TEACHING RAPID AND SLOW LEARNERS
IN SEVENTH GRADE ARITHMETIC

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PREFACE

As the need for trained scientists becomes increasingly greater in our complex technical world, the importance of sound mathematical training also becomes increasingly great. Since it is recognized that individual differences exist among students, teaching methods must take into account the wide range of slow and rapid learners in order to teach mathematics effectively.

The writer, whose interest in mathematics teaching goes back to his own experience as a junior high school mathematics teacher in the public schools of Oklahoma, hopes this study will contribute to a better understanding of the procedures for teaching rapid and slow learners in seventh grade mathematics, and also encourage further studies to determine the best and most effective methods for improving the teaching of arithmetic.

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CHAPTER I

THE PROBLEM

Although there are considerable data available today to support the importance of providing for individual differences in effective teaching, according to Wingo (31:297)*, there is unfortunately not enough knowledge of how to deal with individual differences. In teaching mathematics in an atomic age, it becomes increasingly important to provide for the differential abilities of rapid and slow learners. Recognizing this need for adapting teaching methods in different subjects for pupils who are above or below average, nine secondary school specialists in the Office of Education of the United States Department of Health, Education, and Welfare, prepared a questionnaire consisting of 30 instructional provisions which might be used for teaching rapid and slow learning high school pupils. This questionnaire was used by them in a nationwide survey to find to what extent these 30 provisions were utilized by mathematics teachers (25:1-5 and 42-49).

Statement of the Problem

The purpose of the present study is threefold - to investigate: (1) How and to what extent authorities recommend the use of these 30 provisions for teaching rapid and slow learners in seventh grade

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*All bibliographical references in this paper are listed numerically.

arithmetic. (2) To what extent teachers of seventh grade arithmetic in Oklahoma schools utilize these 30 provisions. (3) Similarities and differences between the extent of use and the recommended uses of these 30 provisions.

Delimitation of the Problem

This study will be delimited to an analysis of ten leading textbooks in teaching arithmetic, four state teachers' manuals and a survey of seventh grade arithmetic teachers in Oklahoma.

The ten textbooks used in the investigation were selected from a list of basic textbooks used in professional courses dealing with the teaching of arithmetic (6:216) and from texts used by Oklahoma State Colleges that offer courses in methods of teaching. These textbooks are:

<u>Making Arithmetic Meaningful</u> (1)
Brueckner and Grossnickle

<u>Guiding Arithmetic Learning</u> (4)
Clark and Eads

<u>Guiding Children's Arithmetic Experiences</u> (8)
J. Allen Hickerson

<u>Teaching Children Arithmetic</u> (11)
Robert Lee Morton

<u>The Teaching of Arithmetic</u> (13)
Fiftieth Yearbook, Part II
National Society for the Study of Education

<u>The Teaching of Arithmetic</u> (17)
Herbert F. Spitzer

<u>Teaching The Meanings of Arithmetic</u> (19)
C. Newton Stokes

<u>Arithmetic for Teacher-training Classes</u> (20)
Taylor and Mills

<u>How To Teach Arithmetic</u> (28)
Harry Grove Wheat

Teaching The New Arithmetic (30)
Guy M. Wilson

The four 7th grade teachers' manuals which accompany state adopted textbooks in arithmetic now in use are:

Teacher's Guide for Thinking With Numbers (2)
Brueckner, Grossnickle and Merton

Teacher's Edition: Making Sure of Arithmetic, Grade Seven (12)
Robert Lee Morton et al

A Teacher's Manual for Numbers In Your Life (14)
Patton-Young

Manual With Answer Key for Row-Peterson Arithmetic Book Seven (29)
Wheat and Douglass.

The survey was in the nature of a questionnaire distributed to seventh grade arithmetic teachers in 175 junior high schools and 175 elementary schools as listed in the Oklahoma Educational Directory for 1955-56. The geographic distribution of the sampling included all counties listed in the Directory.

