compared to results of the American sample of fifth graders matched to the French pupils by sex and mental age.

The Selection of the Test and Its Administration to the French and to the American Samples

The investigator based her selection of the Iowa Test of Basic Skills on the following factors: (1) that its reliability and validity are generally accepted; (2) that the availability of tables of percentile

norms are given for the two parts of the tests: A1-Arithmetic Concepts, and A2-Arithmetic Problem Solving.

Nature of Arithmetic Iowa Test of Basic Skills. The Arithmetic Iowa Test of Basic Skills is composed of one part--A1--made up of short questions on arithmetic concepts, testing how well the pupil understand the number system, terms, processes, operations and units of measurement; and of another part--A2--made up of verbal problems two to five line-long.¹ Both parts are multiple-choice tests, but the student must first work out the problems of the part A2 before he selects the answers, are the answers provided differ only slightly. For example, the choice offered to the pupil in answer to a five-line problem is: 1) \$52.26, 2) \$52.36, 3) \$62.26 and 4) (Not given). The Arithmetic Iowa Test is based on the American arithmetic curriculum, thus its content and manner of presentation, especially for part A1, are more familiar to American students than to French students. American students undoubtedly had the advantage, since they are accustomed to such tests, but French students are not used to objective tests with many questions and multiple-choice answers. The Iowa tests for fifth, sixth and seventh grader were used.

Translation of the Arithmetic Iowa Test into French. Most of the previous comparative studies of the achievements of American and of foreign pupils on standard achievement tests utilized from the tests only a limited number of items--those they had judged free from cultural bias. It was impossible to limit items in this study because the American tables of norms were being used as the criterion of achievement of American fifth,

¹ These problems are similar in nature to problems as defined p. 73.

sixth and seventh graders. Also, it seemed that too great a reduction of the test-items would reduce the validity and the reliability of the test more than would minor changes in the phrasing or in the nature of the question. Most of the 151 items of the tests were translated literally, or with only a minor change; such as the name of the person mentioned (to use a French name), the nature of the object being purchased (to use an object more familiar to French children), or the price of the object purchased (to give it in francs instead of dollars). Only three of the 151 items of the total test underwent changes in the numerical computations involved. Seventeen items were changed in the phrasing of the question asked, and eleven items were changed in the unit of measurement mentioned.

The total French sample. The total French sample consisted of 121 students from four fifth-grade classes in three different public schools of Le Trait, Seine Maritime, France. Le Trait, a town of approximately eight thousand people--a large percentage of them labor-workers and their families--has four elementary schools, two for girls and two for boys. All the fifth graders in Le Trait were tested, with the exception of one class of girls. An authorization to test this class could not be obtained, but an arithmetic-achievement comparable with that of the other class of girls tested could have been expected. Of these 121 pupils, 30 pupils or about 25 per cent, were admitted to the first year of secondary school after completing the fifth grade, and upon considering the averages of their grades in school work and in a test given at the end of each quarter, as well as results on the Entrance to Secondary School Examination. According to official figures supplied by the Minister of National Education, the

proportion of all fifth-graders admitted to secondary school at the end of the fifth grade was 45.7 per cent for the whole school population at the end of the school-year 1961-1962.¹ This seems to indicate that, if the Le Trait sample had been a random sample of French fifth graders, 20.7 per cent more pupils would have been expected to pass the Entrance to Secondary School, and that there are no reasons to believe that the achievement of this sample would be superior to the average achievement of French fifth graders. Only two of the four classes had been tested with an intelligence test, and the total Le Trait sample was not a random sample of French fifth graders. For these reasons, the investigator did not use this larger sample to find significant differences and to accept or reject the hypotheses relating to the achievements of French and of American students. It was only used in the descriptive comparison to find out whether there would be an indication that such a group of French fifth graders, not expected to show an arithmetic achievement superior to national standards, would do as well in arithmetic as an average group of American fifth and sixth graders, and would do as well in problem-solving skills as in other arithmetic skills. The comparison of the achievements of French fifth graders and of American sixth and seventh graders was made because the grade placement investigation had shown that most arithmetic concepts were presented more than a grade sooner in the French program than they were in the American program. Some of the French fifth graders were also expected to be as old as American sixth or seventh graders.

¹Jean Capelle, "Expose," Le Figaro (February 26, 1963), p. 4.

The French Ballard sample. The two French classes from Le Trait, which had been tested by an intelligence test, were used as the French sample to be matched by sex and mental age to a sample of American fifth graders. They were a class of 23 boys, having a mean IQ of 111.5 and a class of 36 boys, having a mean IQ of 102, when tested with a French intelligence test, the Ballard Test, which has been standardized on French and Belgian children.

The American normative sample. The normative sample of the Iowa Test of Basic Skills was composed of 74,174 pupils from 213 school systems in 46 states and included 11,658 fifth graders, 11,911 sixth graders and 13,063 seventh graders. It was chosen at random following the distribution of the United States population in those states. The achievement of this sample was compared to the achievement of the total sample of 121 French fifth graders from Le Trait by using percentile tables of norms for school averages.

The matched American sample. The sample which was used to match American fifth graders by sex and mental age to French sample of 59 fifth graders was drawn from the total fifth grade population of the Emerson public school, in Bozeman, Montana, during the 1961-1962 school year. It included eight fifth grade classes. These fifth graders had been tested with the Otis quick-scoring mental ability test, Beta test, on January 30 of that year. A group of 53 Bozeman fifth graders had also been tested with the translation of the Ballard intelligence test to be able to establish a coefficient of correlation between the Ballard IQ and the Otis IQ. This coefficient was calculated by using the Pearson product-moment

correlation coefficient and was found to be .827, which was a significant correlation at the one per cent level.¹ The regression line equation was calculated to predict the Otis IQ scores from the Ballard IQ scores, and an Otis IQ score was predicted for each of the 59 French fifth graders from Le Trait.² The chronological age of the Le Trait pupils and that of the Boze-man pupils were available. The mental age of these pupils was calculated by multiplying their chronological age by their IQ.

The American 59 fifth graders having (1) the closest mental age, and (2) in case of ties the closest chronological age, were chosen to match the 59 French fifth graders from the Le Trait sample. Among the 59 pairs of pupils, 35 had the same mental age, 11 had a difference of 1 month, 7 had a difference of 2 months, 5 had a difference of 3 months and 1 had a difference of 6 months. The mean age of the French pupils was exactly equal to the mean age of the American pupils.

Administration of the Iowa test. Part A1 and Part A2 of the Iowa Test of Basic Skills were administered to the total French sample as

¹With N being the number of paired students, X the Otis score and Y the Ballard score, the formula used was:

$$r = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{[N\sum X^2 - (\sum X)^2][N\sum Y^2 - (\sum Y)^2]}}$$

²The regression line was calculated with the following equation:

$$b_{xy} = \frac{\sum XY - \frac{(\sum X)(\sum Y)}{N}}{\sum Y^2 - \frac{(\sum Y)^2}{N}} \quad \text{and} \quad a_{xy} = \bar{X} - \bar{Y}(b_{xy})$$

the equation to predict the Otis score from the Ballard score was found to be $X = 15.4 + .89Y$, with an error of prediction equal to 5.7. The formulas used here are from Norville Downie and Robert W. Heath, Basic Statistical Methods (New York: Harper and Row, Pub., 1959), Chapter 8 and Chapter 9.

follows:

Class a--23 boys, Ecole Gustave Flaubert, in June 1961
 Class b--36 boys, Ecole Gustave Flaubert, in June 1962
 Class c--37 boys, Ecole Guy de Maupassant, in June 1962
 Class d--25 girls, Ecole Gustave Flaubert-Filles, in June 1962

The test was administered as two one-hour tests. The achievement results of the French and of the American students are examined and compared next, first for the achievement of the total French sample being compared to the large American normative sample, and second for the achievement of the 59 French fifth graders compared to that of the Bozeman fifth graders.

Comparison of the Arithmetic Achievement of the Total
 Le Trait Sample with That of the Normative Sample
 of the Iowa Test of Basic Skills

In this part of the study--the descriptive comparison of the achievement of French and of American pupils--the researcher first converted the average raw score of the 121 French pupils into grade-equivalent scores. This was done by using the conversion tables that accompanied the tests. Percentile tables were then used to convert the grade-equivalent scores into percentile scores. The tables of percentile scores for school averages were employed to convert the average grade-equivalent score of the French students of each class and also that of the total sample into percentile scores. These scores indicated the rank of each class and also the rank of the total sample in American norms of achievement for this test. The grade-equivalent score of each individual French pupil has also been converted into percentile scores with a special percentile table for

pupils scores, these percentile scores only appear in Appendix B and are not analyzed in this paper. They indicate the rank of each French pupil when his achievement was compared to the achievement of American fifth, sixth and seventh-grade pupils for the arithmetic test.

First, comparisons are made between the achievement of the French sample and that of American fifth, sixth and seventh grade classes for the complete test A-Arithmetic, and then followed by comparisons of achievement scores for part A-1 and part A-2.

