1957

A bibliography of six years (1951-1956) research in arithmetic

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Boston University
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Thesis

A BIBLIOGRAPHY OF SIX YEARS
(1951-1956) RESEARCH IN ARITHMETIC

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CHAPTER I

Problem

The problem of this study is to summarize research publications on elementary arithmetic during the past six years.

Justification

Up until April 1, 1951 the Review of Educational Research, every three years, prepared research summaries on elementary arithmetic. Since that date they have discontinued this practice.

Other research summaries done in the field of elementary arithmetic have been summarized in Chapter II of this thesis. These summaries can be divided into three categories: (1) those dealing with the methods and ways of teaching elementary arithmetic (34, 36, 37, 41, 42, and 45*); (2) those dealing in the theoretical and scientific place of arithmetic (35, 38, 39, 43, 44, and 46); and (3) selected references on elementary school instruction which are not all research on elementary arithmetic (40).

Certain periodicals, such as the Elementary School Journal, have annual selected annotated bibliographies which, in part, deal with elementary arithmetic research.

No serious attempt, as far as we know, has been conducted to summarize research publications on elementary arithmetic for the past six years which is directed exclusively toward the teacher. Therefore, this study has been made in order to acquaint and guide those teachers

*Refers to specific summaries noted in Chapter II of this thesis.
interested in the type of research that has been going on in the field of elementary arithmetic which can be of benefit to them and their pupils.

Scope and Limitations of Study

This study covers grades one through six and such research that has an impact on these grades, dating from April 1, 1951 to December 31, 1956. The type of Arithmetic publications have been limited to the following: experimental studies, status studies, analysis, research summaries, and problems in arithmetic. All publications used were published in the United States of America.

Proposed Procedure

The proposed procedure for this study is: (1) to gather from various indices all research publications; (2) to read and study each of these publications; and (3) to summarize each publication as to the problem, what was done, and the findings and conclusions.

The summaries are found in Chapter II of this thesis under the following categories:

1. abilities and concepts
2. addition
3. concepts
4. division
5. fractions
6. measurements
7. mental arithmetic
8. methods
9. multiplication
10. problem solving
11. remedial arithmetic
12. research summaries
13. subtraction
14. teacher education
15. miscellaneous.

Chapter III of this thesis notes the significant trends in elementary arithmetic and any conclusions which the summaries may imply.
Abilities and Concepts

(See also numbers 35, 36, 56, and 57 in this listing)


An experimental investigation, using children from grades one, two, and five (the data for grade one only, is reported) which examined the hypothesis that the degree of complexity of the perceptual field was a crucial factor in apprehending a number as a group. That is, complexity tended to create counting responses and simplicity tended to create grouping responses.

2. Ilg, Frances and Louise B. Ames "Developmental Trends in Arithmetic." Journal of Genetic Psychology 79;3-28; September 1951

This reports the development of thirty children from birth through age nine in arithmetic processes by presenting a gradient of the development of the child's concepts and abilities in regard to numbers and quantities.

3. Martin, William F. "Quantitative Expression in Young Children." Genetic Psychology Monograph 44;147-219; November 1951

Concerned with the development of a more informal technique by which the number abilities of the young child as they are related to age, sex, occupational level, and intelligence can be studied in the hope that confirmation of previous
findings would be obtained as well as additional information concerning the developmental process. A sample of 150 children ranging from ages three to seven enrolled in the same kind of school were used. Conclusions derived are that children use quantitative vocabularies and characteristics when shown stimuli which possess characteristics of number, size, and quantity. The older the child the greater his ability to handle concepts of number, size, and quantity and a greater discrimination ability. Nearly all sex differences favor the girls but boys are superior when spontaneous expression of children is analyzed with reference to its quantitative aspects.


In order to provide an inventory of the arithmetical meanings and concepts acquired by pupils in grade one and two tests were made. A sampling of about 1000 children were used in this test. The results show that these tests provide a basis for grouping pupils for arithmetic instruction, aid in diagnosis of individual and class strengths and weaknesses on arithmetical meanings and concepts, they help to adapt arithmetic instruction to the level of the group and to each individual, and they provide one basis for assessing progress in arithmetic instruction and for interpreting the arithmetic program in grades one and two to parents and patrons of the school system.
Addition
(See also numbers 14, 15, 45, and 48 in this listing)


An investigation of six arithmetic text books to determine how present text books for children present the higher-decade facts, and of five arithmetic professional books to determine on what points the authorities in the field of arithmetic agree or disagree in regard to the teaching higher-decade addition. The findings were that there is a very definite lack of research in this area, although many opinions are expressed. It was also found that most of the texts introduce the higher-decade facts in the third grade; that one-half of the texts use the vertical form; but that disagreement was found as to when to teach, before, after, or with carrying.