Significance of the Study

The basic problem is to determine which procedures are most effective for teaching rapid and slow learners in seventh grade mathematics. This, of necessity, involves an evaluation of procedures currently used and those recommended by the authorities.

This study is intended to furnish information about the following which is prerequisite to an evaluation of these procedures: 1) The procedures which are being used by Oklahoma teachers and the extent of their use. 2) The procedures which are recommended by teacher-training authorities and how they recommend these procedures be applied.

Clarification of Terms

For this study, rapid learners are defined herein as those among the highest 15 to 20 percent in general intelligence; slow learners are those among the lowest 15 to 20 percent (25:3).

The term authorities, when used in this study, refers to the authors of the ten mathematics methodology textbooks and the four teachers' manuals listed on pp. 2 and 3.

Assumptions

The assumptions are made herein that:

1. The teachers' ratings of the extent of their use of the 30 procedures is a valid indication of the extent to which these procedures are actually used by the teachers. (This assumption is also implicit in the national study reported by the U. S. Office of Education (25).

2. The sampling of 150 Oklahoma teachers who returned the questionnaires, from 49 out of the 77 counties in Oklahoma, is representative of seventh grade mathematics teachers in the state of Oklahoma.

The next chapter will deal with a review of the literature pertinent to this investigation.

CHAPTER II

REVIEW OF THE LITERATURE

Historical Background

Recognition of the problem of differences in the abilities of individuals dates back at least to the ancient Greeks. Plato, in his Republic, proposed that variation in individual capacities be used as a basis to determine man's position in his ideal society. For centuries, the philosophy behind the educational systems of most European countries has been that secondary and higher education should be reserved for the intellectually gifted.

The first half of the 20th century saw a tremendous growth of secondary education in America. Reeve (16:70) in 1956 reported that public secondary school enrollment in 1951 was 6,168,000 as compared to approximately 500,000 fifty years ago.* With this expansion of secondary education, the problem of providing for individual differences became especially acute.

The development of the first widely used intelligence test by Binet in 1905 gave impetus to the field of education for objective measurement of individual differences. In spite of their flaws, according to

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*Paper read at the Winter Meeting of the Association of Mathematics Teachers of New Jersey at Rutgers University in Newark, New Jersey on March 5, 1955; at the University of Wisconsin Summer Conference of Mathematics Teachers in cooperation with the National Science Foundation, at Madison, Wisconsin, on July 21, 1955, and at several other conferences of mathematics teachers.

Tyler (24:9), intelligence tests made it possible to handle the problems created by individual differences more intelligently than they had ever been handled before.

Thorndike in 1914 (21:Part II) reported results of studies he had made to measure individual differences in the learning capacities of students. In 1921 (22:142) he pointed out the importance of the problem of providing for individual differences in teaching arithmetic. In 1922 Thorndike (23:289) stated that the variations within a single class for which a single teacher has to provide is great. Under ordinary circumstances the range is so great as to be one of the chief limiting conditions for the teaching of arithmetic. He (23:293) said that one of the great opportunities for applied science is the invention of procedures of teaching groups of 30 children who differ widely in capacity and previous achievement.

Spitzer (17:129) in 1951 asserted that though we have known for many years that pupils differ in arithmetical ability and achievement, for the most part nothing has been done in classrooms to adjust the programs to the needs of the different types of pupils.

One of the greatest tragedies in American education today, Ragan (15:109) said in 1953, is the vast gap which exists between theory and practice. It is very easy to pay lip service to some fine educational principle, such as democracy in education or, provision for individual differences, and then go right on teaching in a manner entirely incompatible with the principle professed. Failure in arithmetic, he (15:332-333) said has long been one of the principal causes of non-promotion in the elementary school, and arithmetic has probably caused more unhappiness among elementary school children than any other subject.