Achievement differences between the French and the American students for test A-1. The percentile rank of the French sample was 96.5 in the fifth grade test, which means that the average achievement of the total French sample was superior to the achievement of 96.5 per cent of fifth grade classes in the normative sample. The percentile score of the French sample was 85 in the sixth grade test, which means that its achievement was superior to that of 85 per cent of American sixth grade-classes. The French sample scored in the 42th percentile in the seventh grade test, and thus did better than 42 per cent of the seventh grade classes in the United States, as shown in Table 11.

Results for the total arithmetic test (part A-1 and A-2 of test A) show that the French pupils from Le Trait did better in the achievement test than 84 per cent of the American fifth and sixth grade classes. This is also true of all but one of the individual classes of the sample. The girls class--class d--did only slightly better than 50 per cent of the American fifth grade classes.

TABLE 11. PERCENTILE RANK OF THE FRENCH FIFTH GRADE SAMPLE ON AMERICAN NATIONAL NORMS FOR TEST A

Class tested*	Percentile rank for test of each grade		
	5th grade test	6th grade test	7th grade test
a	99	95	70
b	98	84	38
c	99	92	38
d	91	51	26
Total sample	96.5	85	42

*See page 83 for classes corresponding to a, b, c and d.

Achievement differences between the French and the American students for part A1. The French sample ranked in the 67th percentile for part A-1 of the test--Arithmetic Concepts--when its achievement was compared to the averages achievement of American fifth grade classes, it ranked in the 20th percentile when its achievement was compared to that of sixth grade classes, and in the 18th percentile when its achievement was compared to that of seventh grade classes, as shown in Table 12.

TABLE 12. PERCENTILE RANK OF THE FRENCH FIFTH GRADE SAMPLE ON AMERICAN NATIONAL NORMS FOR PART A-1

Class tested	Percentile rank for test of each grade		
	5th grade test	6th grade test	7th grade test
a	87	47.5	44
b	62	20	20
c	81	17.5	12
d	39	9	14
Total sample	67	20	18

The French pupils did better, on the average, than 50 per cent of American fifth grade pupils, they only did better, however, than 20 per cent of American sixth-grade classes.

Achievement differences between the French and the American students for part-A2. The achievement-score of the French sample fell in the 99th percentile in norms for the achievement of American fifth grade classes, in the 99th percentile on norms for American sixth grade classes and in the 78th percentile on norms for American seventh grade classes for part A2--Problem Solving, as shown in Table 13.

TABLE 13. PERCENTILE RANK OF THE FRENCH FIFTH GRADE SAMPLE ON AMERICAN NATIONAL NORMS FOR PART A-2

Class tested	Percentile rank for test of each grade		
	5th grade test	6th grade test	7th grade test
a	99	99	92
b	99	99	66
c	99	99	83
d	99	95	56
Total sample	99	99	78

The French fifth graders did better than 50 per cent of the American fifth, sixth, and seventh graders for the Problem-Solving part of the test. The achievement of the girls-class was still superior to that of 50 per cent of American seventh grade classes of the normative sample.

In summary, the 121 French fifth graders from Le Trait did better in the total Arithmetic test than 85 per cent of American sixth grade classes. This superiority, however, was caused by a very high score on

part 2 of the test (Arithmetic problem-solving) as their achievement on part 1 of the test (Arithmetic concepts) was only superior to 20 per cent of the American sixth graders. The 121 Le Trait pupils did better, on the average, than 99 per cent of American sixth grade classes and than 78 per cent of American seventh grade classes from the Iowa test normative sample for part 2 of the test. The possibility that any group of 121 American fifth graders, who had followed the regular arithmetic program for the fifth grade, could rank in the 99 percentile in the sixth grade test, and the 78 percentile in the seventh grade test for part 2 of the test seems remote, as to do so they would have to answer correctly many problems dealing with concepts not studied in the fifth grade.¹

Differences Between the Arithmetic Achievements
of French and of American Fifth Graders
of the Same Mental Age

This part of the achievement investigation--the statistical analysis--used the raw scores obtained by the 59 French fifth graders and by the 59 Bozeman fifth graders in the arithmetic Iowa Test of Basic Skills. These scores are shown in Appendix C, the chronological age in months on January 30th of the school year they were tested, and the mental age of each student is also given. Separate scores are shown for part 1-

¹No attempt was made to test a group of American fifth graders with the sixth and seventh grade tests, because by their very construction the sixth and seventh grade tests are intended only for students having followed the programs of those grades and are based on a survey of those programs. Furthermore each item has been administered first to three different grades and items with less than 20 per cent of correct answers in any given grade were moved to an upper grade.

Arithmetic concepts and part 2-Arithmetic problem-solving, as well as the average score for the total test.

The differences between the arithmetic achievement of the French sample and that of the American sample were analyzed by figuring out the mean scores obtained by the French students: $\bar{X}_1$ in each part of the test and in the total test, and comparing those scores to the corresponding mean scores obtained by the American students: $\bar{X}_2$. A null hypothesis of no difference at the 5 per cent level between these means was formulated, alternative hypotheses were also formulated, and these hypotheses were tested with the following formulas:¹

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\sum x_1^2}{k_1(k_1-1)} + \frac{\sum x_2^2}{k_2(k_2-1)}}} \quad \text{where } x = \sum X^2 - \frac{(\sum X)^2}{k}$$

Differences between the achievements of the French and of the American samples for test A. The mean score of the French 59 fifth graders was 48.9, the mean score of the American 59 fifth graders was 44.4, the difference between these means being +4.5. The standard deviation of the score of the French pupils was 8.40 and that of the scores of the American pupils was 12.60. The t score was found to be equal to +2.29 which shows that the alternative hypothesis, a positive difference, (see p. 89) that there is a positive difference could be accepted under a one-tail test:

¹This is a formula used for separate group variance.-Sample group equal size. A test for matched pupils was not used because the mental ages of the pupils were not exactly matched. The formula was taken from James E. Wert, Charles O. Neidt and J. Stanley Ahmann, Statistical Methods in Educational and Psychological Research (New York: Appleton-Century-Crofts, Inc., 1954), p. 130.

the difference between the mean scores obtained by the French and by the American pupils is significant at the 5 per cent level.

Differences between the achievements of the French and of the American samples for part A-1 Arithmetic concepts. The mean score obtained by the French pupils for part A-1 was 26.3, and that of the American pupils 28.0, the difference between those means being 1.7. The standard deviation was 5.80 for the scores of the French pupils, and 7.28 for the scores of the American pupils. The t score was found to be equal to -1.39 which was lower than the amount required for significance to the 5 per cent level, so the null hypothesis was accepted and the differences between the mean scores of the French and of the American students was not found to be significant at this level.

Differences between the achievements of the French and of the American samples for part A-2 Arithmetic problem-solving. The mean score of the French sample was 22.6 and that of the American sample was 16.3, the difference between those means being 6.3. The standard deviation of the French scores was 4.01 and that of the American scores 6.15. The t score value was +6.72 and was found to be significant at the 5 per cent level, and the difference between the mean scores obtained by the French and by the American was shown to be significant at this level. The alternative hypothesis that the mean score of the French pupils is significantly higher was accepted.

In summary, the arithmetic achievement of the 59 French fifth graders was shown to be significantly superior (at the 5 per cent level) to

that of American fifth graders of the same sex and mental age, for the total arithmetic test and for part A-2 of the test. The French sample did not appear to be drawn from a school population having an achievement above French national standards of achievement,¹ while on the contrary the fifth grade population of Bozeman had a median percentile score of 75 when compared to national norms of achievement on the Arithmetic Iowa Test of Basic Skills in 1961-62. The mean score of the sample of 59 Bozeman pupils ranked in the 70th percentile when compared to national norms of achievement, which shows that they did better in arithmetic than 70 per cent of American fifth grade classes. The writer, therefore, feels that there are indications that French fifth grade classes are doing better in arithmetic, on the average, than American fifth grade classes composed of students of the same mental age. This higher achievement on test A is the result of a higher achievement of the French students in part A-2--problem-solving skills. The American mean was greater than the French mean for part A-1 arithmetic concepts, although this difference was not significant. This is difficult to explain because some of the concepts presented were the same as those involved in the problem-solving part of the test, and therefore were mastered by French students when they were in problem form. Two of several possible suppositions are: (1) that the concepts are presented more slowly and with more reviewing in the American program and are therefore understood by a greater number of pupils, and (2) that the type of short questions asked in the test A-1 are more familiar to American students than to French students, as the test items were constructed after an

¹See pp. 79-80.

investigation of American current arithmetic fifth grade texts.

Although the problems of part-A2 of the test were also intended for American fifth graders, they are very familiar to French students. The investigation of methods and emphases has shown that problems and lessons on problem-solving techniques occupy more space in the French texts than in the American texts.

Another remark, relating to the investigation of achievements of the two matched groups, is that, although the mean mental ages of both samples was identical, and paired students had very similar mental ages, it was impossible to find enough Bozeman students having both very close mental ages and very close chronological ages. There were some French pupils who were too young to be matched by age with any Bozeman pupils, and others who were too old to be matched with any Bozeman pupils. The mean chronological age of the French students on January 30 was about 134 months whereas the mean age of the American students was about 130 months. The resulting mean IQ of the American sample was slightly higher, 110.3 instead of 107.8 for the French sample in the Otis test.

