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Arithmetic manipulative devices used by first grade of San Joaquin County schools

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ARITHMETIC MANIPULATIVE DEVICES USED BY FIRST GRADE OF SAN JOAQUIN COUNTY SCHOOLS

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CHAPTER I

INTRODUCTION TO THE STUDY

San Joaquin County consultants, together with the administrators of the elementary schools, have done much in attempting to assist first-grade teachers in making today's arithmetic program more meaningful. Consultants and administrators have arranged workshops, grade level meetings, and in-service training programs for teachers. These workshops and meetings have emphasized the importance of a meaningful approach to numbers taught through a learning-laboratory method.

The learning-laboratory method has resulted in the use of a great many kinds of home-made and commercial manipulative devices. The authors of the State-adopted Winston manual, Ready for Numbers,[1] believe that children should engage in a wide variety of concrete, meaningful experiences in which numbers play an essential part. These experiences include manipulating and grouping objects, constructing and measuring things, and dramatizing number situations, all of which contribute toward the discovery of

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[1]Elda L. Merton and Leo J. Brueckner, Teachers Edition Ready for Numbers, Grade 1 (Philadelphia: John C. Winston Company, 1955), p. 144.

number understandings for children. Manipulative devices are an important part of the laboratory equipment for effectively teaching and learning beginning arithmetic.

In themselves, devices teach very little arithmetic. Their usefulness is dependent upon the wise teacher who guides the pupil into arithmetic discovery of number extension through the materials at hand. This kind of teaching is also thought to be more enjoyable and research tends to show that it is not so readily forgotten.

I. THE PROBLEM

Statement of the problem. The purpose of this study was to determine: (1) the importance first-grade teachers of San Joaquin County place on manipulative devices for the teaching of arithmetic; (2) the manipulative devices first-grade teachers of San Joaquin County have and use; and (3) the uses first-grade teachers of San Joaquin County make of manipulative devices in the teaching of arithmetic.

Justification of the study. Meaningful arithmetic has been emphasized by authorities such as Brueckner, Grossnickle, Wheat, Suelts, and Brownell. Three decades past the drill theory, dependent primarily on memory, was the method prominently used. Teachers then were often as guilty as pupils of not knowing "why" for arithmetic processes. During

the last ten years the changes in teaching theories have brought the belief that learning comes from understanding.[2]

Since 1952 the investigator has attended numerous workshops where problems of teaching arithmetic effectively have been discussed. The investigator has been interested in making and working experimentally with manipulative devices. In recent years many workshops and grade level meetings conducted in San Joaquin County have continually stressed the making of laboratory equipment for the teaching of number concepts. The investigator has enthusiastically participated in these activities conducted through in-service training programs prepared by the county consultants and local elementary school administrators.

At arithmetic workshops and in grade level meetings attended by the investigator, consultants, administrators, and teachers have expressed a growing interest in the study of manipulative devices and their use. These persons have asked what the reactions of teachers are to the use of manipulative devices. They have asked if manipulative devices are effective in teaching "meaningful" arithmetic. They have indicated

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[2]William A. Brownell, "The Place of Meaning in the Teaching of Arithmetic," Elementary School Journal, XLVII (January, 1947), 256.

that they would like to know the answers to the questions implied in the statement of the problem of this thesis.[3]

Importance of the study. It is apparent that authors of the most recent arithmetic textbooks advocate the use of concrete materials in the teaching of arithmetic. This is based upon the observation that children instinctively like to handle and look at things. Sueltz makes this statement:

> The impressions gained by taking hold of something are not clearly understood by our psychologists; however researchers tend to show that such learning is not only more enjoyable but also it gives more lasting impressions.[4]

The importance of this study is in determining to what extent first-grade teachers in San Joaquin County are following the recommendations of these authorities.

Teachers newly graduated from teacher-training institutions have been taught the psychological approach to the teaching of numbers. However, without time to equip themselves with the needed objective materials and without adequate finances to purchase commercial devices, they may

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[3]Personal conversations and letters from many county school supervisory personnel to the investigator conveyed these questions and interest in the arithmetic teaching.

[4]Ben A. Sueltz, "Counting Devices and Their Uses," The Arithmetic Teacher, I (February, 1954), 25.

easily fall back into the rut of teaching arithmetic as they themselves had been taught.

Experienced teachers who have given years to the drill method could hardly understand what possible good could come from many contraptions and gadgets. Therefore, those who are responsible for the arithmetic program sensed that time and money must be consistently allocated for helping the classroom teacher change to the meaningful arithmetic approach.

The one and two-day workshops, the grade level meetings, the appearance of outside speakers on arithmetic, the course study outlines and educative services, and materials out of which to make things have been offered to teachers and have been characteristic of in-service education the past few years. It would seem pertinent at this time that there be an evaluation of the reaction of the teachers themselves to these educational experiences. Consultants, administrators, and teachers of San Joaquin County are asking these questions:

1. Has the continual educative program of recent years, stressing meaningful arithmetic, been helpful to our first-grade teachers?

2. Has it been adequate? Should this same kind of assistance be given in the future?

3. Have teachers continued to make and use the devices suggested?

4. Do teachers want to make their own devices as the need for them arises?

5. What kind of assistance do most teachers now want from the county consultants and administrators for teaching arithmetic?

6. Do experienced teachers depend on manipulative devices as much as inexperienced teachers?

7. Does the formal training of a teacher have any bearing on the use and kind of manipulative devices?

8. Are schools justified in using school funds for the purchase of materials for the learning of arithmetic in the same way as purchase of materials for the teaching of science and art?

Limitations of the study. This study was confined to the first-grade teachers of San Joaquin County, exclusive of the city schools of Stockton. These were the first-grade teachers directly responsible to the program of the county consultants and local elementary school administrators in the county office of education.

II. DEFINITIONS OF THE TERMS USED

Certain specific terms used in this study are defined here.

Drill theory. The drill theory of learning placed its emphasis upon repetition for memorization, whether meaning was present or not.

Manipulative devices. Manipulative devices are those concrete materials, manufactured or home-made, which the teacher or the child can handle, feel, and move in such a way as to conduct a mathematical learning situation to the

observer and handler.

Meaningful arithmetic. Meaningful arithmetic follows those teaching procedures which best bring understanding in arithmetic. This expression refers to instruction which is sensible to the learner as well as within his readiness ability.

Contrived-learning situations. Contrived-learning situations are experiences that a teacher purposefully sets up to give opportunity for pupil learnings.

Real experiences. Real experiences are day-to-day situations which children encounter naturally.

III. ORGANIZATION OF THE THESIS

This study was divided into five chapters. Chapter I presents the introduction and statement of the problem. Chapter II will summarize related materials and literature. Chapter III will deal with the procedure used in the investigation, discuss the methods used to obtain data, and explain how the materials were oganized. Chapter IV will report the results compiled from the returned questionnaires and will show tables. Chapter V will summarize the study and state conclusions reached. It will give suggestions and recommendations for further study.

CHAPTER II

REVIEW OF LITERATURE AND RELATED RESEARCH

Within the last decade much research has gone into the study of how children learn arithmetic.

In a recent article, Morton said that there seems to be little doubt that in the modern school more arithmetic learning takes place than was the case in the schools of former years. Those who contend that children do not learn arithmetic as well as children did "in the good old days" speak without knowledge of the facts.[1] Morton believes that children are currently learning more from arithmetical experiences.

These arithmetical experiences do not all start at school. Morton states that there has been considerable research given to the discovery of what number concepts children have already acquired before they enter school. He says that the ability averages are impressive but the spread is great.[2] One such study made by Brownell shows that most pupils entering first grade can do rote counting through at

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[1]Robert L. Morton, "What Research Says about Teaching Arithmetic," National Education Association Journal, XLIII (January, 1954), 19.