Lewis observed 76 schools in 23 states and reported in 1954 (10:66-67) that in most of the groups observed there was little evidence of provision for individual differences among children in their achievement or their ability to learn the necessary facts and processes in arithmetic. More often all were attempting to do the same work out of the same book in the same amount of time with little or no special provisions for either the rapid learner or the slow, except for the help the teacher gave during class. Yet, Lewis continued, here and there it was evident that an attempt was being made to provide for individual differences. Observation, however, seems generally to support the view expressed at times, Lewis said, that teachers need help in individualizing arithmetic teaching in grades seven and eight.

Studies have been made to determine effective methods for teaching mathematics to rapid and slow learners. Unfortunately, there are not too many reported. Gibb (5:607) in 1953 pointed out that not one of eight experimental investigations reported from 1940-1950 concerned with ways for more effective learning of arithmetic, was concerned with the effects of individual differences per se on the learning of mathematics. However, some of the most significant studies which may have bearing on the present investigation will be examined.

Related Studies

A. Review of Research in the Area of Teaching Rapid and Slow Learners in Arithmetic.

In 1928 Weimar (27:104-105) reported that the Wichita High School in Kansas had dealt with the problem of individual differences for ten years by grouping students according to their ability into three groups - honor, medium and slow. The slow group was taught the bare essentials of mathematics needed in everyday life, while the medium and the honor (rapid) group covered the same work, but the medium group was given much more assistance from the teacher. However, there is a lack of agreement among the various reports and research findings on the desirability of the practice of ability grouping.

Wren (32:602) in 1935 reported in a survey of research in the teaching of secondary algebra that research findings differed on the question of ability grouping. Some studies, he said, concluded that ability grouping for algebraic instruction develops more individual initiative, creates more desirable attitudes and reduces the number of failures. Other research results did not favor ability grouping. Wren (32:603) also reported that research in other areas of algebraic instruction in many cases resulted in contradictory findings. For example, some research indicated that group instruction in algebra produced better results than individual instruction. Other research data indicated that the individualized unit method produced better achievement and retention in algebra than the traditional method of instruction. While Wren deals with techniques which relate to individual differences in pupils' abilities, he does not, however, make a distinction between those techniques which are particularly well adapted to the rapid and slow learners of secondary algebra.

In a later survey in 1950 Wren (33:721) reviewed the experimental research pertinent to the teaching of mathematics to rapid and slow learners in secondary mathematics. He said that various experiments with supervised study, individualized instruction, ability grouping, and the technique of making assignments have not been productive or very convincing evidence either for or against any particular method. However, he said, the implication is probably in favor of large-unit assignments and individualized methods of instruction, especially for the brighter students. For the less able students, supervised study with smaller unit assignments seems to produce better results, Wren said.

In 1956 Reeve (16:70) indicated that providing for varying abilities in secondary school mathematics classrooms is still a perplexing problem. He said that the most important and most difficult problem today is the problem of individual differences among students. It has taken the educational world a long time to appreciate fully the fact that great differences among individuals exist, and in many respects, Reeve said. It is this failure to recognize and handle individual differences of ability among students that gives rise to the large and unwarranted number of failures in the schools. Reeve (16:71) said that failure to adopt homogenous classification for teaching purposes has hindered the solution of the problem of individual differences. He (16:75) recommended that bright students be assigned work outside the classroom and that the study class or conference hour be utilized for all students who are behind in their work. Reeve (16:77) deplored the practice of assigning the same amount of work to each student, pointing out that gifted students have the capacity for doing much more work than the mediocre ones.

The question of providing for rapid and slow learners in mathematics is not limited to recognition of individual differences. Reeve (16:70) pointed out that students differ not only in ability but in their experiences and interests. He said that the question of how to provide for varying abilities in the secondary school mathematics classroom is a perplexing problem.

There is a paucity of research reported in the literature on the extent to which mathematics teachers utilize the research findings on provisions for teaching rapid and slow learners and the extent to which they use the provisions recommended by authorities. However, the following two studies may be significant for the present investigation.