Concepts
(See Abilities and Concepts)

Division
(See also numbers 34, 35, 46, and 55 in this listing)


An investigation into the problem of which rule to use in division when using two-digit divisors, the rule for using the first digit as the trial divisor or the rule for increasing the first digit by one as the trial divisor. Although the problem
is only presented in this study, there are cases shown where both rules will and will not work.


Arithmetic readiness as to the introduction to division by two-place divisors is the problem. A sample of 487 children in twenty fifth grade classes who were "average" students was used in this study. The implied conclusions reached were that considerable flexibility should be allowed in the grade placement of division by two-place divisors, many children are not ready for two-place divisors when they are called upon to start the topic, and instruction must be individualized to a greater extent in order to assure real readiness.


Groups of fourth grade children were used to study the relative effectiveness of commonly described practices in the introductory teaching of the division process. Higher achievement, greater retention, and increased ability to solve examples in a new situation were found in the experimental group where increased time was devoted to developing meanings, principles, and generalizations through the use of manipulative materials and visualization procedures.

This report selected findings from a study of second grade children and their thought patterns while working with multiplication and division problems, and how these children discover the use of arithmetic through the use of concrete, meaningful situations.


Using twenty-five grade two children of the University of Wyoming Elementary School an investigation was made to attempt to discover the thought patterns of young children in solving multiplication and division problems before these processes had been taught. The children were allowed the use of many concrete and semi-concrete materials. It was concluded that children have a good understanding of the meaning of problems and grade two is not too early to introduce multiplication and division; that they will solve the problems, if understandable, using addition, subtraction, and the materials; that the children don't have an uncertainty in naming or labeling answers; and that to appreciate multiplication one must have experience in solving multiplication problems using addition.


selected references. The author discusses two types of division, measurement and partition. He recommends that both concepts be taught children as all arithmetic textbooks contain problems relating to both concepts.


This is an investigation which used the arithmetic computation tests of 327 New York City pupils to determine the effect, if any, of the differences in presentation upon the pupil's ability to solve examples in division when, even though the examples were headed by the word "Divide" the division sign was substituted by the word "by". The investigation found that mixed numbers and the division sign seemed to suggest the rule to invert and multiply, whereas the word "by" seemed to confuse some. Further investigation revealed that substituting the word "by" for the division sign had a definite effect.


If two groups of children are taught division in a school situation the one by the conventional method and the other by the subtractive method, will the two groups differ significantly with respect to ability to acquire skills of division, to understand the process of division, to transfer the respective methods to unfamiliar situations and to recall the processes learned after a lapse of three months? Twelve fourth grade classes
were selected as the sampling, six classes doing one method and the other six doing the second method. Conclusions drawn are that by using the subtrative method children can be expected to transfer familiar experiences to unfamiliar situations to have a better understanding of division, especially those of low intellect.

Fractions

(See also numbers 55 and 57 in this listing)


A study to determine to what extent the identification and correction of errors embedded in sets of examples in addition and subtraction of fractions affected learning adversely. It was found, by using control and experimental groups, (six groups in all) that the experimental group which had systematic teaching in the discovery and correction of errors embedded in the examples, showed no significant difference over the control group which did examples without errors using systematic drill.


The problem is that decimals should be taught before common fractions are taught. Used for his study, fifth and sixth grades with the former being taught decimals and their equivalent fractions. The results show that the fifth grade found it easier to use decimals in the addition and subtraction processes.
Conclusions are that it is easier to teach decimals after U.S. money is taught and that place value concept is further enhanced by using decimals. It is also easier to find and correct errors for both teacher and pupil.