[2]Ibid.

least twenty, identify number objects through at least ten, and make comparisons of amounts through seven. They can also give answers to verbal problems based on number combinations up to ten. Yet he found that there are many children who have little knowledge of pre-school numbers.[3]

This knowledge of pre-school number experience common to most pupils, coupled with greatly increased use of numbers when children enter school, is resulting in the belief that a planned program should exist for arithmetic in first grade. This tenet is substantiated by Brueckner and Grossnickle who write as follows:

> Evidence has been given to show that many pupils enter school with a considerable knowledge of number, that they frequently use number in their experiences in and out of school, and that they can and do learn when it is taught in a planned, systematic program in which there are concrete experiences and meaningful social applications of number.[4]

An examination of arithmetic workbooks for first grade show that the subject matter is much the same in all first-grade arithmetic workbooks.[5] These workbooks all recommend

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[3]Leo J. Brueckner and F. E. Grossnickle, Making Arithmetic Meaningful (Philadelphia: The John C. Winston Company, 1953), p. 176, citing W. A. Brownell, Arithmetic in Grades I and II (Durham: Duke University Press, 1941).

[4]Ibid.

[5]First-grade arithmetic workbooks from these companies were examined: Silver Burdett Company, Scott, Foresman and Company, Webster Publishing Company, the John C. Winston Company and the World Book Company.

the use of concrete materials for teaching first-grade arithmetic. The emphasis is on the meaning and application of numbers one through ten. The number concepts are arranged in a three-part learning program. They first stress the concrete phase. This is followed by the semi-concrete phase which leads to the abstract use of numbers, the goal of arithmetic teaching.

The teacher must fit the subject matter to each child's maturation level. Much consideration is given in modern texts to the enrichment of number experience, both social and mathematical.

Morton says that teachers recognize the great difference in children's background and abilities and do provide properly differentiated learning programs. Yet there are those who slavishly follow a course of study or a uniform textbook for all pupils. He also states that research brings out the fact that developing meanings pays big dividends. He states, "What children learn meaningfully stays with them better and is applied more successfully than what they 'learn' by more drill."[6]

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[6]Robert L. Morton, "What Research Says to the Teacher Teaching Arithmetic, No. 2," American Educational Research Association (first edition; October, 1953), 8.

Authors agree that the modern classroom for first grade has the appearance of a learning laboratory. In the classroom there is provision for and an atmosphere for experimentation. There is evidence of many instructional materials-manipulative, visual, pictorial, and symbolic. These materials are in frequent use by teacher and pupils.

First-grade number work begins with an appraisal of each child's number experience and his interest. In the laboratory method Grossnickle, Junge, and Metzner say that the teacher guides, questions, and continues to stimulate the pupils to make individual discoveries of number concepts for themselves.[7]

The teacher and pupils, individually, and in groups, work with objects to gain and further expand their understanding of numbers. The equipment used is as important as the equipment used in any other science.

There should be sequential order from that which has been presented by concrete objects to that which is semi-concrete and symbolic. The gradation of difficulty should secure ease in learning. The child's initial learning takes place by the use of objects. From objects he goes to symbols

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[7]Foster E. Grossnickle, Charlotte Junge, William Metzner, "Instructional Materials for Teaching Arithmetic," The Teaching of Arithmetic, Fiftieth Yearbook of the National Society for the Study of Education, Part II (Chicago, Illinois: The University of Chicago Press, 1951), pp. 155-76.

at his own ability which may vary greatly with his fellow classmates. He may go back to manipulations to rediscover and to strengthen learnings.

Later the pupil passes to the stage where he no longer needs manipulative materials. Since maturation differs with pupils, it follows that all learners do not arrive at the same level of symbol at the same time. Some children will always depend on manipulation to gain understandings.[8]

It is felt that manipulative devices now in use in laboratory classrooms are of definite value as aids in teaching numbers and number concepts. Through the use of these teaching aids, the teacher can make the approach to arithmetic both interesting and exciting. Merton says, "the first experience in grade one should be a happy and successful one."[9]

The need to go slowly in the establishment of number concepts is urged by Swenson.[10] The primary teacher should make no haste in presenting number processes such as addition, subtraction, division, and multiplication. Parents and

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[8] Ibid., p. 160.

[9] E. L. Merton and Leo J. Brueckner, "Seeing Numbers," Textbook for Grade I (Chicago: The John C. Winston Company, 1952), p. 2.

[10] Esther J. Swenson, "Arithmetic for Pre-School and Primary Grade Children," The Teaching of Arithmetic, Fiftieth Yearbook of the National Society for the Study of Education, Part II (Chicago, Illinois: The University of Chicago Press, 1951), p. 64.

teachers alike should not be in a hurry but realize that much time spent on grouping and regrouping of concrete objects brings to the pupil real arithmetical learning situations. The time spent with manipulative materials under the guidance of a wise teacher results in understandings that are "prerequisite for later easy understandings of necessary abstractions."[11]

This caution is also advised by Gage.[12] He emphasized that the real power of mathematics lies in its abstractions, yet teachers are too often guilty of jumping from "things" to abstractions too abruptly. A void is thus created in the understandings of children which causes them to flounder. Hard though it be to determine how fast to move from concrete to abstract, it is safer to err in the direction of being more concrete in presentation.

Maloney suggests that since manipulative devices are regular features of lower-grade instructions, they can also be used extensively to test items in arithmetic.[13] Describing a process, or explaining the "why" with the use of devices can well be considered a test of a pupil's understanding. The

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[11] Ibid., p. 65.

[12] William A. Gage, "One View of Mathematics and What to do about it," The Teacher Letter (New York: Arthur C. Croft Publications, February, 1958), p. 3.

[13] Thomas J. Maloney, "Testing Today's Arithmetic," A Grade Teacher Special Edition (April, 1956), p. 92.

process requires more time than does the usual written test but it is a surer test of meaning.

It is possible in the earlier grades that children, who are taught through the system of meaning and understanding in arithmetic, may score lower on standardized tests of speed and accuracy of computation than children who are taught through the drill method that stresses mechanics and short cuts. More time is needed for children who are taught to think out their problems logically.

A study conducted by Howard attempted to measure whether or not a method of teaching which required a considerable amount of time used for developing the meaning of arithmetic through the extensive use of audio-visual and concrete materials was worth the extra time.[14] Fifteen classes of children in grades five and six were taught fractions by three different methods. The groups were equated by mental age, arithmetic ability, socio-economic background, school facilities, and time spent upon arithmetic. The teachers involved were skillful, experienced, and competent in all three methods. Group A emphasized the "how" followed by much drill. Group B emphasized the "why" with

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[14]Charles F. Howard, "Three Methods of Teaching Arithmetic," California Journal of Educational Research, I (January, 1950), 4-7.

many concrete objects, visual aids, and verbal problems, but they were not given drill exercises in computation. Group C employed a combination of the methods used in the other two groups.

Tests were given at the end of the sixteen week experimental period and following the summer vacation. The first test showed no general advantage for any one method over the other two. A retest after vacation showed a large difference, statistically significant, in favor of Group C. The study indicated that the child needs understanding of the "why" of arithmetic and also practice in computation if he is to retain what he has learned. Manipulative materials are particularly helpful in building meaningful concepts in arithmetic.

From all the evidence presented, it is concluded that manipulative devices are not a "frill" but a necessity. Koenker sums up the value of devices in these statements:

> (1) They are self-teaching since the child can discover the answer for himself; (2) they add meaning and understanding; (3) they are aids in thinking; (4) they add the senses of visualization and feeling to the learning process; and (5) they increase interest.[15]

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[15]Robert H. Koenker, "What is Meaningful Arithmetic," A Monograph on Language Arts No. 68 (Evanston: Row, Peterson and Company, 1952), p. 3.

Teachers should not hesitate to ask for necessities such as materials for teaching arithmetic.

Suelta comments:

> It is just as important for a school to furnish materials for learning arithmetic as it is to furnish materials for art, music and social studies. Teachers should not be afraid to ask for money for arithmetic materials.[16]

The materials essential in the establishment of the learning-laboratory for number experiences need to be carefully considered. Spencer and Brydegaard imply that only materials that result in experimentation have any place in the classroom.[17] These, they contend, are within the reach of every teacher. Some of the items listed are cups, glasses, bottles, cans, jars, boxes, measuring sticks, and innumerable other things. "Fancy gadgets," they say, are not necessary, but "some of the better commercial materials are helpful."[18]

Besides having the usual materials common to most classrooms such as crayons, oaktag, and pencils, Hickerson

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[16] Ben A. Suelta, "Counting Devices and Their Uses," The Arithmetic Teacher, I (February, 1954), 25.