B. Review of Studies Related to Teachers' Utilization of Specific Procedures for Teaching Rapid and Slow Learners in Arithmetic

In 1949 LeBaron (9:1-9) reported on a study of teachers' opinions in methods of teaching arithmetic in the elementary school. In this study, 22 experienced teachers in grades kindergarten through six were used. A list of 72 statements based on findings in arithmetic research and on the judgment of outstanding authorities was used to sample teachers' judgments. Every statement was a declarative sentence, either true, false, or uncertain in the light of research or in the judgment of a recognized authority. It was found in this study that teachers were in about 50 percent agreement with current research findings and the judgments of experts.

It should be pointed out that the small sampling surveyed in LeBaron's study may throw some question on the statistical reliability of the findings. Even though LeBaron's study covers the elementary grades and does not deal with procedures for rapid and slow learners, it is included here as it does deal with the extent to which teachers are in agreement with authorities in reference to mathematics teaching procedures. It may, therefore, have some relevance to the present study.

In 1954 the United States Department of Health, Education, and Welfare (25) published a report compiled by nine secondary school specialists in the Office of Education. This covered a study made during 1952 and 1953 to determine the extent to which certain instructional practices are being used in public high schools today and to encourage and help high schools to study ways in which they can make better provisions for their rapid and slow learners. A questionnaire (25:90-91), listing 30 selected procedures for teaching rapid and slow learners, was developed by these specialists. The questionnaire they used is as follows:

1. Give individual assistance to pupils after school hours.
2. Provide individual supervision and guidance during class.
3. Assign simple drill problems.
4. Assist students in learning vocabulary and reading skills peculiar to mathematics.
5. Emphasize the social uses of mathematics.
6. Encourage students to make scrapbooks and prepare graphic materials showing uses of mathematics.
7. Emphasize manual activities which illustrate mathematical principles.
8. Encourage students to read simple stories about mathematics or famous mathematicians.
9. Require all students in a given class to do approximately the same amount of work and type of work for the same mark.
10. Encourage students to compete for awards given for superior scholarship.
11. Encourage able students to assist slower students.
12. Encourage study of the applications of mathematics to science.
13. Encourage students to make aids to instruction for the classroom.
14. Display student's work on bulletin board.
15. Provide a mathematics laboratory.
16. Make individual assignments based on student's ability.
17. Encourage each student to work at his own rate, but require the student to confine his work to the same topic as the other students.
18. Encourage each student to work at his own rate and to complete as many topics as his ability will permit.
19. Assign the same homework to each student.
20. Permit students to use class time for other subjects when mathematics assignment is completed.
21. Provide students experiences in group work.
22. Encourage student self-evaluation.
23. Provide field trips related to classwork.
24. Encourage solution of mathematical problems from field of students' interests.
25. Provide students with experiences in evaluating types of reasoning in newspaper and magazine articles.
26. Plan class activities with students.

27. Give students experience in group evaluation.
28. Encourage students to make up problems by securing data from own reading or experiment.
29. Provide students with experiences in a Mathematics Club.
30. Give the students experiences in applying the principles of mathematical reasoning to social problems.

In the section of the report on Mathematics (25:42-49) it is stated that the results are based on returns from 635 schools which enrolled 335,510 pupils in mathematics. This enrollment is equal to approximately 7 percent of all the pupils enrolled in mathematics in grades 7 to 12 in the United States in 1953.

According to the report, the data from the questionnaire indicate that teachers are attempting to provide for individual differences in many ways.

The findings of the national report indicate that item No. 2, "provide individual supervision and guidance during class," was rated high among the procedures used by effective teachers of rapid or slow learners. Item No. 21, "provide students experiences in group work," was used by some teachers in providing for the individual differences in their pupils. However, individual work was reported in use more than group work and item No. 22, "encourage student self-evaluation," was utilized more than item No. 27, "give students experience in group evaluation."