The older mean age of the French sample, together with the writer's acquaintance with the French and the American school systems led her to believe that an average fifth grade class would have more repeaters, and thus more older pupils, than the average American fifth grade class. It was also believed that pupils were spending more classtime on arithmetic in the French schools than in the American schools. An attempt was made to determine whether these differences in age-spans of the French and of the American fifth graders were significant, and also to determine the

extent of the difference in the amounts of schooltime spent on arithmetic in the schools of both countries. This investigation is reported in Chapter 5.

CHAPTER VI

AGES OF STUDENTS AND LENGTHS OF TIME SPENT ON ARITHMETIC IN FRENCH AND IN AMERICAN SCHOOLS

The purpose of the investigation of differences in the ages of French and American fifth graders, and of differences in the length of school-time spent on arithmetic in the French and in the American public schools was to see whether a grade by grade comparison was meaningful.

Differences in the Ages of French and of American Elementary School Pupils

Although education is compulsory in France, just as it is in the United States, and the age for enrolling in the first grade is comparable --in France the child starts to school if he is six years of age on or before October first--it is still necessary to investigate differences in the ages of French and of American pupils because there are variations in the practice of letting pupils skip a grade or in that of retaining pupils in the same grade. Both of these practices are common in French schools, as the standards appear to be quite rigid for each grade and children are placed according to their scholastic abilities. Current practices in the United States are to let very few elementary-grade pupils skip a grade and to avoid as much as possible retaining a pupil in the same grade.¹

To investigate differences between the ages of French and of American pupils, the mean ages of samples of French and of American pupils were

¹Sister Josephina, "Promotion a Perennial Problem," Education, LXXXII (February 1962) 375.

compared. Differences between the mean age of the 121 Le Trait fifth graders and the mean age of French fifth graders from a national sample were first investigated. An investigation of differences between the mean age of the Le Trait sample and the mean age of an American fifth grade sample was then made. It was followed by an investigation of differences between the mean age of the Le Trait sample and the mean age of an American sixth grade sample. Hypotheses of no difference between these means were formulated.

Ages of French elementary grade pupils. The French Ministry of National Education published statistics showing the ages of all the French pupils who attended each grade of the elementary public schools during the 1960-1961 school year.¹ According to these figures 23 per cent of the French first-graders were older than the normal age for this grade, and thus had repeated a grade.² The same was true of 54 per cent of the second and third graders (pupils of these classes being counted together), 51 per cent of the fourth graders, and 54 per cent of the fifth graders. These students had, therefore, repeated at least one grade previously. Out of the 54 per cent of fifth-graders older than normal age for that grade, 17 per cent were one year older than normal age, thus showing that, previously, they had repeated more than one grade. Eight per cent of the French pupils attending the fifth grade, however, were younger than normal

¹ France, Ministère de l'Education Nationale, Informations Statistiques 38, (Mars 1962) 77-86.

² The expression "normal age for a grade" is used in this part of the paper to indicate the age of a pupil who started the first grade when he was six years of age on or before October first and never repeated a grade.

age for this grade.

Age-span of American elementary grade pupils. The writer was unable to find official statistics indicating the age of American pupils registered in each grade of the elementary schools. Sister Josephina,¹ however, reviewed in 1962 various researches concerning promotion-practices in the elementary schools of the United States. She investigated also the number of pupils not promoted in a sample of 150,257 pupils from elementary schools in the United States, these schools being of either the system A--a combination of elementary-school and high-school, or system B--with a junior high-school. The figures obtained were very similar for both systems, and the sample for system B was smaller, so only the figures for system A are to be considered here. Sister Josephina showed that in the school system A, the percentages of promotion-failure were as follows:

7.1 per cent not promoted in the first grade
 5.0 per cent not promoted in the second grade
 4.3 per cent not promoted in the third grade
 4.0 per cent not promoted in the fourth grade
 3.6 per cent not promoted in the fifth grade

The studies reviewed by Sister Josephina may serve as indication that comparable figures could be applied for the years previous to the time the investigation was made. On the basis of this assumption then, the investigator of this study used an estimation of the number of American pupils older than the normal age for fifth graders at the beginning of the fifth-grade because they repeated previous grades. It was estimated that 18 per cent of American pupils had repeated a grade by the beginning of the fifth-grade--if the percentage of repeaters applied also to previous

¹Sister Josephina. op. cit., pp. 373-6.

years.¹ A fifth grade class would also have 3.6 per cent of its students who repeated the fifth grade, according to Sister Josephina's figures, thus bringing the percentage of fifth-graders who have previously repeated a grade to 21.6 per cent, or about 22 per cent. There being no authoritative information available, the researcher found it impossible to determine what proportion of this 22 per cent represented pupils who were over a year older than normal age for fifth-graders, and had thus repeated more than one grade. The only information available included statements which indicated opposition to the retention of pupils for over one year in the elementary grades. This information led the investigator to assume that the percentage of pupils being retained more than one year during the first five years of the American elementary grades would be very small; it was estimated arbitrarily at 1 per cent for two year-repeaters, and less than one per cent for more than two year-repeaters and also for pupils younger than normal age because they were permitted to skip a grade.

Age-span of the French sample from Le Trait. The distribution of the ages of the French sample of 121 fifth graders from Le Trait has been plotted in Table 14, and the frequency polygon of this distribution in Figure 9, page 98. The ages of the French fifth graders varied from nine and one-half years--or 114 months--to thirteen and one-half years--or 162 months.

¹The reasoning involved here is as follows: of one-hundred first graders, about seven would be repeaters; thus, 93 pupils would be promoted to the second grade. Five per cent of these pupils were repeaters, so about 88 would be promoted to the third grade, 4.3 per cent of them being repeaters. About 86 pupils would be promoted to the fourth grade. Of these 86 pupils about 4 per cent were repeaters so only 82 would be promoted to the fifth grade; 18 per cent of the original group had repeated.

TABLE 14. DISTRIBUTION OF THE AGES OF FRENCH AND AMERICAN FIFTH GRADERS
AND OF AMERICAN SIXTH GRADERS

Age in months October 1st	French samples		American samples	
	Le Trait 5th grade	5th grade (national sample)	5th grade	6th grade
164-168	0	1	0	0
159-163	1	3	0	1
154-158	2	4	0	5
149-153	9	5	0	11
144-148	6	9	1	11
139-143	14	15	10	39
134-138	12	15	10	39
129-133	27	15	28	15
124-128	19	20	40	0
119-123	23	20	32	0
114-118	8	9	0	0
109-113		4	0	0
104-108		1	0	0