In which concrete materials were used in teaching fractions rather than use of textbook. Twenty-seven children in the fifth grade were taught by the concrete method for a six month period. Iowa Achievement Tests taken at the end of the period were used (elementary battery grades three, four, and five) in which there was an overall gain of seven months. Conclusions are that the majority of the class can work meaningfully with fractions and the others are able to work with concrete material to arrive at correct solutions. It also gives slower learner feeling of security within the group and is invaluable as a device for coping with individual differences within a group.

Measurement


An investigation involving testing with a verbal question-answer form of inventory test to find the knowledge of measurement, such as time, weight, quantity, measure groups of like things, and money in pre-school children. It was concluded that children hear these terms in infancy and remember the context in which they were used, although most don't comprehend
their meaning. Therefore, it is termed only recall of words and phrases.


What should be taught in weights and measures? A sample was taken from 6,573 grade and high school pupils in 380 cities and towns in over 43 states. A questionnaire was provided for children to answer. Conclusions were that experience is the differentiating factor of weights and measure knowledge, that teaching of tables of measure is not worthwhile, as there is little carry over into life experiences, that different units of measure for a commodity are not the same in all communities, and that if teaching of weights and measures was not taught in school, the results of the questionnaire apparently would not have varied greatly. It is recommended that a program of clear concepts be developed.

**Mental Arithmetic**

(See also number 62 in this listing)


The purpose of the study was to find out pupils' ability to solve, without aid of paper and pencil, examples and word problems presented orally; pupils' general growth in arithmetic; the ways pupils think when performing the four fundamental processes with-
out use of paper and pencil; and the general acceptance of mental arithmetic on part of teachers and pupils. A total of 550 pupils in twenty intermediate-grade classrooms were given one lesson each day, requiring 10 to 12 minutes, for a period of 52 school days. Conclusions are that children need specific experiences with mental arithmetic, that pupils progress in written arithmetic is not hindered by time used in mental arithmetic, that standardized-test scores showed highly satisfactory gains, and both teacher and pupil were in favor of planned mental-arithmetic experiences.


The purpose was to ascertain the uses made by business people of mental arithmetic during the conduct of one day's business affairs in Ellensburg, Washington. A sampling of 126 business men and women were taken representing sixty-two occupations. The conclusions derived are that mechanical computing devices have not replaced need for mental arithmetic; that nine-tenths of the people interviewed solved mentally whole numbers and money 80% to 100% of the time; that when solving problems mentally the processes used most frequently are addition and multiplication; that 66% of the people interviewed solve problems using numbers under 100; and that one-step problems were solved mentally more than any other type of problem.

The purpose was to study the effectiveness of a non-pencil and paper method of solving verbal problems in arithmetic by comparing children who had practiced solving problems without paper and pencil and with those who did the same problems using paper and pencil. The sample used were 257 sixth grade pupils from ten different classrooms in Iowa. 133 children were in the pencil and paper group and 124 children were in the non-pencil and paper group. Tentative conclusions drawn on the data are that neither method is superior in solving verbal problems; as the difficulty of problems increased paper and pencil was more essential for successful performance; pupils tended to increase in problem solving ability on the type they practiced; and teachers involved in the testing believe both methods should be employed.

Methods

(See also numbers 4 and 60 in this listing)


The purpose of the study was to investigate factors concerning effects of "knowledge of results," "group competition," "level of aspiration," and "self-estimates of performance." Data was secured from 216 sixth grade children who were given ten problem exercises and ten computation exercises. Tentative
conclusions are that with some groups knowledge of results and group competition produced superior performance whereas in other groups it did not. There was some indication that group motivation required some time to produce superior arithmetic performance. It implies that the teacher should have a greater understanding of children in order to be most effective in the guidance of a child.


This describes a method of teaching arithmetic evolved through a period of experimentation and research for a method that gives the most recognition to individual differences and permits each pupil to work at a pace that is in accordance with his ability and present state of development. No data was available to verify his experiments or research work.


This report tells of a study started in 1945 for developing meaningful arithmetic to children and also, in many cases, to the teachers. From it has developed a curriculum program for each grade. Some of the conclusions from this study are to provide time and opportunity for children to tell or to show what mathematics means to them, for teachers to accept children's own expressions, to expect more mature thinking from more mature children than from less mature children, for teachers to talk less and listen more, and for teachers to differentiate between
what they teach and what various children learn.