Item No. 3, "assign simple drill problems," was second in extent of use with slow learners while item No. 15, "provide a mathematics laboratory," was little used in providing for either the rapid or slow learner.

Other items which ranked high for rapid and slow learners were item No. 5, "emphasize the social uses of mathematics," and item No. 12, "uses of mathematics in science." However, item No. 23, "provide field trips related to classwork," was used very little. Also not used to a great extent were items No. 25, "provide students with experiences in evaluating types of reasoning in newspaper and magazine articles," and item No. 30, "give students experiences in applying the principles of mathematical reasoning to social problems."

A summary of the review of the literature follows.

Summary of the Literature

A survey of the literature indicates that one of the most important and most difficult problems today in teaching mathematics is the problem of individual differences among students. In addition, much has to be done to determine how to provide for varying abilities in the secondary school mathematics classroom. Furthermore, there is a need to determine what teaching techniques can best be used to help the slow-moving pupil and the exceptional pupil, each to progress according to his ability. A study in 1949 of 22 elementary school teachers' judgments as compared to authorities' judgments indicated that teachers were in about 50 percent agreement with current research findings. The United States Office of Education Study reported in 1954 indicated to what extent teachers throughout the country were utilizing selected procedures for teaching rapid and slow learners in seventh grade mathematics. It also indicated that teachers were attempting to provide for individual differences in many ways.

The next chapter will discuss the method and procedure used in the present investigation.

CHAPTER III

METHOD AND PROCEDURE

Procedure for Analyzing Textbooks and Manuals

A printed questionnaire (See Appendix A, p. 90) was prepared for this study. It listed 30 selected provisions and procedures which might be used for teaching rapid and slow learners in seventh grade arithmetic classes. This questionnaire is essentially similar to the one developed by the U. S. Office of Education Study. (See pp. 11 and 12.)

There is a slight difference in the wording of two items on the printed questionnaire as compared to the U. S. Office of Education questionnaire. These are Items No. 22 and 30 which are listed on the printed questionnaire used in this investigation as "Provide students self-evaluation," and "Give students experiences in applying the principles of mathematical reasoning in social problems." On the U. S. Office of Education questionnaire these items read "Encourage student self-evaluation," and "Give the students experiences in applying the principles of mathematical reasoning to social problems." The differences in wording between the two questionnaires appear to be so insignificant that the essential meaning of the two items is not affected.

Ten leading mathematics methodology texts and four teachers' manuals (which accompany seventh grade textbooks used in the state of Oklahoma) were analyzed to determine how and to what extent they recommended the use of the selected procedures listed on the printed questionnaire. (See pp. 2 and 3 for the list of texts and manuals.)

Author's recommendations of each of the 30 items were classified as follows:

<u>No Opinion</u> for practices not mentioned at all.
<u>None</u> for practices mentioned, but considered of negligible value.
<u>Some</u> for approved practices.
<u>Much</u> for practices discussed in detail with emphatic approval.

See summary tables, pp. 47 and 48 for texts and pp. 69 and 70 for manuals.

The assumption is made that where the specific text or manual does not mention a provision, the author has no opinion one way or another. Those practices which were considered of little or no value were easily identified and classified as <u>None</u>. There was little difficulty in most instances in determining whether an author emphatically approved of a practice, in which case it was designated as <u>Much</u>. However, in some cases, a particular item could be just as easily classified as <u>Some</u> or <u>Much</u>. When this occurred, the writer was compelled to make an arbitrary judgment in assigning the classification.

The procedure for classification of items and assignment of weights to <u>None</u>, <u>Some</u>, and <u>Much</u> categories followed that of the U. S. Office of Education Study. (25:20)

The total number of responses for each item (1 through 30) under <u>None</u>, <u>Some</u>, or <u>Much</u> were totaled. A response of <u>None</u> was weighted 0; a response of <u>Some</u> was weighted 1; a response of <u>Much</u> was weighted 2, and a response of <u>No Opinion</u> was not included in the total responses.