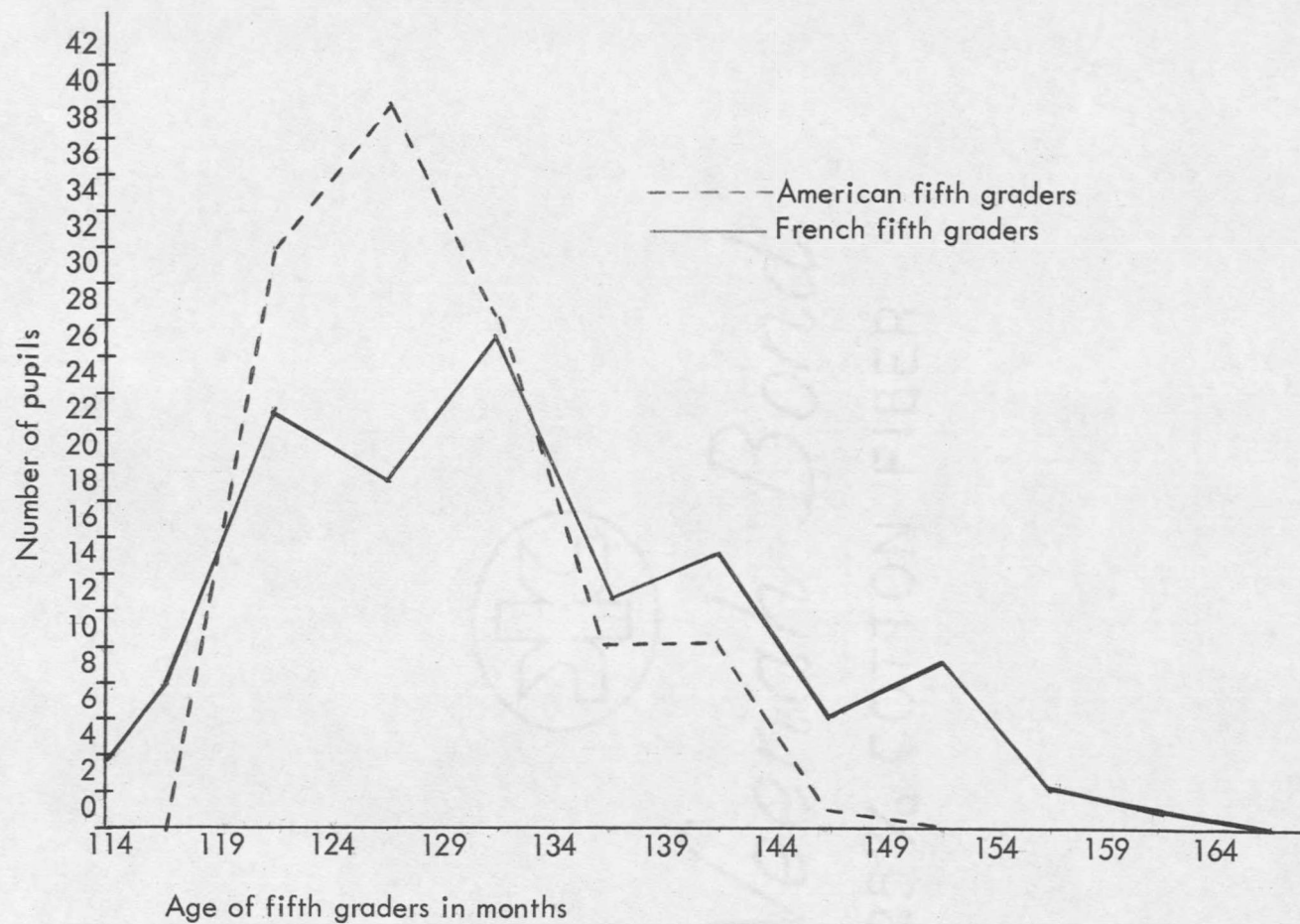


Figure 9. Frequency Distribution Of Ages Of Fifth Graders On October First For French And American Samples

An estimated frequency distribution of a national sample of 121 French fifth graders is also shown in Table 14. This distribution was estimated by analyzing the age distribution of the total French fifth grade population in the year 1960-1961 and figuring out the percentage of fifth graders of each age-group. These percentage figures were then converted into the expected frequency within each interval. It was assumed that children born within a given year would have birthdays equally distributed in each month of the year.

The mean age of the Le Trait sample ($\bar{X}_1$) was 131.9 months and the mean age of the national sample from the actual French school population ($\bar{X}_2$) was 132.4. A null hypothesis of difference at the 1 per cent level between these means was formulated. The standard deviation of the Le Trait sample (s_1) was 10.5 and that of the national sample (s_2) was 11.8. The standard variable of the differences between the means was tested with the following formula: where k is the number of students of each sample.¹

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2 + s_2^2}{k}}}$$

The t score was found to be .11, which is not significant at the 1 per cent level; the mean age of the French sample from Le Trait does not appear to differ significantly from the mean age of a national sample of 121 fifth graders.

Age span of an American sample of 121 fifth graders. The age distribution of a sample of 121 American fifth graders was estimated with the

¹This is the formula from which the formula on p. 88 was derived and it comes from the same source.

same procedure as that used for the estimated French sample, using the percentage figures derived from Sister Josephina's study. A sample of 121 American fifth graders would include 21 per cent of one-year repeaters and 1 per cent of pupils who had repeated more than one grade. The rest of the pupils would be of normal age, or from ten to eleven years of age October first of the school year--or from 120 to 131 months. The distribution of such a group has been plotted in Table 14 and is illustrated in Figure 9.

Differences in age-span in the French and in the American fifth grade samples. The mean age of the American fifth grade sample was 128.1, that of the French sample from Le Trait was 131.9. An hypothesis of null difference between these means at the 1 per cent level was formulated. The standard deviation of the French sample was 10.50, that of the American sample was 6.20. The standard variable of the difference between the means was 1.20 and was not significant at the level considered. The mean age of the French fifth grade sample is not significantly different from the mean age of the American fifth grade sample.

Difference in age-span in the French sample and in an American sample of 121 sixth graders. The age span of a sample of 121 American sixth graders was estimated by the same procedure used to estimate the American fifth grade sample.¹ Such a sample would be composed of 93 pupils of normal age--132 months to 143 months--, 27 one-year repeaters--

¹See footnote p. 93. Of the eighty-two pupils promoted to the fifth grade, 3.6 per cent would not be promoted to the sixth grade at the end of the school year. This would leave about 79 sixth-graders or 21 per cent of the original group. According to Sister Josephina, a sixth-grade class would also include 2.5 per cent of sixth graders who repeated the sixth grade. Therefore 23.5 per cent of the 121 sixth-graders--or 28 pupils--would not be promoted, one of these pupils being a two-year repeater.

144 months to 155 months-- , 1 two-year repeater--156 months to 167 months. The age distribution of this sample has been plotted in Table 14. The mean of this distribution was 140.3 months, and the standard deviation was 6.48. The significance of the difference between this mean and that of the mean of the Le Trait sample was figured out and the standard variable was 2.64, which was significant at the 1 per cent level. The null hypothesis was rejected and the alternative hypothesis leading to a one-tail test could be accepted. The mean age of the French sample of Le Trait has been shown to differ significantly from the mean age of a sample of American sixth graders. The mean age of French fifth graders is thus closer to the mean age of American fifth graders than to the mean age of American sixth graders.

A grade by grade comparison of the achievement of pupils, and a comparison of arithmetic programs in the French and in the American elementary schools, seems therefore meaningful from the standpoint of the age-levels of the pupils in the fifth grade. An investigation of the age-distribution of the French school population in 1960-61¹ shows that the proportion of repeaters was greater in the fifth grade than in any other grade, whereas Sister Josephina's survey showed that the same proportion was smaller in the American fifth grade than in any other grade. The difference between the mean ages of the French pupils and that of the American pupils should, therefore, be smaller from the first to the fourth grade than it is in the fifth grade, and should not be significant.

¹France, Ministère de l'Education Nationale, Information Statistiques 38 (Mars, 1962), p. 85.

An important remark to be made at this point is that, although the differences in age-spans were not found to be "significant," they might still be "important" differences. The standard deviation of the American sample was 6.2 months, whereas the standard deviation of the French Le Trait sample was 10.5 months and that of the French national sample was 11.8 months. The age-span of French fifth graders is much larger than the age-span of American fifth graders because of the number of students older than normal age, but also because of the number of students younger than normal age.

Differences in Time Allotted to Arithmetic in French and in American Schools

An investigation of the extent of time allotted to arithmetic in the French and in the American schools included an analysis of the length of the school-year and of the weekly arithmetic schedules in the schools of both countries. The actual time spent on arithmetic by French fifth-graders and by American fifth-graders by the end of the fifth grade, was then estimated and compared.

The length of the school-year in France is exactly 180 days, according to the official figures of the Ministry of National Education.¹ During the 1961-1962 school-year, classes started on September 17, and ended July first, but the Easter vacation was longer for French students than for American students. Although the length of the school-year varies from

¹France, Ministère de l'Education Nationale, Emploi du Temps pour 1961-1962, Ecoles Primaires. (Paris: Ministère de l'Education Nationale, 1961)

state to state in the United States, a survey of educational literature revealed that 180 days is considered the average length of the school-year also in the United States.¹

The weekly arithmetic schedule in French elementary public schools was readily available, for it is established by the Ministry of National Education.² It is, therefore, the same for all public schools in France. The following indicates the breakdown of time scheduled:

45 minutes a day in the first grade
42 minutes a day in the second and in the third grade
60 minutes a day in the fourth and fifth grade

Arithmetic schedules vary greatly in American schools, especially in the first two grades. In examining some of the literatures in the field to find evidence of surveys of weekly schedules, the researcher discovered, in a survey made in 1960, the average number of minutes allotted to arithmetic each week in American schools.³ It was as follows:

200 minutes a week, or 40 minutes a day, in the first three grades
225 minutes a week, or 45 minutes a day, in the fourth and fifth grades

On the basis of these figures, it was determined that a French pupil spends 180 times 45 minutes, or 8,100 minutes on arithmetic in the first grade, 180 times 42 minutes, or 7,560 minutes in the second, and also in the third grades, and 180 times 60 minutes, or 10,800 minutes in the

¹D. S. Sarnier, "Why 180 Days of School," Clearing House, LIX (November 1959), p. 181.

²France, Ministère de l'Education Nationale, Horaires et programmes de l'Enseignement du Premier Degré, (Paris: Vuibert, 1960) p. 2

³Edward Smith, Standley W. Krouse, and Mark M. Atkinson, The Education Encyclopedia (England Cliff, N. J.: Prentice-Hall, Inc., 1961)

fourth, and also in the fifth grades. From the first grade through the fifth grade such a pupil would thus spend 44,020 minutes on arithmetic.

On the average, the time spent on arithmetic in an American elementary school would be 180 times 40 minutes, or 7,200 minutes in each of the first three grades, 180 times 45 minutes, or 8,100 minutes in each of the fourth and fifth grades; thus, a total of 37,800 minutes on arithmetic in the first five grades. In other words, the total number of minutes spent on arithmetic during the first five years in French schools is 7,020 minutes longer than the average time spent on arithmetic in American schools during the comparable period. This is a large difference although it is less than the length of time spent on arithmetic in any grade of the French or of the American schools.