[17] Peter Lincoln Spencer and Marguerite Brydegaard, Building Mathematical Concepts (New York: Henry Holt and Company, 1952), pp. 2-8.

[18] Ibid., p. 5.

specifies that children should have ready access to all kinds of measuring devices when their needs, interests, and abilities warrant.[19] He specifies various instruments to measure the following: distance, capacity, time, weight, and weather. He adds that such instruments are readily obtainable. Markers, blocks, checkers, beans, horsechestnuts, bottle caps, and other items are either made or collected by the teacher and children. The abacus and modern calculating machine should also be available for those who need them. He says that the many day-to-day experiences, real and contrived, involving the use of concrete materials, will be utilized to provide opportunity for developing quantitative concepts.

From her study of manipulative devices in the elementary school, Hertz lends her support to the usefulness of devices, both home-made and commercial.[20] She further suggests the summer school workshop in arithmetic as a place where teachers may be introduced to the devices needed for their grade levels. She indicates that workshops in arithmetic show the usefulness of devices as well as when and how they

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[19]J. Allen Hickerson, Guiding Children's Arithmetic Experiences (New York: Prentice-Hall, Inc., 1952), pp. 48-69.

[20]Pauline Hertz, "Manipulative Devices in Lower Grades," The Arithmetic Teacher, IV (November, 1957), pp. 214-16.

should be used. Teachers attending workshops become secure in their arithmetic teaching because they have the opportunity to make and experiment with the devices they will use.

Dr. Hartung confirms this view of the workshops. He believes that because children's first experiences at the beginning of the arithmetic program are so important to their future success, teachers ought to feel secure in this phase of their teaching. The workshop, he says, can get teachers back into a simple, concrete approach to number.[21]

More important than the aids for instruction in arithmetic is the classroom teacher. The modern psychological approach in teaching numbers demands a thorough preparation on the part of the teacher. Buswell believes that abstract generalizations in arithmetic have always been the most difficult to teach. In former days, when the association theory of learning prevailed, abstract number generalizations had to be learned through drilled memorization. The field-theory, emphasizing meaning, makes use of organization and presentation of materials that make understanding possible.[22]

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[21]Maurice L. Hartung, "Number Readiness in Grade One," The Supervisor's Notebook, Service Bulletin XIII 2 (Chicago: Scott, Foresman Company, March-April, 1949), 1-4.

[22]G. T. Buswell, "The Psychology of Learning in Relation to the Teaching of Arithmetic," The Teaching of Arithmetic, Fiftieth Yearbook of the National Society for the Study of Education, Part II (Chicago, Illinois: The University of Chicago Press, 1951), 195.

Buswell further states that good teaching in arithmetic "begins with concrete situations that are full of meaning to the learner and gradually proceeds to the general so that when abstract generalization is reached it is not a mere verbalism but a statement full of meaning."[23]

A study made by Mrs. Pauline Hertz indicated that elementary teachers wanted to improve their teaching in arithmetic. Her questionnaire, sent to a cross-section of the schools of Idaho, Oregon, and California showed 85.4 per cent of those responding believed that teachers should have more training in the use of manipulative devices for the teaching of arithmetic. Over 36 per cent of these thought that the colleges should teach this phase of methods in workshops. Forty-one and eight-tenths per cent of the teachers believed the training should be offered in workshops and should be combined with training elsewhere.[24]

Confirming that there is a need for critical study of the use of aids, Spitzer adds: "These are aids and their place in instructional practices can only be based on their contribution to the major problem of arithmetic to which they

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[23] Ibid.

[24] Hertz, op. cit., p. 214.

pertain."[25]

An extreme view concerning the value of manipulative devices is held by Wheat. He recommends as a profitable study, the over-use and mis-use of manipulative devices. He says that arithmetic is not learned at "finger-tips." At best, he says, "the arrangement of objects in group (manipulation) by the pupil serves to confirm (or illustrate to himself) what he is thinking or has thought about."[26]

He further insists that most manipulative devices, especially the commercial kind, are a needless expense because the teacher and pupils can easily supply the few needed materials to teach arithmetic. Color and the particular uniqueness of devices impress children and teachers; the actual usefulness for which they were intended is lost. Wheat maintains that manipulative objects tend to confuse through over-illustrating; his conclusion is that they cannot do for the pupil what he can do for himself.[27]

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[25]Herbert F. Spitzer, "Learning and Teaching Arithmetic," The Teaching of Arithmetic, Fiftieth Yearbook of the National Society for the Study of Education, Part II (Chicago, Illinois: The University of Chicago Press, 1951), p. 139.

[26]H. C. Wheat, "Letter to Pauline Hertz in A Study of the Use of Manipulative Devices in the Teaching of Arithmetic in the Primary and Elementary Grades" (unpublished Master's thesis, College of Idaho, Caldwell, 1956), p. 77.

[27]Ibid., pp. 77-79.

Certainly authors would agree that one device well used is better than many devices stored away or used in such a way that both teacher and pupil are confused. Sueltz makes this pertinent statement:

> Perhaps the time has come in many schools to spend more time on thinking about how supplementary aid should be used rather than on seeking more gadgets to "show off" to parents and school officials. In other schools of visual-manipulative materials are woefully lacking. Good judgment tempered with experience seems to be needed.[28]

According to this review of literature and related research there is ample evidence to support the contention that manipulative devices do have value in teaching and learning beginning arithmetic.

A partial list of manipulative devices used for teaching arithmetic is found in the questionnaire.[29]

Summary. Actual studies relating to the use of manipulative devices are few. Studies show that children: (1) have considerable knowledge of numbers before entering school; (2) have need for numbers upon entering school; and (3) have profited by arithmetic programs in first grade.

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[28]Ben A. Sueltz, "Manipulative Devices in Lower Grade," The Arithmetic Teacher, IV (November, 1957), Editor's Note, p. 216.

[29]Appendix A, pp. 65-73.

The arithmetic program should be in the atmosphere of a learning-laboratory. Extra time spent with manipulative materials under the guidance of wise teachers results in understandings that become basic for later abstractions. Some characteristics of arithmetic teaching devices may be noted; concrete materials: (1) are self-teaching; (2) give meaning and understanding; (3) aid thinking; (4) add sight and feeling to learning; (5) increase interest; and (6) can be used for testing. Schools should furnish and have available for teachers and pupils suitable arithmetic materials. Teachers want to improve their training to teach arithmetic effectively.

CHAPTER III

PROCEDURE OF INVESTIGATION

Methods used to collect data. Manipulative devices currently used in teaching arithmetic are described and illustrated from several sources: catalogs and printed matter from arithmetic textbook companies, displays by publishers of arithmetic texts, and from ideas gained in in-service arithmetic workshop and in college classes.

Before making up the list of manipulative devices used in the questionnaire, numerous cards and letters were sent to various publishing and manufacturing companies asking for catalogs and illustrative materials. Some companies responded also with samples of their latest aids for teaching numbers.

At the National Education Association convention in Philadelphia, arithmetic book companies had elaborate displays of old and new devices for teaching arithmetic. Their representatives were generous with free literature and demonstrations which were helpful in the bringing together of a partial list of manipulative devices, home-made and commercial.

Much additional help was obtained from suggestions for beginning number work given in various courses of study. Many useful devices and ideas were gleaned from participation

in several arithmetic workshops. The list thus accumulated was checked against a similar compilation made by Mrs. Pauline Hertz, instructor of Arithmetic Workshops at the College of Idaho. The resulting list of manipulative devices included devices which could be obtained commercially and could be home-made.

Opinions concerning devices expressed by writers, teachers, consultants, and administrators have been carefully noted by the writer since she attended the elementary teachers' workshop in arithmetic held at Ontario, Oregon in 1952.

Organization of the survey instrument. The materials and opinions concerning concrete objects were studied. The different devices were grouped into similar categories and in the manner in which they were commonly used. Those groups, constituting Part II,[1] were as follows: (a) Counting devices, (b) Concept devices, (c) Measuring and fractional concepts, (d) Practice devices for drill in fundamental processes, and (e) Boards with adhesive. Teachers were asked to check these items as "Having" and "Using" and whether the device was "Home-made," or "Commercial."

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[1]Appendix A, p. 65.

The last group (f), included a list of social practices involving the use of manipulation of numbers. These social practices included real experiences and contrived experiences commonly found in the regular classroom. Teachers were to indicate whether they provided these and if they used them.