The mean for each item was then obtained by multiplying the <u>None</u> responses by 0; the <u>Some</u> responses by 1, and the <u>Much</u> responses by 2. The total was then divided by the sum of all the responses (including those under <u>None</u>, but not including those under <u>No Opinion</u>) for each item.

For example, assume that Item 1 had the following total number of responses:

	None	Some	Much	No Opinion
Item No. 1	3	5	1	2

The weighted total would be found by multiplying 3 x 0, 5 x 1, and 1 x 2. Then, these results would be added (5 and 2) to obtain 7. This sum, divided by the total number of responses for Item No. 1, not including No Opinion, (3 and 5 and 1 equal 9) results in a mean of .777 (7 divided by 9). This mean, when compared with other means, is interpreted as an index of the relative extent to which a provision was recommended by the textbooks and manuals.

Each of the 30 items was ranked according to the magnitude of the mean -- the largest mean ranked first, the second largest next, and so forth.

Questionnaire to Oklahoma 7th Grade Mathematics Teachers

The printed questionnaire was distributed to 350 Oklahoma teachers, who were asked to classify under the headings of None, Some, and Much the extent to which they used these practices. Questionnaires (See Appendix A, p. 90) were mailed with letters to School Superintendents or Principals (See Appendix B, p. 91) asking them to have their seventh grade teachers of mathematics fill out the questionnaires. A self-addressed envelop was enclosed for the return of the questionnaires.

Mean and rank for each response was derived by the same procedure that was used to analyze the textbooks and manuals.

The next chapter will report the results of the analysis of the textbooks and manuals and also of the findings from the questionnaires.

CHAPTER IV

RESULTS

Analysis of the Ten Arithmetic Methodology Textbooks' Recommended Use of the 30 Teaching Provisions

Each of the ten arithmetic texts (See pp. 2 and 3) was carefully analyzed to determine how and to what extent the 30 items on the questionnaire were recommended. Results of the analysis are listed by item in the same sequence that they appear on the questionnaire sent to Oklahoma teachers (See Appendix A, p. 90).

No. 1, p. 47, "Give individual assistance to pupils after school hours."

This provision was not specifically mentioned by any of the texts. Hickerson (8:49) says that the teacher should organize the total instruction program in such a way that he will meet each child for about 15 to 30 minutes at least two or three times a week either alone or in a small group to become acquainted with the thinking processes of each child and thus be able to guide him in his various types of arithmetic experiences. However, Hickerson does not specify whether this should be done during or after school.

No. 2, p. 47, "Provide individual supervision and guidance during class."

The nine authors who mention this practice suggest its use with both rapid and slow learners. Spitzer (17:130) says that provision for meeting individual differences can be made by providing arithmetical experiences through oral exercises and projects that go beyond the minimum set by textbooks and courses of study for the abler pupils.

Morton (11:7) says that only the teacher can discover the special interests and abilities of the pupils and go beyond the basic instructional materials to satisfy them. He says that there are many places where the teacher can and should differentiate the program to suit the varying ability levels found in a class.

According to Stokes (19:221), pacing instruction means that the learning situation must be fitted to the individual's level of maturation. Pacing instruction (19:232) requires that teaching be adapted to the varying abilities of the children found in any classroom.

Through this practice, Brueckner and Grossnickle (1:452) say, the teacher should see to it that the more able children are challenged by tasks that are of concern to them, while children of lower intelligence levels are given responsibilities each in accordance with his ability.

Referring to finding pupils' difficulties in problem solving, Taylor and Mills (20:231) say that each pupil needs individual attention to find out what his specific difficulties are.

No. 3, p. 47, "Assign simple drill problems."

This practice was recommended by all ten textbooks. Wheat (28:339) says that practice in computation should be a mode of studying and thinking, not merely a mode of drill. Practice, he says, should be deliberative rather than hurried for speed and deliberative practice of computation aids in improving familiarity with numbers and number relations.