The time spent on arithmetic by the French Le Trait sample by the end of the fifth grade is that spent by all French pupils as the French official program is the same for all public schools, the first grade schedule has not changed since 1947, and the schedule from the second grade to the fifth has not changed since 1956. The weekly time spent on arithmetic by the Bozeman sample was:

- 240 minutes in the fifth grade in 1961-62
- 250 minutes in the fourth grade in 1960-61
- 250 minutes in the third grade in 1959-60
- 200 minutes in the second grade in 1958-59
- 180 minutes in the first grade in 1957-58

This corresponds to a total of 40,320 minutes a year, or 3,700 minutes less than the French Le Trait pupils spent on arithmetic. This difference is about 40 per cent of the time spent on arithmetic by the Bozeman pupils in the fourth or in the fifth grade.

This extra time spent on arithmetic by the French pupils is probably a contributing factor in the differences in grade placements and in achievements which were found in the first parts of the investigation. Concepts of the same difficulty, however, were found to be presented more than a year earlier in the French textbooks than in the American textbooks, and there were some indications that the achievement of French fifth graders in problem-solving skills might be superior to that of American sixth graders. In this case, other factors, beside the length of school-time spent on arithmetic, would have to be involved to explain the differences in grade placements and in achievements.

In summary, the grade by grade comparison of grade placements of arithmetic concepts, of methods employed to teach these concepts, and of achievement of pupils in the French and in the American schools, seems meaningful from the standpoint of the age-level of the pupils, as the mean age of the French pupils does not differ significantly from the mean age of the American pupils of the same grades. Although French pupils spend more school-time on arithmetic than American pupils, the difference, by the end of the fifth grade, is less than the length of time spent on arithmetic in any one grade. The time spent on arithmetic by French pupils by the end of the fifth grade is closer to the time spent on arithmetic by Bozeman pupils at the end of the fifth grade than to that spent by Bozeman pupils by the end of the sixth grade. It was, therefore, more logical to compare the achievement of French fifth graders to that of Bozeman fifth graders instead of comparing it to that of Bozeman sixth graders, from the standpoint of school-time spent on arithmetic.

These differences in age-spans and in school-time spent on arithmetic in the French and in the American schools should, however, be considered, together with possible differences in the French and the American philosophies of education, when evaluating the results of this investigation and considering its implications for the American program. A summary of the findings for the investigation appears in Chapter 7.

CHAPTER VII

SUMMARY, CONCLUSIONS, AND IMPLICATIONS OF THE STUDY

The problem in this investigation was to determine what differences, if any, existed in the grade placements of arithmetic concepts, in the methods employed to teach the concepts, and in the achievement attained by students in the first five grades of the French and of the American elementary public schools.

The study consisted of four main steps:

1. The grade placements of major arithmetic concepts in the French and in the American textbook series of current use were investigated and compared.
2. The procedures employed to present major arithmetic concepts related to various topics, as revealed in the style presented in the French and in the American textbook series, were investigated and compared.
3. The emphases placed on all the concepts of respective topics in the French and in the American textbook series were investigated and compared.
4. The achievement of French fifth graders was compared to that of American fifth, sixth, and seventh graders, to determine whether the differences found in the first three steps of the investigation corresponded also to differences in achievement.

Summary

The comparison of grade placements of major arithmetic concepts showed that concepts of the same difficulty were presented earlier in the French arithmetic series than they were in the American arithmetic series for most topics. Concepts representing the upper level of difficulty

reached by each arithmetic textbook investigated were placed, on the average, 1.2 grades earlier in the French arithmetic texts than in the American arithmetic texts, when all topics but the topic of measures, and that of terms and other topics, were investigated.

The second step, an investigation of the differences in procedures employed to present arithmetic concepts revealed that the French and the American arithmetic textbooks appear to use very similar techniques and devices to explain the concepts of most arithmetic topics.

The investigator found differences between the French and the American texts in the emphases on the concepts of respective topics, as evidenced by the proportion of textbook space devoted to the concepts of these topics. These differences were: (1) the textbook-space devoted to addition, subtraction, multiplication, and division of whole numbers in the French arithmetic textbook series is mostly distributed in the first three grades, whereas the textbook-space devoted to these topics in the American arithmetic textbook series of the fourth and fifth grades is still very large; and (2) as a result the French textbooks of the fourth and fifth grades devote much of their textbook-space--a total of 46.5 per cent of the fourth grade textbook-space and 41.5 per cent of the fifth grade textbook-space--to concepts relating to geometry, ratio and per cents, whereas the American textbooks of the same grades devote much less space to concepts relating to these topics--4.5 per cent of the fourth grade textbook-space and 12 per cent of the fifth grade textbook-space.

An investigation of the textbook-space allotted to problems or to lessons on problem-solving techniques revealed that the portion of

textbook-space devoted to these subjects was more expansive in the French arithmetic texts than in the American texts at each grade level, the average difference for all five grades being 24.5 per cent, or almost one-fourth of the textbook-space.

The next step of the study was to investigate the differences in achievements of French and American elementary-school pupils. The achievement of a sample of 59 French fifth graders, who took the Iowa Arithmetic Test of Basic Skills, was investigated and compared with the achievement of a sample of 59 American fifth graders from Bozeman, Montana, who took the same test and were matched to the French pupils by sex and mental age. The arithmetic achievement of the French pupils was found to be significantly superior at the 5 per cent level to that of the Bozeman pupils for the total arithmetic test. This superiority of achievement in the total test by the French pupils, however, resulted from a high average score on part A2 of the test--Arithmetic problem solving--, as the achievement of the Bozeman pupils was slightly better than that of the French pupils for part A1 of the test--Arithmetic concepts--, although this difference was not significant. The arithmetic achievement of a larger sample of 121 French students was also compared to the arithmetic achievement of the normative sample of the Iowa Test of Basic Skills. The achievement of the French students for part A2 of the test--Arithmetic problem solving--was superior to that of 99 per cent of the American fifth grade classes, 99 per cent of the sixth grade classes and 78 per cent of the seventh grade classes of the American normative sample.

An investigation of differences in the ages of the students and

differences in the lengths of school-time spent on arithmetic in the elementary public schools in France and in the United States, was made to see whether a grade by grade comparison of arithmetic programs and of achievements was meaningful. The difference between the mean ages of French and of American fifth graders was not found to be significant. The amount of school-time spent on arithmetic by a French student by the end of the fifth grade was found to be larger than that spent on arithmetic by an American student by the end of the fifth grade, although the difference was less than the length of time spent on arithmetic in any of the first five grades.

Conclusions

The first main conclusion which can be drawn from the findings is that greater challenges in arithmetic are offered at an earlier grade-level to French elementary grade pupils than to American elementary grade pupils, arithmetic concepts of the same difficulty being presented over a year earlier for most arithmetic topics.

A second important conclusion is that problems and lessons on problem solving appear to occupy a greater place in the arithmetic elementary program in the French schools than in the American schools.

A final conclusion is that there are indications that the achievement in arithmetic by French fifth graders is superior to the achievement in arithmetic by American fifth graders of the same mental age because of a superiority in problem-solving skills. More specific conclusions cannot be drawn until the achievement of large random samples of French and of

American pupils are investigated.

Implications of the Study

The new trend in arithmetic teaching is toward a more challenging program earlier in the American schools. This study was an investigation of grade-placements, method of teaching and achievement in a country which has such a program. This certainly does not mean that the American school system should adopt the French arithmetic program, for the French and the American school systems and their objectives of education differ greatly, and the investigator feels that differences in the length of school-time spent on arithmetic and in the distribution of the ages of students in the French and in the American schools should be taken into consideration when evaluating the arithmetic programs of both countries. The mean age of French fifth graders was not found to differ significantly from the mean age of American fifth graders; the French fifth grade classes, however, are composed of a greater number of younger pupils and a greater number of older pupils, and this might reflect differences in practices and objectives of the French and of the American school systems.

The French school system is very different from the American school system, as the philosophy of "one school for all" applies only up to the end of the fifth grade in France. The program of the French elementary public schools is practically the same for all children, just as it is in the United States. The fifth grade, which is the last year of the French elementary school, is a decisive year for the French children as, from this grade on, they attend different types of secondary schools. Their

achievement in the fifth grade is to determine the type of secondary school they are to attend. This might create a greater incentive to pupils and teachers in the French schools, whereas such an incentive would have no reason to exist in the American fifth grade, as students still have many years to decide on their future curricula and professions.

The investigation of age-span differences has shown that French fifth grade classes had a large number of pupils older than normal-age, whereas American fifth grade classes had fewer of those pupils. One of the reasons for this might be that the curriculum is too difficult for many pupils of average or below average ability. Repeaters might become disinterested in the class or socially misadjusted, although the number of pupils who repeated a grade previously is large enough that such children would not feel singled out as they would in the United States.

The age-span investigation, however, has also shown that the number of children younger than normal age was greater in the French fifth grade than in the American fifth grade. The writer feels that a child of above average ability has more chance to work up to his ability in a French public school than in an American public school having no special classes for the gifted. American enrichment programs within the classroom give very good results, but only if such programs are followed from year to year. Also, if the enrichment is intensive, the pupil might be so advanced by the beginning of the next year that the curriculum no longer seems challenging to him.