Space was left after each group of listed devices for the respondents to write in names of other devices they had. They were also to indicate whether the devices had been used and whether the devices were home-made or commercial.

The introductory part[2] of the questionnaire was set up after Part II was developed in order to obtain general information about each teacher working with first-grade children in San Joaquin County. After Part II and the introductory part of the questionnaire was completed, it was thought advisable to develop Part I[3] to include in the questionnaire, questions related to general reactions of teachers concerning the value and use of devices in teaching first-grade arithmetic.

Part I of the questionnaire directed the respondents to indicate the relative importance each item held. A rating

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[2]Appendix A, p. 65.

[3]Appendix A, p. 65.

of one (1) meant that the item was "very important"; two (2), the item was of "average importance"; three (3), the item was of "little importance"; and four (4), the item was of "no importance."

The items in Part I of the questionnaire had been grouped to obtain specific teacher opinion on the following factors: (1) purposes for which teachers mainly use manipulative devices; (2) considerations teachers give toward the selection and making of manipulative devices; (3) teachers' reactions about devices (home-made and commercial); and (4) the attitudes teachers reflect toward more training for more effective use of manipulative devices.

The distribution of the questionnaire. After the questionnaire[4] was prepared an explanatory letter to be sent to the teachers was written to accompany it. This letter briefly explained the purpose of the study and requested each teacher to fill out the questionnaire and return it in the enclosed self-addressed envelope.

A copy of the questionnaire, together with the teacher letter,[5] was sent to the consultants of San Joaquin County

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[4] Appendix A, p. 65.

[5] Appendix C, p. 76.

Schools and to Mr. James Linn, Assistant Superintendent of Lodi Elementary School District. These copies were accompanied by another letter[6] explaining the purposes of the study and asking cooperation from the county and local administrators. Immediately thereafter, Mr. Hamilton Hodgson, Assistant Superintendent of San Joaquin County Schools, reported that the questionnaire had received favorable consideration in the meeting of San Joaquin County consultants. Mr. Hodgson furnished the 1957-1958 roster of 112 San Joaquin County first-grade teachers with their addresses. Further comments and communications were received from various members of the county staff, as well as from Mr. James Linn and Mr. Ralph Wetmore, Principal of George Washington School, Lodi.

The six-page questionnaire was then sent to the teachers. After six weeks 55 out of 112 teachers had returned their completed reports. A "follow-up" postal card was sent to the remaining 57 teachers. This brought 19 more returns. A final reminder brought 3 more reports. The total returns were 78 which constituted 70 per cent of the entire number of first-grade teachers included in the survey.

Replies to the 78 questionnaires were tabulated. Tables of the results were compiled. Data from the returned

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[6]Appendix B, p. 74.

questionaires will be presented in Chapter IV.

Summary. Data for the survey was organized into three sections of the questionnaire: (1) Introduction, to obtain general information about each first-grade teacher in San Joaquin County; (2) Part I, to obtain specific teacher opinion on factors pertaining to selection and making of devices, reactions about devices, and attitudes of teachers toward more training for effective use of devices; (3) Part II, to discover what home-made and commercial devices teachers had and used.

The questionnaire and the accompanying teacher-letter were approved by the county consultants and school personnel of Lodi (California) Elementary Schools and sent to 112 first-grade teachers. Total returns were 70 per cent of the number of questionnaires sent out.

CHAPTER IV

DATA REVEALED FROM RETURNED QUESTIONNAIRES AND INTERPRETATION OF DATA

The investigator sent out 112 questionaires and received 78 returns. This number returned represents 70 per cent of San Joaquin County first-grade teachers, exclusive of first-grade teachers in Stockton Public Schools. Respondents sometimes failed to answer certain items on the questionnaire form; consequently the tables reporting data on certain items report fewer than 78 replies.

I. GENERAL INFORMATION CONCERNING TEACHERS WHO RESPONDED TO THE QUESTIONNAIRE

Grades taught. Seventy-four respondents stated the grade or grades which they taught. More than one-half of these 74 respondents taught only the first grade. Table I shows that approximately 25 per cent of the teachers taught a combination first and second grade. Other teachers were teaching in one and two-room schools where they taught three or more grades.

Size of class. The classes varied in size from 11 pupils to 39 pupils. The average class enrollment was 26.3 pupils. The survey shows that apparently class size has no

TABLE I

GRADES TAUGHT BY FIRST-GRADE TEACHERS IN SAN JOAQUIN COUNTY SCHOOLS*

	Grades Taught						
	K & 1st	1st	1st & 2nd	1st thru 3rd	1st thru 4th	1st thru 5th	1st thru 8th
Number of Respondents	1	43	19	3	3	1	4

*Seventy-four teachers reported the data which is summarized for this table.

bearing on the number of manipulative devices used, as indicated by Table II. In 72 classes varying from 17.4 to 32.3 average pupils, the average number of devices used were approximately the same.

Experience. This study included both experienced and inexperienced first-grade teachers. Seventy respondents had taught first grade for 9.9 years on the average. Their entire teaching experience averaged 14.3 years. It is obvious that most of these teachers had had experience teaching other grades before they taught the first grade.

Teaching credential. An important consideration of the study was the kind of credential held by the respondents. Approximately 63 per cent of the teachers reporting held a General Elementary Credential. Ten kinds of credential were reported. The credentials held by San Joaquin County first-grade teachers are reported in Table III, page 33.

The survey showed that there is a definite relationship between units of preparation and credentials held as related to the use of manipulative devices. The teachers holding the General Elementary Credential and other credentials in addition, had and used more devices than those who had only provisional certification.

The survey also indicated that the more units of preparation teachers had, the higher was the credential held

TABLE II

COMPARISON OF CLASS SIZE AND NUMBER OF ARITHMETIC DEVICES USED IN FIRST-GRADE CLASSROOMS OF SAN JOAQUIN COUNTY SCHOOLS*

No. of Rooms	Pupil Enrollment	Average No. of Pupils	Average No. of Devices Used
14	11-20	17.4	33.7
16	21-25	24.8	41.8
25	26-29	26.8	33.3
17	30-39	32.3	31.6

*Seventy-two teachers reported the information presented in this table.

TABLE III

KIND OF CREDENTIAL HELD BY FIRST-GRADE TEACHERS IN SAN JOAQUIN COUNTY*

Kind of Credential	Gen. Elem.	Elem. Prov.	Kgdn. & Prim.	Life	Super-vision	Ad-min.	Gen. & Life	Jr. High	M.R.[a]
Number of Teachers Holding Credential	49	19	6	5	2	2	2	1	1

*Because some teachers hold more than one teaching credential, the total number of credentials held by the respondents is 89. Seventy-one respondents reported the information which is presented in this table.

[a]M.R. designates the credential for teaching mentally retarded children.

and the more kinds of credentials.

Formal preparation. Teacher preparation was reported by 71 of the 78 who returned the questionnaires. On the average, teachers had completed 120 units. The least formally educated teacher reported 30 college units; 18 teachers had earned 150 or more units.

For this study it was important to discover if teacher preparation and experience or the lack of these qualifications had a direct relationship upon the use of manipulative devices. From Table IV by comparing column 4 with columns 6, 7, 8, and 9, it is noted that experience does not seem to have any significant effect on whether or not a teacher uses, makes, or buys manipulative devices. Table IV does show that Group A teachers, who listed 150 or more units of preparation, generally have and use manipulative devices more than those with less preparation. This might substantiate the theory that those teachers with most formal preparation, through college units completed, depend on and frequently use concrete teaching devices in their arithmetic instruction. If this is true, it is likely that these teachers were following the suggestions of the Winston state-adopted text in arithmetic concerning the making and use of devices.