An experiment with four groups of fourth graders to find if tachistoscopic training is effective in the teaching of computational skills, and if it is more effective than the conventional pencil and paper approach. It was concluded that the effects of fourteen, eight minute training sessions of working with arithmetical combinations in multiplication and division, that the tachistoscopic training is effective in teaching number skills, but not more effective than the ordinary workbook method.


An experiment with a fourth grade over a five week period using actual experiences in dealing with money instead of those experiences presented by the arithmetic textbook. A Stanford Achievement Test was given before and after the experiment and the concluded results were that the children showed normal or better than normal progress in this area. It was also concluded that this helped to strengthen social relationships, to give a feeling of adequacy in handling money and to develop a variety of concepts concerning money.

This deals with several misconceptions concerning rationalization in arithmetic. Using his own views on the subject, supplemented by several research studies, the author, cites the advantages of the "why-how" sequence, the advantages of the "how-why" sequence, in certain conditions, and the possibility of coupling "why" with "how" as soon as feasible. The unsoundness of using mental age as a primary criterion for determining readiness for rationalization was also discussed.

Multiplication

(See also numbers 9, 10, and 55 in this listing)


By using the multiplication section of a diagnostic test given to 517 pupils in fifteen sixth grades in September and February, a study was carried out which analyzed the tests to determine causes of errors when zeros are contained in multiplication examples. It was found that a good method for helping most pupils improve their skill in multiplication was to reteach correctly the work most frequently missed on the test, and then retest. Also a marked improvement in teaching methods and remedial work by teachers was noted.

Problem Solving

(See also numbers 35, 46, and 62 in this listing)


The purpose was to discover if formal analysis of problems
will help child to find answer. The sampling was taken from 305 fourth, fifth, and sixth grade pupils in thirteen Massachusetts and New Hampshire classrooms in which formal analysis had been taught for a number of years. A formal analysis test was used and a comparable non-analytic test using the same problems but omitting the formal-analysis features was constructed. Conclusions are that students scored highest on the test which did not require steps of formal analysis; that correctly responding to each formal-analysis step was harder to do than solving the problem; and that students, even though strongly indoctrinated in formal-analysis procedure, do not use it unless required to do so.


This report is concerned with factors that enter into patterns of problem-solving thinking as revealed through tests and recordings of high school pupils and university students as they attempted to solve six sets of problems. The report falls into three general divisions: preliminary procedures in problem solving, discovery of generalization, and an analysis of procedures in solving a single problem. The conclusions arrived at are that better training is required in preliminary procedures in problem solving, there is a great lack of familiarity with the nature of forming generalizations, and that there is a lack of
technique of thinking in solving problems.

31. Ullrich, Anna. "Labeling Answers to Arithmetic Problems."

In marking answers to problems in arithmetic, if the answer has no label but is otherwise correct, should it be marked right or wrong? A questionnaire divided into three parts was sent out to 250 school people and 30 authors of books. No real agreement among teachers and writers in the matter of "labeling answers" to problems in arithmetic was found. The outstanding result was that the majority of teachers indicated that they would consider "correct" an unlabeled answer if the question asks, "How many?" of a certain unit explicitly expressed in the question.

Remedial Arithmetic

(See also numbers 4, 35, 37, and 43 in this listing)


The purpose of this diagnostic study was to aid in establishing a classification procedure and as an aid in defining problems of remedial arithmetic. A sample of 326 students were administered The Iowa Every Pupil Test of Basic Skills, Part D and The Cody High School Diagnostic Arithmetic Test. The two primary causal areas for error patterns were lack of understanding of the number system and basic personality factors.


This describes a two week summer clinic in remedial arithmetic in which twenty-two children from grades six, seven and eight attended. The major arithmetic problem of the children was emotional. The specific nature of the clinic was to discover the specific weaknesses of each child, and to determine at what stage in the development of his ability to use numbers effectively, this trouble arose. Some of the conclusions noted, other than that the clinic was a success, was that it pointed up some neglected techniques of remedial arithmetic and provided good in-service training for the teacher.

Research Summaries


This summarizes selected research and references, and a study relating to the problem of should division with two place divisors be deferred until after proficiency in the sub-skills or should it be taught after a high degree of competency has been reached. The author concludes that practice in dividing by two place numbers had no single uniform and predictable result so far as proficiency in the sub-skills is concerned.