Another problem to be considered is: Could a more difficult arithmetic program be presented, even to gifted pupils, without adding some

school time to arithmetic teaching? The achievement investigation gave indications that the achievement in arithmetic of the French pupils might be superior, for problem-solving skills to that of American pupils of a higher grade. The writer feels that, without extra time spent on arithmetic, American pupils could master more difficult problem skills if such skills were stressed more in their programs from the first grade on.

The practice of letting pupils proceed at their own pace, throughout the grade-system, renders the classes more homogeneous for mental ages of pupils, but less homogeneous for chronological ages. Furthermore intelligence does not necessarily correspond to social maturity. More research has to be done, and more experimental programs have to be tried out before a solution can be reached. This is especially true for the United States where the social adjustment of the pupils is considered a major aim of education. Experiments in non-graded schools seem very promising, and the writer feels that a solution might be reached in the future.

APPENDIX

Appendix A

Grade Placement Table of Arithmetic Concepts
in the French and the American
Series Investigated

APPENDIX A

Table Showing Grade Placements of Arithmetic Concepts
in the French and in the American Textbook
Series Investigated*

Level of arithmetic concepts	Grade in which concept is presented												Difference	Rank of difference		
	American texts											French texts				
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Mean grade	F1			F2	Mean grade
<u>Number System</u>																
to 100	1	1	1	1	1	1	1	1	1	1	1.0	1		1.0	0	
to 150	2	2	2	2	2	2	2	2	2	2	1.9	2	2	2.0	+ .1	3
to 200	2	2	2	2	2	2	2	2	2	2	2.0	2	2	2.0	0	
to 500	2	3	3	3	3	2	2	3	2	3	2.6	2	2	2.6	+ .6	13
to 999	3	3	3	3	3	2	2	3	2	3	2.7	2	2	2.0	+ .7	14
to 9,999	3	4	4	4	4	3	3	4	3	4	3.6	2	2	2.0	+1.6	39.5
to 5 figures	4	4	4	4	4	4	4	4	4	4	4.0	3	3	3.0	+1.0	22.5
to 6 figures	4	4	4	5	4	5	4	4	4	4	4.2	3	3	3.0	+1.2	30.5
to 7 figures	5	5	5	5	5	5	4	4	5	4	4.7	3	3	3.0	+1.7	42
to 8 figures	5	5	5	5	5	5	4	4	5	5	4.8	3	3	3.0	+1.8	43

APPENDIX A (Continued)

Level of arithmetic concepts	American texts										Mean	French texts			Difference	Rank of difference
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10		F1	F2	Mean		
to 9 figures	5	5	5	5	5	5	5	5	5	5	5.0	4	4	3.5	-1.5	38
to 12 figures												5	5			
<u>Addition of whole numbers</u>																
Sums to 6	1	1	1	1	1	1	1	1	1	1	1.0	1		1.0	0	
Sums to 7	1	1	1	1	1	1	1	2	1	1	1.1	1		1.0	+ .1	3
Sums to 9	1	2	1	1	1	1	1	2	1	1	1.2	1		1.0	+ .2	7.5
Sums to 10	1	2	1	1	2	1	1	2	1	2	1.4	1		1.0	+ .4	10.5
Sums to 12	2	2	2	2	2	2	2	2	2	2	2.0	1		1.0	+1.0	22.5
Sums to 17	2	2	2	2	2	2	2	3	2	2	2.1	1		1.0	+1.1	26.5
Sums to 18	2	2	3	2	2	2	2	3	2	2	2.2	1		1.0	+1.2	30.5
2 fig. by 1 fig., no carrying.	2	2	3	2	2	2	3	3	2	3	2.4	1		1.0	+1.4	35.5
2 fig. by 2 fig., no carrying.	2	3	3	2	2	2	3	3	2	3	2.5	1		1.0	+1.5	38.
3 fig. by 3 fig., no carrying.	3	3	3	3	3	3	3	3	2	3	2.9	1		1.0	+1.9	45.5
2 fig. by 2 fig., carrying.	3	3	3	3	3	3	3	3	3	3	3.0	1		1.0	+2.0	52.5

APPENDIX A (Continued)

Level of arithmetic concepts	American texts											French texts			Difference	Rank of difference
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Mean	F1	F2	Mean		
3 fig. by 3 fig., carrying.	3	3	3	3	3	3	3	3	3	3	3.0	2	2	2.0	+1.0	22.5
4 fig. by 4 fig., carrying.	4	4	4	4	4	4	4	4	4	4	4.0	2	2	2.0	+2.0	52.5
5 fig. by 5 fig., carrying.	5	5	5	5		5		4				3	3	3.0		
6 fig. by 6 fig., carrying.												3	3	3.0		
9 fig. by 9 fig., carrying.												4	4	4.0		
12 fig. by 12 fig., carrying.												5	5	5.0		
<u>Subtraction of whole numbers</u>																
Minuend to 6	1	1	1	1	1	1	1	1	1	1	1.0	1		1.0	0	
Minuend to 7	1	1	1	1	1	1	1	2	1	1	1.1	1		1.0	+ .1	3
Minuend to 9	1	2	1	1	1	1	1	2	1	1	1.2	1		1.0	+ .2	7.5
Minuend to 10	1	2	1	1	2	1	1	2	1	2	1.4	1		1.0	+ .4	10.5
Minuend to 12	2	2	2	2	2	2	2	2	2	2	2.0	1		1.0	+1.0	22.5
Minuend to 17	2	2	2	2	2	2	2	3	2	2	2.1	1		1.0	+1.1	26.5
Minuend to 18	2	2	3	2	2	2	2	3	2	2	2.2	1		1.0	+1.2	30.5

APPENDIX A (Continued)

Level of arithmetic concepts	American texts											French texts			Difference	Rank of difference
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Mean	F1	F2	Mean		
1 fig. from 2 fig., no borrowing.	2	2	3	2	2	2	2	3	2	3	2.3	1		1.0	+ 1.3	34
2 fig. from 2 fig., no borrowing.	2	3	3	2	2	2	3	3	2	3	2.5	1		1.0	+ 1.5	38
3 fig. from 3 fig., no borrowing.	3	3	3	3	3	3	3	3	2	3	2.9	1		1.0	+ 1.9	45.5
1 fig. from 2 fig., borrowing.	3	3	3	3	3	3	3	3	3	3	3.0	1		1.0	+ 2.0	52.5
2 fig. from 2 fig., borrowing.	3	3	3	3	3	3	3	3	3	3	3.0	2	2	2.0	+ 1.0	22.5
2 or 3 fig. from 3 fig. borrowing.	3	3	3	3	3	3	3	3	3	3	3.0	2	3	2.5	+ .5	12
4 fig. from 4 fig., borrowing.	4	4	4	4	4	4	4	4	4	4	4.0	3	3	3.0	+ 1.0	22.5
5 fig. from 5 fig., borrowing.	5	5	5	5		5		4				3	3	3.0		
6 fig. from 6 fig., borrowing.				5								3	3	3.0		
9 fig. from 9 fig., borrowing.												4	4	4.0		
12 fig. from 12 fig., borrowing.												5	5	5.0		

APPENDIX A (Continued)

Level of arithmetic concepts	American texts										French texts			Difference	Rank of difference	
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Mean	F1	F2			Mean
<u>Multiplication of whole numbers</u>																
Concept of subgroup	3	2	1	2	3	2	2	2	3	2	2.2	1		1.0	+1.2	30.5
Easier multiplication facts.	3	3	3	3	3	3	3	3	3	3	3.0	1		1.0	+2.0	52.5
1 fig. by 3 fig., no carrying.	3	3	4	3	3	3	4	3	3	3	3.2	1		1.0	+2.2	60.5
1 fig. by 2 fig., carrying.	3	3	4	4	3	3	4	3	3	3	3.3	1		1.0	+2.3	62.5
1 fig. by 3 fig., carrying.	3	3	4	4	3	3	4	4	3	3	3.4	2	2	2.0	+1.4	35.5
2 fig. by 2 fig., carrying.	4	4	4	4	4	4	4	5	4	4	4.1	2	2	2.0	+2.1	58.5
3 fig. by 2 fig., carrying.	4	5	5	5	5	4	5	5	4	5	4.7	3	3	2.5	+2.2	60.5
3 fig. by 3 fig., carrying.	5			5		4	5		4			3	3	3.0		
4 fig. by 2 fig., carrying.	5						5					4	4	4.0		
4 fig. by 4 fig., carrying.												4	4	4.0		
4 fig. by 6 or more fig., carrying.												5	5	5.0		
<u>Division of whole numbers</u>																
Concept of subgroup	3	2	1	2	3	2	2	2	3	2	2.2	1		1.0	+1.2	30.5

APPENDIX A (Continued)