It is significant that teachers with more training by college units reported that they had more commercial devices

TABLE IV

COMPARISON OF TEACHER PREPARATION, TEACHING EXPERIENCE, AND USE OF MANIPULATIVE DEVICES BY SAN JOAQUIN COUNTY FIRST-GRADE TEACHERS

					Manipulative Devices and Their Use			
1 Units of Preparation	2 No. of Cases in Grp.	3 Av. Yrs. Taught 1st Grade	4 Av. Yrs. Total Teach. Exp.	5 Av. Pupil Enroll.	6 Present in Room	7 Used in Room	8 Home-made Devices Present in Room	9 Commercial Devices Present in Room
A Group 150 or more	18	9.1	12.7	24.9	38.8	37.3	16.3	19.3
B Group 130 to 149	26	7.0	11.7	25.5	37.7	35.8	17.2	14.7
C Group 100 to 129	13	8.4	11.4	24.1	32.4	26.7	22.5	11.4
D Group 99 or fewer	14	7.8	12.9	25.4	28.5	23.7	14.7	11.1

in their classrooms than teachers with fewer completed college units. Table IV, page 35, column 9 indicates that an average of over 8 more commercial devices are found in rooms of the A Group teachers than of the D Group teachers. Since these teachers of A Group, had more units of college work and had higher credentials, they would have better salaries and more security. These teachers probably had more influence to persuade school administrators to meet their classroom needs for such devices, or they may have personally purchased materials.

It is interesting that Table IV, column 8, page 35, shows that the C Group teachers have made more devices than any other group. It may be that this group, being younger and closer to college preparation for teaching, are more aware of how to make and use their own materials.

II. PURPOSES FOR WHICH TEACHERS USE MANIPULATIVE DEVICES AS SHOWN BY SURVEY

The purposes for use of concrete materials in arithmetic teaching and the degree of importance for particular uses, as reported by 78 respondents, is presented in Table V. Most teachers responded more fully to this section than to any other part of the questionnaire. Item 1, "Presenting a new concept," and item 14, "Teaching slow learners," were checked as "very important" uses for manipulative

TABLE V

PURPOSES FOR WHICH FIRST-GRADE TEACHERS OF SAN JOAQUIN COUNTY USE MANIPULATIVE DEVICES

Purposes	A	B	C	D*	No. of Respond. Supplying Ratings
1. Presenting a new concept	69	5	0	1	75
2. Clinching a process (Make it more thorough)	45	24	1	1	71
3. Reviewing a previous presentation	25	38	11	1	75
4. Testing a pupil's knowledge	23	32	12	5	72
5. Reteaching an idea	36	25	10	0	71
6. Used as toys	2	13	17	39	71
7. Gives pupils opportunities for experimenting	38	22	9	3	72
8. Teacher demonstration	55	13	3	2	73
9. Pupil demonstration	45	17	6	2	70
10. Use in group situations	42	24	5	2	73
11. Use with individual pupils	48	21	2	0	71
12. Teach bright pupils	15	25	19	12	71
13. Teach average pupils	31	31	9	0	71
14. Teach slow learners	68	4	0	1	73
15. Help timid pupils gain confidence	49	13	7	2	71
16. Speed up the learning process	35	26	7	0	68
17. Put fun into practice or drill work	35	26	9	3	73

TABLE V (continued)

Purposes	A	B	C	D*	No. of Respond. Supplying Ratings
18. Challenge the gifted child	16	20	14	17	67
19. Prove an abstract idea (self checking)	32	26	10	5	73
20. Aid creativity	14	28	14	15	71
21. Impress parents by an up-to-date display	5	7	13	43	68
22. Provide incidental number teaching without formal class teaching	18	25	15	9	67

*In the table "A" stands for "Very Important"
"B" stands for "Average Importance"
"C" stands for "Little Importance"
"D" stands for "No Importance"

devices much more often than any other use. Item 8, "For teacher demonstration," received the second highest place for "very important" use.

Teachers seemed to be undecided about the use manipulative devices have for challenging the gifted child, for teaching bright pupils, and for aiding creativity. The 78 teachers checking these respective purposes, in regard to use of concrete materials, seemed to be in close agreement concerning the relative importance of these purposes. This could indicate that teachers have not yet fully explored the areas of uses to which manipulative devices may be applied. It rather suggests that teachers still believe that manipulative devices are more for slow learners.

The over-all pattern of Table V, pages 37-38, shows definitely that these teachers uphold the beliefs of such arithmetic authorities as Suelta, Brueckner, and Grossnickle who insist that learning follows understanding. The use of manipulative devices for "Teacher demonstration," "Pupil demonstration," "Use in group demonstration," and "Use by the individual pupil as he works alone" are items in the order that the majority of teachers checked as "very important."

It is noteworthy that item 6, "Used as toys" and item 21, "Impress parents by an up-to-date display," were given the fewest marks for "very important" and consistently received the most checks as "no importance." This would

indicate that teachers believe that devices in themselves teach very little arithmetic unless used under wise guidance. In other words, the teachers believe that the devices are in the classroom to enhance learning.

III. CONSIDERATIONS TEACHERS GIVE TO THE MAKING OR SELECTION OF DEVICES

The teachers responded to all items listed under the question, "How important are the following considerations in the making or selection of manipulative devices?" The answers to this question are shown in Table VI. Primarily the teachers believe that manipulative devices must be safe to handle. Secondly, they must not only conform to standards of measurement, but they must also be simple in directions for operation. Thirdly, manipulative devices must be suited to the child's needs.

Table VI indicates that teachers want: (1) devices that last and stand up to the use called for in ordinary classrooms; (2) colorful devices made of good quality material; (3) compact devices which are easy to keep in order; and (4) those devices with flexibility in their use.

The report for item 10 in Table VI, "Devices should be only those suggested by manual for the Winston series in use," shows a degree of professional understanding on behalf of the teachers surveyed. They do not confine their use of

TABLE VI

IMPORTANCE OF CERTAIN QUALITIES FOR MAKING AND SELECTING CONCRETE ARITHMETIC MATERIALS ACCORDING TO SAN JOAQUIN COUNTY FIRST-GRADE TEACHERS*

Considerations	A	B	C	D	No. of Respondents Supplying Ratings
1. Color	47	19	5	2	73
2. Compactness	38	27	4	3	72
3. Quality of material	42	26	3	1	72
4. Durability	54	16	0	2	72
5. Safety and Manipulation	66	5	1	0	72
6. Conformity to standards in measurement (A foot should equal a foot. A Nickel should at least be aluminum. The four sides of a square should be equal. Etc.)	61	9	0	1	71
7. Flexibility (It can be used for more than one thing.)	41	25	5	1	72
8. Simplicity in directions for operation	61	12	1	0	74
9. Difficulty suited to grade level	57	12	2	0	71
10. Devices should be only those suggested by manual for the Winston series in use	3	11	19	38	71

*In the table, "A" stands for "Very Important"
"B" stands for "Average Importance"
"C" stands for "Little Importance"
"D" stands for "No Importance"

devices only to those suggested by the present state-adopted text for first-grade numbers. It would further indicate that all the teachers undoubtedly use materials at hand to clarify questions as they arise. Several respondents commented that they were using the many devices suggested in the text as well as others not mentioned.

IV. GENERALIZATIONS OF TEACHERS TOWARD MANIPULATIVE DEVICES

Information stated by San Joaquin County first-grade teachers concerning their reactions about devices is presented in Table VII. Evidently this section of the questionnaire concerned with teachers' reactions about devices was either confusing or indefinite for it brought more individual comments than any other section. Typical comments included were: "I don't think you can generalize here," "Too large an area to generalize," "Hard to generalize," and "Home-made devices fit better for specific difficulties." Item a, "Commercial devices are superior to home-made," received a definite "No" or negative comments in nearly all cases.

In addition to the specified markings for item b, "Home-made devices are superior to commercial," there were seven teachers who marked "No" and three who marked "Yes." Three others indicated by their comments that teachers were not justified in making "heavy wooden devices which require

TABLE VII

GENERALIZATIONS TOWARD MANIPULATIVE DEVICES MADE BY THE FIRST-GRADE TEACHERS OF SAN JOAQUIN COUNTY*

Reactions	A	B	C	D**	No. of Respondents Supplying Information
a. Commercial devices are superior to home-made	9	19	15	12	55
b. Home-made devices are superior to commercial	19	15	13	10	57
c. We have too many manipulative devices in classrooms	3	7	10	21	41
d. Teacher-made devices take too much time	10	14	14	4	42
e. We do not have enough manipulative devices	20	11	4	8	43

*This table shows fewer respondents' replies because answers were too varied and scattered.