Brueckner and Grossnickle (1:122) suggest that practice materials be organized in such a way that the pupil can progress at his own rate with a minimum amount of guidance by the teacher. Slow learners (1:464-465) should have more time for practice exercises varied to avoid monotony and repetition by using games and similar interesting devices. They should be provided with a larger amount of practice, such as is provided in workbooks.

Hickerson (8:53) recommends the following general principles governing drill:

> Practice should be a means, not an end in itself.
> Practice should be performed only on combinations that are understood.
> Practices should be adjusted to meet the needs, interests and abilities of the child.
> Practice should be oral on computations that are to be performed mentally.

Drill should be used as a method only after understanding has been established, Clark and Eads (4:252-253) say. Repetition before understanding has been established may fix immature, perhaps even incorrect, ways of dealing with mathematical ideas and procedures. Where understanding and insight are stressed, often less repetition is needed.

Spitzer (18:398) says that only practice on a process or fact can give to pupils the mastery which is essential for proficiency in arithmetic. He (18:399) says that before drill is undertaken, the pupils should have an opportunity to acquire understanding. Supplementary procedures to promote understanding should then be interspersed with drill and review. The slower learners (18:401-403) can "advantageously use specially constructed work exercises, workbooks and easier readers."

The primary function in the activity called practice, Stokes (19:177) says, is the meaningful recurrence of a learning element in many and varied associations.

Taylor and Mills (20:42) say that drill is essential in the teaching of arithmetic (a) to build and (b) to maintain skills.

Buswell (3:147) says that practice should follow, not precede, understanding. Effective drill must emphasize the systematic character of number relations and of the number system, he says.

No. 4, p. 47, "Assist students in learning vocabulary and reading skills peculiar to mathematics."

All ten authors mention this provision. Wheat appears to disagree with the other nine on its use. Wheat (28:321) says that explanation of mathematical terms is not required. The teacher does not need to explain, but merely furnishes the terms as names of activities and ideas already known to the pupils. Vocabulary difficulties become non-existent.

Wilson (30:75), referring to early grades, says that if the initial teaching of arithmetic is right, the language symbols (word labels) of arithmetic will become meaningful to the child. The words he will use in his thinking about arithmetic will have "true-to-fact" meanings for him and will mirror correctly his concrete objective experiences. In reference to textbooks for all grades, he (30:458) says that the teacher can also help in interpretation by substituting simple explanations when textbook explanations are too abstruse or involved.

Taylor and Mills (20:228) say that before assigning problems from books, the teacher should find out if the pupils understand the vocabularies of the problems. If technical terms are used they should be defined and should be used often enough so that their meanings are fixed. If a term is not of sufficient importance to be well taught, it should not be used.

Stokes (19:205-206) says that vocabulary improvement should receive attention, especially those words used in expressing quantitative relationships. Having children write problems for the class to solve is helpful, Stokes says.

The child should be ready to read the particular word problems he is to solve, Hickerson (8:8-9) says. This readiness depends largely upon the mental development of the child, the number and kinds of first-hand experiences the child himself has had in situations similar to that described in the word problem, the oral language development of the child, the child's understanding of the arithmetical language and symbolism contained in the problem, his ability to determine what words and symbols the printed words and symbols represent, and his ability to visualize the concrete situation described by the words and symbols. The teacher is wise, therefore, if he sees to it that his children gain the necessary first-hand experiences and acquire the necessary learnings if he expects them to solve word-problems with any degree of understanding.

Clark and Eads (4:81) recommend that mathematical terminology be used by children after other more comprehensive terms have been used for some time. Even after mathematical terms have been introduced, children are expected to use easier terms as well.

No. 5, p. 47, "Emphasize the social uses of mathematics."

This practice is unanimously favored by all ten texts for use with both rapid and slow learners. Taylor and Mills (20:3) say that teaching the use of number processes in solving problems in everyday life is one of the three phases in the teaching of arithmetic which are emphasized throughout their book.