Level of arithmetic concepts	American texts											French texts			Difference	Rank of difference
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Mean	F1	F2	Mean		
Easier division facts	3	3	3	3	3	3	3	3	3	3	3.0	1		1.0	+ 2.0	52.5
2 fig. by 1 fig., no borrowing.	3	3	3	3	3	3	3	3	3	3	3.0	1		1.0	+ 2.0	52.5
3 fig. by 1 fig., no borrowing.	3	3	3	3	4	3	4	3	3	3	3.2	2	2	2.0	+ 1.2	30.5
2 fig. by 1 fig., borrowing.	4	4	4	4	4	4	4	4	4	4	4.0	2	2	2.0	+ 2.0	52.5
3 or 4 fig. by 1 fig., borrowing	4	4	4	4	4	4	4	4	4	4	4.0	2	2	2.0	+ 2.0	52.5
2 fig. by 2 fig., borrowing.	5	5	4	5	5	5	4	5	5	5	4.8	2	2	2.0	+ 2.8	64.5
3 fig. by 2 fig., borrowing.	5	5	4	5	5	5	4	5	5	5	4.8	3	2	2.5	+ 2.3	62.5
4 fig. by 2 fig., borrowing.	5	5	5	5	5	5	4	5	5	5	4.9	3	3	3.0	+ 1.9	45.5
5 fig. by 2 fig., borrowing.	5	5	5	5	5	5	5	5	5	5	5.0	3	3	3.0	+ 2.0	52.5
6 fig. by 2 fig., borrowing.				5			5		5			3	3	3.0		
4 fig. by 3 fig., borrowing.				5			5	5	5			4	4	4.0		

APPENDIX A (Continued)

Level of arithmetic concepts	American texts											French texts			Difference	Rank of difference
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Mean	F1	F2	Mean		
5 fig. by 3 fig., borrowing.							5		5			4	4	4.0		
7 fig. by 5 fig., borrowing.												4	4	4.0		
<u>Fractions</u>																
one half	2	1	1	1	1	1	2	1	1	1	1.2	1	1	1.0	+ .2	7.5
one half, one fourth	2	2	2	2	2	2	2	2	2	3	2.1	2	2	2.0	+ .1	3
one half, one fourth, one third	3	3	2	3	3	3	3	2	2	3	2.7	3	2	2.5	+ .2	7.5
unit fractions to one ninth	4	3	4	4	4	4	4	4	3	4	3.8	3	3	3.0	+ .8	16
Fractions of several units	4	4	4	4	4	4	4	4	3	4	3.9	4	4	4.0	- .1	3
Comparison of fractions.	4	4	4	4	4	4	4	4	4	4	4.0	4	4	4.0	0	
Add., sub. of like fract. and mix. nrs.	5	5	5	5	5	5	5	5	4	4	4.8	4	4	4.0	+ .8	16
Add., sub. of unlike fract. and mix. nrs.	5	5	5	5	5	5	5	5	5	5	5.0	5	5	5.0	0	

APPENDIX A (Continued)

Level of arithmetic concepts	American texts										Mean	French texts			Difference	Rank of difference
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10		F1	F2	Mean		
<u>Decimal numbers</u>																
Money decimals	3	3	2	3	3	3	3	3	3	3	2.9	5	5	5.0	-2.1	58.5
Add., sub. of decim. to one hundredth.	5	5	5	5	5	5		5	5	5		5	5	5.0		
Add., sub. of decim. to one thousandth.									5			5	5	5.0		
Four oper. of decim. to ten thousandth.												5	5	5.0		
<u>Geometry and geometrical measurement</u>																
Introduction to basic shapes.	5	1	1	1	1	1	3	5	5	3	2.6	1		1.0	+1.6	39.5
Perimeter of square, rectangle.	5	5	5	5	4	5	5	5	5	4	4.8	2	2	2.0	+2.8	64.5
Area of square, rectangle.	5	5	5	5	5	5	5	5	5	5	5.0	3	3	3.0	+2.0	52.5
Volume cube, rect., prism, etc.												4	4	4.0		

APPENDIX A (Continued)

Level of arithmetic concepts	American texts											French texts			Difference	Rank of difference
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Mean	F1	F2	Mean		
<u>Graphs</u>																
Tables and bar graphs	5	5	4	5	4	5	5	5	5	5	4.8	4	4	4.0	+ .8	16
Bar and line graphs	5	5	5	5	4	5	5	5	5	5	4.9	4	4	4.0	+ .9	18.5
<u>Ratio</u>																
Ratio in speed, distance and rate prob.	5	5	4	5		4	5	5	5	5		3	3	3.0		
More advanced concepts							5					4	4	4.0		
<u>Per cents</u>																
Concept of percentage							5					4	4	4.0		
Discount, benefit.												4	4	4.0		
<u>Scale-drawing</u>	5	5	5	5	5	5	4	5	5	5	4.9	4	4	4.0	+ .9	18.5

*See pp. 17-19 for titles of series corresponding to code number T1-10 and F1-2.

Appendix B

Percentile Scores of Pupils of the French Sample
on the Iowa Arithmetic Test of Basic Skills
in American Norms for Fifth, Sixth,
and Seventh Graders

APPENDIX B

PERCENTILE SCORE OF PUPILS OF THE FRENCH SAMPLE ON THE
IOWA ARITHMETIC TEST OF BASIC SKILLS IN AMERICAN
NORMS FOR FIFTH, SIXTH AND SEVENTH GRADERS

Pupils	Age in months October first	5th grade test			6th grade test			7th grade test		
		A1	A2	A	A1	A2	A	A1	A2	A
Class a										
a1	114	86	65	75	65	59	63	66	69	68
a2	116	90	91	89	86	95	91	80	86	83
a3	125	88	83	85	81	97	93	89	95	93
a4	122	92	97	96	86	99	97	80	94	89
a5	117	86	65	75	74	74	75	73	62	68
a6	122	46	99	92	47	99	93	50	86	71
a7	124	78	60	68	47	74	59	62	62	62
a8	127	70	77	71	50	80	68	36	46	41
a9	124	92	94	91	86	97	94	89	86	88
a10	134	46	94	79	43	95	78	62	95	87
a11	133	70	77	71	37	85	63	46	79	64
a12	130	88	96	93	77	95	90	46	76	62
a13	123	46	83	66	30	67	46	14	26	18
a14	121	29	77	52	12	67	34	14	54	31
a15	133	56	96	85	43	98	86	44	79	60
a16	132	61	97	89	54	99	94	46	84	68
a17	134	52	74	59	37	42	38	27	36	37
a18	118	61	74	63	20	59	34	27	21	23
a19	139	86	95	91	86	95	91	70	79	75
a20	124	56	87	71	33	89	63	44	62	50
a21	144	88	94	91	90	99	98	73	86	81
a22	150	78	98	94	47	99	90	44	84	64
a23	152	12	60	31	1	59	11	3	26	8
Class b										
b1	129	93	99	98	81	99	96	80	89	86
b2	125	96	98	98	88	97	94	80	76	78
b3	131	90	96	94	74	97	91	77	92	87
b4	125	83	99	97	65	99	95	73	86	81
b5	117	86	99	97	62	99	95	54	89	77
b6	141	74	99	95	50	99	93	62	86	77
b7	124	78	98	93	54	97	87	73	69	71
b8	124	83	94	90	40	99	89	62	84	75
b9	132	88	99	97	50	98	89	46	54	50
b10	125	78	98	94	54	97	87	46	79	64
b11	133	78	98	93	58	97	88	46	79	64

APPENDIX B (Continued)

Pupils	Age in months October first	5th grade test			6th grade test			7th grade test		
		A1	A2	A	A1	A2	A	A1	A2	A
Class b										
b12	132	70	98	91	54	95	84	70	46	58
b13	143	50	98	89	37	95	76	43	79	62
b14	125	61	91	79	54	97	87	66	69	68
b15	134	56	98	90	54	98	90	43	69+	56
b16	132	74	94	87	43	85	68	43	46	45
b17	123	61	98	89	50	99	93	36	54	45
b18	122	74	87	79	43	59	50	36	54	45
b19	148	41	94	77	12	91	55	36	62	48
b20	137	37	94	75	33	91	69	30	62	46
b21	117	33	83	59	37	89	68	43	62	52
b22	121	65	83	73	65	74	71	24	54	38
b23	118	46	22	29	40	31	34	59	26	40
b24	149	33	98	82	14	89	52	24	26	24
b25	142	37	83	61	20	80	48	24	38	31
b26	122	61	74	65	26	59	40	18	26	21
b27	136	46	77	61	37	43	38	8	63	28
b28	128	17	91	59	17	95	65	14	62	35
b29	143	29	74	50	7	59	26	30	38	35
b30	129	38	77	57	26	35	28	24	32	28
b31	137	33	91	68	12	89	50	8	69	31
b32	156	33	43	36	32	35	32	27	38	33
b33	140	33	39	31	33	8	15	30	14	20
b34	123	25	74	59	6	67	28	8	26	11
b35	130	12	87	50	12	59	30	3	21	6
b36	130	12	65	31	12	46	24	1	14	3
Class c										
c1	133	94	99	98	91	99	99	66	98	92
c2	132	92	97	96	74	99	95	62	96	89
c3	133	96	98	98	91	99	98	66	92	84
c4	128	94	96	95	91	98	97	54	86	73
c5	130	88	98	96	62	99	95	43	94	78
c6	119	98	98	98	70	99	94	36	84	62
c7	119	78	98	94	65	98	93	46	86	70
c8	139	78	94	88	70	91	85	66	84	77
c9	137	88	94	92	74	91	86	46	62	55
c10	120	61	98	91	37	99	93	46	79	64
c11	139	61	96	86	47	91	75	54	79	68
c12	120	61	99	94	54	99	95	30	84	58
c13	125	55	91	80	50	91	78	36	76	56