**In the table "A" stands for "Very Important"
"B" stands for "Average Importance"
"C" stands for "Little Importance"
"D" stands for "No Importance"

too much time," but "Alas," said one, "we sometimes do."

Eighteen teachers explicitly stated by comments in answer to item c that in their estimation they did not have too many devices in their classrooms. One teacher said, "We have too many devices only if we fail to use them wisely." Another respondent replied with this statement, "Yes, We have too many to pick up and too much clutter in room."

An interesting comment in reference to item d, "Teacher-made devices take too much time," was the following: "I think the schools should buy more materials for first-grade arithmetic. Too much valuable time is spent in preparing materials. Everything I have is home-made."

Answers to item e, "We do not have enough manipulative devices," included seven "Yes's" and seven "No's." Reactions to this item were expressed in such remarks as: "In some cases no," "True, we usually do not have enough!" "We do not!" and "I have many."

The conclusions evident from the many comments on this part of the questionnaire might be as follows:

1. Home-made devices serve for teaching purposes as well as commercial devices.
2. Teachers would like more devices and more time to make devices.
3. Teachers have not been granted sufficient funds for purchase of commercial devices.
4. Teachers cannot justify the use of time for making all devices needed.

V. REACTIONS OF TEACHERS TOWARD MORE TRAINING FOR MORE EFFECTIVE USE OF MANIPULATIVE DEVICES

This section verifies the investigator's assumption that teachers have profited from college courses, workshops, grade level meetings, and in-service training. In general, the help of consultants and administrators, all of whom stressed the importance of the psychological approach to numbers, is considered important. Typical comments made in replying to this section were: "Grade level meetings have been most helpful because we have met needs without wasting time"; "My needs have been adequately met by consultants"; "Have greatly appreciated workshops"; "We learned the 'why' for gadgets while we were given time to make them"; and "The exchange of ideas in meetings were most helpful."

A tabulation of the results of this part of the survey is shown in Table VIII. It is significant, as indicated by item c, that most teachers would like demonstrations in classroom situations on the use of manipulative devices.

TABLE VIII

REACTIONS OF FIRST-GRADE TEACHERS OF SAN JOAQUIN COUNTY TO MORE TRAINING FOR MORE EFFECTIVE USE OF MANIPULATIVE DEVICES

Help wanted from:	A	B	C	C*	No. of Teachers Reporting
a. Additional college courses	15	10	8	16	49
b. More in-service training on the county level	25	15	6	6	52
c. Demonstrations in a class situation	38	14	4	1	57
d. My principal or a fellow teacher when I am actually faced with a need	18	24	5	4	51
e. Grade level meetings with my principal or consultant	18	20	9	3	50

*In the table "A" stands for "Very Important"
"B" stands for "Average Importance"
"C" stands for "Little Importance"
"D" stands for "No Importance"

VI. REPORT OF TEACHERS CHECKING REPRESENTATIVE LIST OF MANIPULATIVE DEVICES

In the survey instrument, a representative list of manipulative devices was given for the teacher to check as "Having," "Using," "Home-made," or "Commercially made." These were divided into groups and types. A list of social practices involving manipulation of numbers was included which teachers checked as "Having" and "Using." Table IX shows this list with the number of times each device was marked.

A place was given in each group for the teacher to mark if other devices, not listed, were available. When this place was marked, the device described was very similar to those listed. The manipulative devices added to the list of counting devices were plastic toys, tag discs, counting boards, box games, and others which usually were made by the teacher.[1]

It can be seen from Table IX that the teacher used those devices mostly made of low cost material. It is also evident from these tables that the devices called for in the Winston Teacher's Manual, Ready for Numbers, are predominantly

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[1]Appendix D, p. 78.

TABLE IX

TYPES OF INSTRUCTIONAL MATERIALS USED BY FIRST-GRADE TEACHERS IN SAN JOAQUIN COUNTY SCHOOLS AS REPORTED BY 78 RESPONDENTS

Devices	Categories and Number of Times Checked			
A. Counting Devices	"Had"	Used	Home-made	Commercially Made
Separate objects	74	67	56	36
Pictures of ungrouped objects	45	41	41	11
Pictures of grouped objects	50	46	47	14
Discs or dots ungrouped	58	52	42	27
Discs or dots grouped	67	45	57	6
Ten-ten counting frame (child's)	33	31	18	15
Teacher classroom counting frame	31	29	23	22
Hundred Bead Frame	18	18	5	13
Hundred Spool Board	14	12	12	2
Geometric objects	20	18	8	14
Peg Board	31	29	6	26
Abacounter	7	7	2	6
Counting Bar	13	13	9	7
Readiness Number Poster	47	53	47	11
Others	31	31	31	9

TABLE IX (continued)

Devices	Categories and Number of Times Checked			
B. Concept Devices	"Had"	Used	Home-made	Commercially Made
Numberite	6	5	0	6
Number Jumble	18	17	10	18
Units, tens, hundreds bead frame	11	8	8	5
Match mates	13	13	8	10
Additive Board	1	1	1	1
#10 Number Work Board	6	5	5	3
#20 Number Work Board	3	3	3	2
Place Value Board	20	18	17	4
Place Value Charts	39	31	31	3
Place Value Pocket Charts	37	33	30	6
Place Value Counting Meter	2	2	2	1
Domino blocks	40	38	10	31
Number sorter	1	1	0	1
Place value sticks	44	41	31	14
Abacus	14	11	2	13
Comparison charts	15	14	15	2
Fraction charts	15	12	12	5
Fraction discs	13	8	13	3
Everybody show card kit	53	49	53	4
Ideal Fraction Wheel	4	3	3	3
Fractioneer	1	0	0	1
Geometric Solids and Figures	4	2	1	4
Devices for teaching ordinals	19	18	19	1
10 bead fact finder	31	28	24	7
Emery paper numbers	51	53	52	0
Cloth numbers	16	14	10	8
Others	17	16	14	3

TABLE IX (continued)

Devices		Categories and Number of Times Checked			
C. Measuring Devices and Fractional Concepts		"Had"	Used	Home-made	Commercially made
Distance	- foot ruler	70	69	6	62
	- yard stick	61	57	2	53
	- tape measure	18	12	2	16
Liquid	- cup	47	40	3	32
	- pints	50	48	4	38
	- quarts	48	44	3	34
	- gallon	22	19	0	16
Weight	- scales	26	23	0	24
	- balances	6	5	0	5
Temperature	- thermometer	52	57	5	46
Capacity	- boxes	14	13	3	8
	- bushel basket	3	2	0	4
	- tablespoons	23	18	0	20
	- milk cartons	50	47	0	44
Quantity	- egg carton	56	55	0	44
	- pair socks	29	27	0	23
	- pair shoes	23	21	0	18
	- others	7	7	1	6
Value	- toy money	44	41	4	32
	- real money	40	40	0	40
	- stamps	7	6	0	6
	- tokens	2	2	0	2
	- cash register	21	19	0	18
Time	- clock in room	69	64	0	63
	- Judy clock	28	30	0	28
	- clock faces	57	53	37	20
	- watch	18	17	1	16
	- calendar	64	62	49	35
	- others	4	3	1	2

TABLE IX (continued)

Devices	Categories and Number of Times Checked			
D. Practice Devices	"Had"	Used	Home-made	Comercially Made
Flash cards	28	24	21	14
Perception folding cards	52	49	50	5
Everybody show card kit	47	46	49	2
Answer pockets	18	17	16	1
Arithmetic games	42	39	40	12
Spinno	4	4	4	0
Magic plastic slates	4	4	0	4
Other games	10	9	6	6
E. Boards with Adhesive				
Velour board	3	2	1	2
Magnetic board	4	4	1	3
Cohere-O-Graph	0	0	0	0
Flannel Board--Teachers'	57	46	46	6
Flannel Board--Pupils'	13	12	13	0
Others	0	0	0	0

the ones marked "We have," "We use," and "Home-made." Since the county workshops included the making of manipulative devices this would imply that the work of the county consultants and school administrators has influenced the classrooms of San Joaquin County.

VII. REPORT OF TEACHERS CHECKING LIST OF SOCIAL EXPERIENCES

The results of the last part of the questionnaire, section (F), "Social Practices Involving Manipulation of Numbers," are treated in Table X. This table indicates that teachers used a great many social experiences, real and contrived, in teaching children number concepts.