This summarizes and discusses research and related literature of mathematics in grades one through eight from 1948 to 1951. Some of the problems discussed are: evaluation of the meaning approach, social aspects, textbooks, readiness, the division process, problem solving, evaluation, multisensory aids, individual differences and others.


This article summarizes five research studies in which each study supports the "meaning approach" to teaching arithmetic. It is implied that the so called meaning approach leads to greater retention, greater transfer potential, and an increased ability to solve new processes independently.


A summary of eight experimental investigations reported from 1940 through 1950 which compare methods of teaching arithmetic. The following conclusions were made: that the two methods of learning, drill and method, have a different effect for pupils having different levels of intelligence and initial achievement; that the use of crutches in subtraction is not harmful; that individual instruction is more favorable than group; that first hand experience is effective; and that the use
of materials in teaching arithmetic vocabulary shows specific growth.


Provides annotations for 18 selected research studies on the teaching of arithmetic reported within the preceding ten-year period.


A research summary which covers 38 significant questions and issues of theoretical and scientific knowledge of the place of arithmetic, of the teaching of arithmetic, and of the learning of arithmetic in the modern elementary school with the hope of bringing about improved methods of teaching and improved growth of the learner.


These are annual selected annotated bibliographies, some of which are research, in the field of arithmetic instruction.

The author has summarized and interpreted those issues in arithmetic research which he thinks will promise most to be of immediate help to the classroom teacher. It covers such areas as meaning theory, zero facts, program planning, grade placement, drill, crutches, evaluation and others.

42. Sherer, Lorraine. "Some Implications from Research in Arithmetic." 
Childhood Education 29:520-524; March 1953.

This article discusses the implications of some thirty five selected investigations and research studies from 1935 to 1951. It mostly covers instructional matters in arithmetic that are non-computational. It points to a need for getting teachers, who know children, and experts, who know arithmetic, together for more comprehensive research in this field.


Using a selected bibliography of twenty two authors covering a period of twenty years, Dr. Weaver summarizes research pertaining to individual differences in arithmetic. Types of individual differences, methods of differentiating instruction, and ways of evaluation, diagnosis and remedial work are discussed.


This summarizes and discusses research and related liter-
ature from 1948 to 1951 concerning the education of teachers and its impact upon the mathematics in elementary schools.


This study gives the results and conclusions on several theses conducted from 1929 to 1942 at Boston University on the corrective load in the fundamentals of arithmetic in the upper grades and high school, the possibility of better scores and the possibility of perfect scores in the fundamentals. The results given are in addition with the tests being given in grades five through twelve. No group received perfect scores although marked progress was made and usually the teacher became interested. The conclusions made were that traditional methods provide discouragement and defeat to the child, but good teaching, regular follow-up, mastery of the fundamentals, and with the child receiving judicious help and guidance this situation can be alleviated.


The influence of selected research studies on instruction in arithmetic is summarized in this paper. The research findings are as follows: stressing informal but meaningful number experiences in grades one and two; methods of instruction in systematic arithmetic; individualization of instruction; difficulty of certain combinations; a fusion of systematic and informal instruction above grade three; the judicious use of
crutches; preference for the decomposition method of subtraction; inconclusive findings on trial divisors; emphasis on the meaning theory in arithmetic instruction; inconclusive trends in teaching arithmetic vocabulary; the need for more definitive research on problem solving; and recent changes in the grade placement of arithmetic processes. The bibliography covers the years 1930 to 1950.

Subtraction

(See also numbers 14, 15, 37, 46, and 55 in this listing)


A study using second graders for the purpose of analyzing children's thoughts in solving mathematical problems involving the process of subtraction. The conclusions were that relatively young children with a limited number of experiences give different responses to problems involving three kinds of situations commonly associated with the subtraction process and that children don't conceive that one basic idea appears in all applications.


Educational Administration and Supervision 40:336-348; October, 1954.

An article which summarizes selected research of seventeen authors on these three questions: (1) What is the effect of the
upward versus the downward method, (2) What is the effect of the additive versus the take-away method on pupil achievement of accuracy in subtraction, and (3) What is the effect of checking upon pupil achievement of accuracy in addition and subtraction. The author concluded that the issues were not settled and that the criteria (rate and accuracy) be supplemented by other criteria that would give more weight to the effects of each method on understanding and problem solving.