APPENDIX B (Continued)

Pupils	Age in months October first	5th grade test			6th grade test			7th grade test		
		A1	A2	A	A1	A2	A	A1	A2	A
c14	130	50	98	89	30	98	97	30	76	52
c15	142	55	97	90	47	85	69	40	62	50
c16	127	61	98	91	33	89	65	36	46	49
c17	133	46	96	82	12	99	82	30	84	58
c18	150	56	98	90	37	99	93	8	89	64
c19	150	50	96	83	30	95	73	36	69	52
c20	162	55	98	92	37	95	79	24	54	38
c21	121	46	94	79	33	95	75	30	76	52
c22	132	37	91	69	37	89	68	40	62	50
c23	137	61	98	91	47	80	65	43	6	17
c24	122	41	96	80	26	98	81	24	54	38
c25	126	46	87	69	20	85	52	30	54	41
c26	152	46	83	65	33	98	84	24	69	45
c27	123	25	96	71	6	95	55	11	84	43
c28	119	74	97	92	40	97	82	14	62	35
c29	115	33	87	63	14	91	57	14	76	41
c30	140	25	94	69	7	85	42	36	32	35
c31	123	65	83	73	30	55	40	27	21	23
c32	148	37	50	43	26	67	44	11	79	40
c33	140	46	60	52	12	42	22	11	38	21
c34	131	17	83	50	12	55	28	18	32	24
c35	145	25	65	43	4	55	20	5	21	8
c36	133	25	17	16	6	24	9	1	32	7
c37	132	1	5	1	1	1	1	1	3	1
Class d										
d1	124	83	98	95	54	91	79	66	76	71
d2	132	90	99	98	65	99	95	96	76	62
d3	143	74	98	93	65	85	78	62	84	75
d4	121	56	98	90	43	97	84	17	69	70
d5	131	37	98	86	30	91	68	36	84	62
d6	136	46	87	69	33	89	65	43	84	66
d7	127	61	91	79	33	55	42	11	84	43
d8	150	37	97	83	33	85	61	40	54	47
d9	124	50	77	63	47	85	69	46	54	50
d10	152	50	97	87	20	80	48	27	46	37
d11	141	61	97	89	47	89	73	30	21	24
d12	132	37	83	61	33	91	69	36	76	56
d13	121	56	87	73	40	55	46	30	26	28
d14	152	29	91	73	33	85	61	24	76	48
d15	136	33	77	55	17	59	34	24	62	41
d16	148	70	50	59	33	55	42	11	38	22

APPENDIX B (Continued)

Pupils	Age in months October first	5th grade test			6th grade test			7th grade test		
		A1	A2	A	A1	A2	A	A1	A2	A
Class d										
d17	157	46	83	65	20	80	48	8	46	22
d18	135	25	77	50	26	67	44	36	32	33
d19	123	17	74	43	6	59	40	27	62	43
d20	136	25	74	48	12	80	42	14	26	19
d21	119	25	91	63	12	46	24	14	32	22
d22	143	12	77	41	26	55	38	40	21	29
d23	147	50	32	38	37	31	32	36	21	28
d24	120	21	32	46	6	55	22	14	46	28
d25	132	17	83	50	6	67	26	11	32	17

Appendix C

Scores of French and American Fifth Graders
on the Arithmetic Iowa Test of Basic Skills

APPENDIX C

SCORES OF FRENCH AND AMERICAN FIFTH GRADERS ON
THE ARITHMETIC IOWA TEST OF BASIC SKILLS

French fifth graders					American fifth graders				
Age in months Jan. 30	Mental age Otis	Scores			Age in months Jan. 30	Mental age Otis	Scores		
		Test A1	Test A2	Test A			Test A1	Test A2	Test A
114	155	32	18	50	122	156	36	23	59
120	162	34	23	57	132	165	37	27	64
129	160	33	21	54	124	160	37	26	63
126	155	35	26	61	127	154	37	18	55
121	146	32	18	50	129	146	26	6	32
126	151	23	28	51	141	151	18	12	30
128	154	30	17	47	133	154	35	25	60
131	157	28	20	48	135	157	36	26	62
128	154	35	24	59	133	153	38	21	59
138	164	23	24	47	132	170	36	24	60
137	163	28	20	48	134	163	32	15	47
134	155	33	25	58	133	156	35	17	52
127	147	23	21	44	126	147	27	17	44
125	141	19	20	39	125	141	27	17	44
137	153	25	25	50	135	153	26	16	42
136	152	26	26	52	133	152	35	26	61
138	159	24	19	43	128	159	35	14	49
122	135	26	19	45	135	135	31	17	48
143	154	32	24	56	144	152	29	22	51
128	136	25	22	47	128	136	17	7	24
148	154	33	24	57	136	152	35	13	48
154	154	30	27	57	143	156	18	13	31
156	117	15	17	32	136	114	16	8	24
133	161	36	28	64	134	161	33	22	55
129	159	38	27	65	130	161	34	21	55
135	159	34	25	59	139	157	35	20	55
129	142	31	28	59	128	142	32	22	54
121	142	32	28	60	130	142	23	21	44
145	144	29	28	57	143	144	19	9	28
128	140	30	26	56	130	140	33	19	52
128	142	31	24	55	133	142	22	9	31
136	159	33	28	61	129	156	37	21	58
129	146	30	27	57	126	146	30	19	37
137	144	30	26	56	133	144	33	22	55
135	150	28	26	54	136	150	23	10	33
147	144	24	27	51	137	144	27	9	36
129	144	26	23	49	127	144	26	21	47
127	141	25	27	52	129	141	24	9	33
136	137	29	24	53	134	137	26	15	41

APPENDIX C (Continued)

French fifth graders					American fifth graders				
Age in months Jan, 30	Mental age Otis	Scores			Age in months Jan, 30	Mental age Otis	Scores		
		Test A1	Test A2	Test A			Test A1	Test A2	Test A
127	150	26	27	52	127	150	37	16	53
126	151	29	22	51	136	152	33	26	59
151	157	22	24	46	133	156	30	15	45
141	133	21	24	45	129	134	10	9	19
121	138	20	21	41	124	138	24	10	34
125	141	27	21	48	129	143	31	16	47
133	153	23	10	33	134	150	32	20	52
153	161	20	26	46	134	158	33	26	59
146	115	21	21	42	146	114	17	13	30
126	145	26	19	45	128	145	37	23	60
140	141	23	20	43	140	141	17	8	25
132	135	16	23	39	136	136	24	8	32
147	132	19	19	38	144	132	19	10	29
133	124	21	20	41	138	126	14	8	22
141	137	20	23	43	125	137	29	16	45
160	149	20	14	34	133	149	28	8	36
144	144	20	13	33	144	145	17	14	31
127	135	18	19	37	129	134	28	21	49
134	138	15	22	37	145	138	16	6	22
134	127	15	18	33	135	127	23	12	35

Appendix D

Sample of Questionnaire Sent to State
Superintendents

Appendix D

Sample of Questionnaire Sent to State Superintendents

Dear Sir,

I am working on a Doctoral thesis and would appreciate very much your statement or opinion concerning the most used current Arithmetic textbook series used in the elementary schools of your state.

Would you say that the most used Arithmetic textbook series in your state are included in the following list of ten series?

If not, I would appreciate very much if you would write the name of the series which you are using extensively and which were not included in the list. Thank you.

Sincerely yours,

1. American Book Co. Arithmetic series: First Day with Numbers and American Arithmetic by Upton and Fuller.
2. Ginn series. Numbers We Need and Arithmetic We Need by Brownell and Weaver.
3. Harcourt, Brace and World series. One by One, . . . and Growth in Arithmetic by Clark and others.
4. Heath series. Learning to Use Arithmetic, by Fehr, Guderson and others.
5. Laidlaw series. Arithmetic, by McSwain and others.
6. C. Merrill series. Arithmetic for Today, by Columbus and others.
7. Scott, Foresman, series. Our Number Workshop . . . and Seeing through Arithmetic, by Hatung and others.
8. Silver Burdett series. Making Sure of Arithmetic, by Morton and others.
9. Webster series. Exploring Arithmetic, by Osborn, Spitzer and others.
10. Holt, Rinehart, and Winston series. Ready to Begin Numbers . . . and Using Number Ideas, by Bruecker, Morton and others.

Does this list include the Arithmetic textbook series which are used extensively in your state? YES _____ NO _____

If not what is the publisher (and title) of the series used extensively in your state? _____

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Differences in the grade place
ments of arithmetic concepts...

NAME AND ADDRESS	
10-11-65	RA 55
10-17-65	10-17-65
6-25-66	Mr
12/15	H. TUSHANS 707 S 13 Av
	12. TUSHANS 707 S1
	12/15

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