The items in section (F) which were considered "contrived social practices" received most checks from the teachers in the following order: "Building with blocks," "Use of play telephones," and "Play store with store stock." These items received an average of 35 checks from the teachers who made replies.

The remaining items in section (F) considered as "real life experiences" are also listed in the order in which the teachers gave most checks. They are: "Weather records," "Sports equipment for P.E.," "Buying lunch tickets," "Use of real telephone," "School bank," "Building with real materials," and "Buying stamps." These items received an

TABLE X

TYPES OF SOCIAL PRACTICES INVOLVING MANIPULATION OF NUMBERS AVAILABLE AND USED BY FIRST-GRADE TEACHERS OF SAN JOAQUIN COUNTY AS REPORTED BY 78 RESPONDENTS
SECTION F

	"Had"	Used
Buying lunch tickets	36	34
School Bank	12	11
Post Office buying stamps	6	8
Use of play telephone	36	35
Use of real telephone	11	13
Play store and store stock	32	29
Weather records	38	36
Sport equipment for P. E.	37	36
Building with real materials	12	10
Building with blocks	41	41
Others	4	3

average of 21 checks per teacher replying.

These results would indicate that first-grade teachers purposefully set up for their pupils, many learning situations for experiencing number use. They also utilize for their children, day-to-day opportunities for number experience in natural settings. It was evident from the comments added to this part of the questionnaire that teachers have a better understanding of this type of experience as an approach to the understanding of numbers.

VIII. SUMMARY OF DATA FROM RETURNED QUESTIONNAIRES

Exclusive of first-grade teachers of Stockton Public Schools, 112 questionnaires were sent to San Joaquin County first-grade teachers to find out about arithmetic devices and their use in first-grade classrooms. Seventy-eight returns were received which represented 70 per cent of the first-grade teachers. Some returned questionnaires were incomplete in certain items, hence data reported in certain tables show fewer than 78 replies. More than 50 per cent of the teachers taught only first grade, 25 per cent taught first and second grades, while remaining teachers had combinations of other grades. The average number of pupils was 26.3. The entire teaching experience of the teachers averaged 14.3 years; their first-grade teaching experience averaged 9.9 years. Ten kinds of credentials were reported

held by the San Joaquin County first-grade teachers. Approximately 63 per cent of the teachers held a General Elementary credential. Teachers' college preparation ranged from 30 units to 150 units. On the average, teachers had completed 120 units of college work.

All teachers reporting used manipulative devices to some extent. For the teaching of arithmetic the average number of devices per room was 33.6. Teachers in multi-graded rooms used approximately as many devices as those who taught only one grade. Teachers would like more devices, more time to make devices, and more money with which to purchase devices. Teachers used many real and contrived situations to teach number experience.

The better-trained teachers obtain more commercial devices than do the teachers with less training. Formal education makes a difference; for the better trained teachers, those teachers having completed 150 college units or more, have more kinds of devices, use more devices, and find more uses for their devices, than do less-prepared teachers. The teachers having completed nearly 120 units of college preparation make more devices and have less commercial devices.

Years of teaching experience does not seem to have a bearing on the number of devices used. First-grade teachers seem to be undecided as to what use manipulative devices

have for the gifted child. Teachers ask that devices be safe, standardized, attractive, serviceable, and easy to keep in order. Devices should be flexible in use and should be suited for demonstration purposes.

Teachers agree that home-made devices are as effective as commercial devices providing that the home-made devices do not require excessive time in their construction. Teachers cannot justify the use of time for making all the devices needed for presenting beginning numbers.

Teachers are supporting the attempt on the part of consultants and administrators to obtain greatest use from the suggestions offered in the State-adopted text in arithmetic for first grade. Teachers appreciate the workshops and grade level meetings that give time and guidance for device making. Teachers appreciate the furnishing of materials with which to make teaching aids as needed. The study indicates that teachers want the in-service training and workshops which consultants and administrators arranged for them.

Teachers now request that they be given demonstrations on the presentation of beginning numbers in actual classroom situations.

CHAPTER V

SUMMARY OF SURVEY PROCEDURE, CONCLUSIONS, RECOMMENDATIONS, AND SUGGESTIONS FOR FURTHER STUDY

Chapter IV presented a summary of findings from the study. This chapter presents a summary of the survey procedure, conclusions, recommendations, and suggestions for further studies.

Summary of survey procedure. This study was made for the purpose of determining:

1. What importance do first-grade teachers of San Joaquin County place in the use of the manipulative devices for the teaching of arithmetic?
2. What manipulative devices do the first-grade teachers use?
3. What are some of the uses San Joaquin County first-grade teachers make of manipulative devices in the teaching of beginning numbers?

The introduction to the questionnaire, the instrument for this study, requested general information from each teacher. The information was used to determine whether grade, class size, teacher experience, and teacher preparation were factors which would have a direct relationship upon the use of manipulative devices.

An inventory of teacher opinions, concerning arithmetic devices in general, was made up from observations noted since

1952. A review of available literature was also made to find out about devices and their use. The inventory compiled from these sources was included in the instrument to determine the use and importance teachers give to manipulative devices for the teaching of beginning numbers.

A list of home-made and commercially made manipulative devices, was compiled from certain information.[1] The resulting list comprised Part II of the questionnaire and was used to discover which of these devices teachers had available and which materials were actually used. This section of the survey instrument also attempted to discover whether these devices were home-made or commercially manufactured.

The six-page questionnaire was sent to all first-grade teachers of San Joaquin County, exclusive of the Stockton Public Schools. Of the 112 questionnaires sent, 78 were returned completed. In some instances the returned questionnaires were incomplete in certain items; therefore, tabulations in tables sometimes showed less than 78 respondents.

Conclusions. From the data of this study the following conclusions have been reached;

1. Work of the county consultants and administrators aids teachers in realizing the value of teaching arithmetic by means of manipulative devices.

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[1]See pages 24-25.

2. The more professional training teachers have, the more they are aware of the values derived from using concrete materials in learning and teaching arithmetic.

3. San Joaquin County first-grade teachers use specific teaching aids to give children opportunity to discover arithmetic ideas and concepts that are basic for later abstractions.

Recommendations. On the basis of findings from this study the following recommendations are made:

1. Teachers want time and instruction to restore depleted materials and to make new devices; therefore, the in-service training workshops in arithmetic should be continued.

2. College training elementary teachers should offer workshops through which teachers would have opportunity to learn to make, and to use, manipulative devices.

3. Money should be budgeted for arithmetic devices. Administrators, consultants, and school patrons should be lead to understand it is just as important to have money spent for materials for learning arithmetic as it is for them to furnish globes and maps for social studies, brushes and paints for art, and test tubes and aquariums for science classes.

4. Teachers should seek help from shop and art instructors, and from parent groups who have tools and workshops available for the actual construction of manipulative devices.

5. Consultants and administrators should consider ways by which they can best meet the request of teachers for demonstrations in how to teach beginning arithmetic. The teachers have indicated these demonstrations should be in actual classroom situations.

Suggestions for further study. The following topics are suggested for further study:

1. A similar study should be made of manipulative devices used by teachers in second and third grade to discover what use manipulative devices have in extended number experiences.

2. In order to improve the accelerated program for gifted pupils, a study should be made concerning the use and construction of manipulative devices for the gifted child.

3. A comparison should be made of the rates of learning in the teaching of beginning arithmetic with manipulative devices and without manipulative devices. This might demonstrate how effective these teaching aids are.

4. A comparison should be made of the use of audio-visual aids, supplementary materials, field trips, and other components of a satisfactory enrichment program by the less-formally prepared teacher and the teacher having better formal training. If, as in the use of manipulative devices for teaching arithmetic, the better trained teacher is using more of these techniques than the less-formally prepared teacher; there will then be need for training in this area.

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APPENDIX A

THE QUESTIONNAIRE

A QUESTIONNAIRE ON MANIPULATIVE DEVICES

GENERAL INFORMATION

Grade you teach _____ Class enrollment _____

Number of years teaching First Grade _____

Number of years teaching experience _____

Check kind or kinds of Credential you hold.

General Elementary ____ Elementary Provisional ____

Supervisional ____ Administrative ____

List other Credentials _____

Below circle the number which nearest approximates the number of College, semester units, you have completed.