A problem to determine whether the method of decomposition or the method of equal additions is superior in speed and accuracy after a time lapse of five years. A sample of eighth graders was used, one group of higher I.Q. (95 to 125) and socio-economic backgrounds and another group of about an 89 I.Q. and low socio-economic background. For higher intelligent group, decomposition and equal additions methods were about the same. In the lower intelligent group, decomposition method proved superior. Conclusion is that decomposition method be taught at beginning of instruction in subtraction to all pupils because teaching meaningfully produces superior results especially with the dullest pupils.

A summary and discussion of approximately seven selected references that pertain to compound subtraction as a basis for criticizing certain aspects of a study reported by Rheins and Rhenins in the October 1955 issue of the *Arithmetic Teacher* (see number 49 of this listing). Also given are suggestions for further research in the area of compound subtraction.

**Teacher Education**

(See also numbers 31, 37 and 44 in this listing)


The problem was to study the attitudes held by prospective elementary-school teachers. Written statements were received from 211 prospective teachers enrolled in three elementary-curriculum methods classrooms at the University of California Los Angeles. Conclusions were that it helped them to overcome unfavorable attitudes. Recommendations for additional study are given among which a suggestion for more study to evaluate the attitudes of students coming from more modern schools, as the students in this study came from traditional schools, taught by traditional methods.


The purpose of this article was to report attitudes of prospective teachers toward arithmetic as determined by an objective evaluation instrument. A collection of statements favoring and not favoring arithmetic were collected over a
five year period from approximately 600 students. These were processed and brought down to twenty-two statements going from one extreme of disliking arithmetic to the other extreme of liking arithmetic. This scale was administered to 289 college students. The conclusion was that more college students favor arithmetic than disfavor it.


An investigation of 129 questionnaires sent to teacher's colleges in this country, and a review of related literature and college catalogs which revealed the professional requirements of arithmetic teachers. It was found that: (1) about 40 states require about \( \frac{2}{3} \) times as many semester hours in history, social studies and science than in mathematics, (2) about \( \frac{3}{3} \) of state teacher colleges require no background in secondary school mathematics for admittance, (3) that most teacher colleges give only a general math course and (4) about \( \frac{1}{3} \) of the teacher colleges do not require a methods course in arithmetic, but that it is given as a part of the general math course.


A study of catalogs of 85 institutions of higher learning which prepare elementary school teachers, to determine the
mathematics training prescribed. It was found that about one-fourth of the institutions specify mathematics for entrance; that generally, the art and English requirements are greater than that of mathematics; and in general, the mathematics requirements are poor. It is implied that various mathematics associations should get together and act through state certification channels to have the situation improved.


The purpose of the study was to ascertain the extent to which teachers and prospective teachers of arithmetic understand the processes and concepts which are represented by the short cuts which they teach. For this purpose two tests, and some supplementary questions, were developed to cover items such as the understanding of steps in long division and long multiplication, the meaning of dividing by a fraction, the concept of reducing and raising fractions to lower and higher terms, the meaning of a remainder, the relation between subtraction and division, the meaning of percent and several other items. The two tests were administered to a total of 1,044 undergraduates, graduates and teachers, and it was concluded that our teacher-education programs have not done an adequate job.

A study which was conducted first, by giving an open answer test which represented a systematic sampling of 722 subjects. 193 of these were undergraduates taking a methods course in arithmetic; 348 were undergraduates doing student teaching in elementary schools, 43 were graduate students, and 80 were teachers. This open answer test was the basis of a multiple choice test which used the wrong answers from the first test as the wrong multiple choice answers. This multiple choice test was given to 322 teachers and it was inferred by the results of the test that people in general, teachers and educated laymen, have a difficulty in verbalizing their explanation of arithmetic processes, concepts and relationships in arithmetic which are understood by a large percent of teachers.


A study which involved testing of 391 teachers and education majors from 1947 through 1952, to find the background and competencies in mathematics of teachers. It was observed that factors which influence students' reactions to mathematics are the method of presentation the opportunities for achievement, the personality of the teacher and the type of problems to be solved. It was also observed that the elementary and high school mathematics completed gave little indication of the
achievement in meaning, understanding, and mechanical mastery; that the lack of achievement usually started with fractions and continues through decimals and per cent; and that, in general, the achievement is the meaning and understanding of arithmetic is extremely low.