30 - 40 - 50 - 60 - 70 - 80 - 90 - 100 - 110 - 120 - 130 - 140 - 150 - or more.

PART I

DIRECTIONS FOR SECTIONS A, B, C, AND D

In each of the boxes below put down the number one (1) in the box to the right if the item is <u>very important</u> to you. Put down the number (2) if the item is of <u>average importance</u>. Put down the number (3) if the item is of <u>little importance</u> and put down the number (4) if the item is of <u>no importance</u> to you.

A. For what purpose do you mainly use manipulative devices?

1. Presenting a new concept ____
2. Clinching a process (make it more thorough) ____
3. Reviewing a previous presentation ____
4. Testing a pupil's knowledge ____
5. Reteaching an idea ____
6. Used as toys ____
7. Gives pupils opportunity for experimenting ____
8. Teacher demonstration ____
9. Pupil demonstration ____
10. Use in group situations ____
11. Use with individual pupils ____
12. Teach bright pupils ____
13. Teach average pupils ____
14. Teach slow learners ____
15. Help timid pupils gain confidence ____
16. Speed up the learning process ____
17. Put fun into practice or drill work ____
18. Challenge the gifted child ____
19. Prove an abstract idea (self checking) ____
20. Aid creativity ____
21. Impress parents by an up-to-date display ____
22. Provide incidental number teaching without formal class teaching ____

B. How important are the following considerations in the making or selection of manipulative devices?

1. Color ____

2. Compactness ____

3. Quality of material ____

4. Durability ____

5. Safety in manipulation ____

6. Conformity to standards in measurement, such as,
   A foot should equal foot
   A nickel should at least be aluminum
   The four sides of a square should be equal, etc. ____

7. Flexibility (It can be used for more than one thing) ____

8. Simplicity in directions for operation ____

9. Difficulty suited to grade level ____

10. Devices should be only those suggested by manual for the Winston series we are now using ____

C. In General Do You Think

a. Commercial devices are superior to home-made ____

b. Home-made devices are superior to commercial ____

c. We have too many manipulative devices in our classrooms ____

d. Teacher-made devices take too much time ____

e. We do not have enough manipulative devices ____

D. As a teacher I feel that I need more training about how to effectively use manipulative devices. This help I want from:

a. Additional college courses ____

b. More in-service training on the county level ____

c. Demonstrations in a class situation ____

d. My principal or a fellow teacher when I am actually faced with a need ____

e. Grade level meetings with my principal or consultant ____

PART II

Listed below is a partial list of devices which can be obtained commercially or made by teacher, teacher and pupils, or with the help of parents. Please indicate your answer with a (✓) in the appropriate columns at the right.

A. Counting Devices	We Have	We Use	Home-Made	Commercially Made
Objects such as separate blocks, buttons, spools, beads, sticks, tickets, bottletops, markers, etc.				
Pictures of objects ungrouped				
Pictures of objects grouped				
Discs or dots ungrouped				
Discs or dots grouped				
Ten-Ten counting frame (child's)				
Teacher Classroom counting frame				
Hundred Bead frame				
Hundred spool counting board				
Geometric objects, cubes, triangles, etc.				

A. Counting Devices (continued)	We Have	We Use	Home-Made	Commercially Made
Peg Board				
Abacounter				
Counting bar				
Readiness number posters				
Others				
B. Concept Devices				
Numberite				
Number Jumble				
Units, tens, hundreds, bead frame				
Match mates				
Additive Board				
No. 10 number work board				
No. 20 number work board				
Place value board				
Place value charts				
Place value pocket charts				
Place value counting meter				
Domino blocks				
Number sorter				
Place value sticks				
Abacus				
Comparison Charts				
Fraction Charts				

B. Concept Devices (continued)	We Have	We Use	Home-Made	Commercially Made
Fraction discs				
Everybody show card kit				
Ideal Fraction Wheel				
Fractioneer				
Geometric Solids and Figures				
Devices for teaching ordinals				
10 bead fact finder				
Emery paper numbers				
Cloth numbers				
Others				

C. Measuring Devices and Fractional Concepts

Distance - foot ruler
yard stick
tape measure

Liquid - cup
pints
quarts
gallon

Weight - scales
balances

Temperature- thermometer

Capacity - boxes
bushel basket
tablespoons
milk cartons

C. Measuring Devices and Fractional Concepts (continued)	We Have	We Use	Home-Made	Commercially Made
Quantity - egg carton				
pair socks				
pair shoes				
others				
Value - toy money				
real money				
stamps				
tokens				
cash register				
Time - clock in room				
Judy clock for demonstration				
Clock faces for pupils				
watch				
calendar				
others (indicate kind)				

D. Practice Devices for Drill in Fundamental Processes

Flash cards using number symbol like $\frac{3}{4}$

Perception folding cards

Everybody show card kit

Answer pockets

Arithmetic games

Spinno

Magic plastic slates

Other games (indicate kind)

E. Boards with Adhesive	We Have	We Use	Home-Made	Commercially Made
Velour board				
Magnetic board				
Cohere-O-Graph				
Flannel Board--teachers' size				
Flannel Board--pupils' size				
Others				

F. Social Practices Involving Manipulation of Numbers		
Buying lunch tickets	____	____
School bank	____	____
Post Office buying stamps	____	____
Use of play telephone	____	____
Use of real telephone	____	____
Play store and store stock	____	____
Weather records	____	____
Sport equipment games for P.E.	____	____
Building with real material	____	____
Building with blocks, etc.	____	____
Others	____	____

APPENDIX B

THE LETTER TO CONSULTANTS

20 S. Ham Lane
Lodi, California
January 20, 1958

Dear San Joaquin County Consultants:

San Joaquin County Consultants have done much to assist First-grade Teachers in making the arithmetic program for children meaningful. Teachers are profiting educationally from workshops, grade level meetings, prepared outlines, all of which emphasize the importance of a psychological approach to numbers.

The laboratory method is bringing into use a great many kinds of manipulative devices, home-made and commercial. It seems reasonable to believe that at this time there would be value in a study of which kinds of manipulative devices are actually in first-grade rooms and what uses are being made of some of them. Also, how are the teachers reacting toward manipulative devices for use in teaching primary arithmetic.

Could I have your cooperation for such a study? I am enclosing the questionnaire I propose to use. If you have suggestions for revisions of the questionnaire I would like to have them. The final form will be sent to all first-grade teachers in this county.

Mr. Hamilton Hodgson has given his consent for the study which I am doing under Dr. Lloyd King at the College of the Pacific. May I hear from you soon regarding the questionnaire and your interest in such a study.

Sincerely,

(Mrs.) Sylvia Osborne
First-Grade Teacher
George Washington School

APPENDIX C

THE LETTER TO THE TEACHERS

20 S. Ham Lane
Lodi, California
January 20, 1958

Dear First-Grade Teacher:

This is from one busy primary classroom teacher to another.

The purpose of this questionnaire is to find out the kinds of manipulative devices the first-grade teachers of San Joaquin County have available in their classrooms. I also wish to know how first-grade teachers react toward manipulative devices for use in beginning arithmetic. Will you help me to make this study by completing the enclosed questionnaire and return it in the enclosed self-addressed envelope?

The county supervisors have shown considerable interest toward my study and hope that the results will be of some use to them in their work to help you. Your assistance is greatly appreciated.

Sincerely,

(Mrs.) Sylvia Osborne
First-grade Teacher
George Washington School

APPENDIX D

ADDITIONAL DEVICES LISTED BY THE TEACHERS

Other Devices Teachers Listed:

A. Counting devices:
- Counting boards with discs
- Large animal abacus (6 ft. tall)
- Number board with rings
- Plastic cars (From Plymouth Auto Co.)
- Tag discs
- Home-made box games
- Commercial games

B. Concept devices:
- Flocking numbers
- Clothes pin game
- Pop bottle caps
- Real cakes, pies, apples, oranges, and sandwiches
- Acetate packet marked with crayons
- Home-made games
- Numerous commercial box games

C. Measuring devices:
- Time: Alarm clock
  - Cuckoo clock from Switzerland
  - Hour glass
  - Sun dial

D. Social Practices Involving Manipulation of numbers:
- Special sales, cake, candy, etc.
- Selling tickets