A brief review of some of the conditions which now exist regarding the preparation of elementary school teachers of arithmetic; and the results of a questionnaire sent to the so-called "specialists" in the field of arithmetic to determine their opinions as to what should be included in the mathematics program in education for undergraduates. Some of those topics which received a high number of votes for inclusion were: acquisition of power in reasoning (problem solving), the inverse relationships within the operations evaluation of the college student's arithmetic learning and others.


This reports a study of mathematical understandings possessed by undergraduates majoring in elementary education. From a pretest given before a methods course in the teaching of arithmetic and an endtest given after the course to 348 students, it was found that before the course the students lacked a background of mathematical understandings. After having taken
the course a substantial increase in the level of understandings was noticed. The implications were that although a methods course results in a significant improvement, a general mathematics background course should be given at the college level to elementary education majors.

Miscellaneous


This booklet attempts to define the problems of research activities which would lead to better mathematics courses and teaching in the elementary and secondary schools in terms of what has been written and said on the subject, and to locate the areas that need the attention of research. The three main elements having trouble are the learner, the teacher, and the mathematics curriculum. Each of these elements are discussed as to the problems of each and what is being done to correct the situation or what the writers think should be done.


The problem was to find out if pupils who use computing machines to learn arithmetic will gain significantly in paper and pencil computations and in arithmetic reasoning over those who do not use computing machines. 92 fifth graders were used as a control group and 87 as an experimental group for a period
of 4½ months. The control group were taught in the usual method and the experimental group used machines. The conclusions showed that: (1) the machine-taught students gained more in reasoning and computation ability, (2) machine-taught students learn to understand machine computation, (3) student and teacher interest heightened by use of machines, and (4) machines fit into our present culture.


A study made of a general mathematics test given to 175 pupils of different high schools over a three year period. This 60 to 65 item test was given in conjunction with a mathematics contest by Nebraska State Teachers College at Kearney. The areas where the most failures were noted were in applied mathematics, problems in application of percentage, in the evaluation and use of simple formulas, in the interpretation of graphic representation and in all phases of simple algebra. The author contends that this implies a need for a study of the effectiveness of the general mathematics program.


The problem was to determine, if possible, students attitudes towards arithmetic and mathematics. The sampling used was sixteen freshmen enrolled in the University of California at Davis. The conclusions were that the child's
attitudes for or against arithmetic or mathematics are influenced by his parents like or dislike of arithmetic, the parents expectations of their child's performance in arithmetic, and the encouragement that they give. It also concludes that arithmetic teachers have strong positive or negative effects by their ability to teach, their interest in the subject, their enthusiasm, and their good control over the class without being overly strict.
Conclusions and Trends

The two most significant trends in elementary arithmetic noted in this annotated bibliography are: (1) an increasing awareness of the need of more meaningful teaching of arithmetic and (2) the need of clearer arithmetical understanding by the teacher.

Several studies conducted imply that more meaningful arithmetic helps children of all levels of intelligence and especially those of low intelligence (49, 16, 13, and 9*). Using the subtractive method of division and the decomposition method of subtraction not only helps all children in the initial teaching but is a great aid for the dull child later on, as he is able to retain what he has learned (13 and 49). It was also shown that using concrete material in teaching fractions also aids the dull child (15 and 16).

Studies conducted on teacher education seem to indicate a lack of enough arithmetical background in both high school and college for the teacher and pointing out that such a background is very desirable (53, 54, 55, 56, 57, 59, and 60). Studies also indicate that when a prospective teacher's dislike for arithmetic is brought "to light" and analysed her or his dislike disappears (51 and 52).

Other trends noted are: (1) that grade two is not too early to introduce multiplication and division (#10); (2) flexibility in the

*Refers to specific summaries noted in Chapter II of this thesis.
curriculum is needed for the teaching of two-place divisors (#7); (3) it is easier to teach decimals before fractions (#15); (4) that the teaching of weights and measures is of little use unless a program of clear concepts of weights and measures be developed (#17 and 18); (5) that more mental arithmetic should be used because so much of it is employed in later years #19 and 20); and (6) that formal-analysis problem solving tends to be harder for the child to do and, if possible, he will avoid it (#29 and 30).