Spitzer (18:312) says that perhaps the best guide for the selection of arithmetic content is a logical analysis of the mathematics system as it applies to life situations. He suggests a good guiding statement (18:185): "Use the social situation in arithmetic when the social situation has a contribution to make in arithmetic and not just because the social situation has some arithmetic in it."

Wheat (28:281) says that the pupils need to study the common problems involving the number and number relations they meet in affairs of the home, the farm, the store, the shop, the community, and through their social studies in the more obvious activities of state and nation. They should look for relations between the quantities and amounts that are involved, and they should use the methods of work they have learned to determine the relations.

Hickerson (8:16) suggests that teachers in any community can make a study of the arithmetic needs of the local community and determine the kinds of experiences and problems the children in the community meet from season to season and year to year. In this way each community will have its own "grade" placement level of first-hand concrete experiences that its children generally encounter, Hickerson says.

Rapid learners should be given many units of problems presenting more difficult application of arithmetic, Brueckner and Grossnickle (1:464) suggest. They say that slow learners should make greater use of concrete social experiences to give meanings and to enrich background.

Wilson (30:395) says that functional problem units serve the true purpose of arithmetic and provide opportunity for using the tool phases of arithmetic in solving real problems in business and life.

No. 6, p. 47, "Encourage students to make scrapbooks and prepare graphic materials showing the uses of mathematics."

Four of the five textbooks which mention this practice suggest its use for both rapid and slow learners. One recommends it only for rapid learners. Brueckner and Grossnickle (1:463-464) suggest scrapbooks, exhibits, and collections as a way of enriching the work in arithmetic expecially for the gifted children.

Clark and Eads (4:236) say that pictures and (for older children) diagrammatic representations help children focus attention on relationships. They suggest that tables of measure may be derived by individual children or by small groups of children and records of measurement may be kept in tabular form, or for older children, in the form of graphs.

Morton (11:443) says that there are pupils whose greatest interest in the mathematics of the elementary school lies in the field of graphs, mensuration, and intuitive geometry. They enjoy constructing and studying graphical representations of statistical data, constructing plane figures and noting the facts and relationships involved, and constructing and studying figures in which three dimensions are involved. Teachers find that the content of this phase of the arithmetic program can be organized and lesson materials can be planned in strict accord with the interests and abilities of children.

According to Spitzer (18:330), the arithmetic notebook (or a section of the child's general notebook) for recording special assignments, statements of rules the class has developed, summaries and similar information is good instructional equipment for upper grade pupils. He recommends the teaching of scale drawings and map scales in sixth, seventh and eighth grade arithmetic. (18:293-296).

Stokes (19:53) suggests various types of materials which might be placed in a notebook or scrapbook to illustrate the uses of arithmetic. These include:

advertisements
business forms used in the community

charts
clippings from newspapers or magazines
diagrams
graphs
handbills
illustrations from catalogs
pamphlets which contain information which may be useful in illustrating or formulating current arithmetical problems.

No. 7, p. 47, "Emphasize manual activities which illustrate mathematical principles."

The eight authors who mention this provision agree on its use with rapid and slow learners although they point out that slow learners can profit most from this practice.

Clark and Eads (4:16) say that the use of concrete materials helps children see relationships, discover others, and grow toward more mature levels of thinking.

Taylor and Mills (20:36) state that facts gained through sense experiences are remembered better than those given by abstract descriptions. One of the principal uses of laboratory work is to give vivid experiences which are more easily remembered. Work with objects is the laboratory work of arithmetic. They (20:378) say that the simpler constructions with ruler and compasses are useful and interesting, and are easily mastered by seventh-and-eighth grade pupils. The mastery of these constructions and of the theorems that can be developed through them gives a valuable preparation for demonstrative geometry.

Morton (11:4) says that in the development of most topics, the first experiences should be concrete. They should be sensory in character; they should deal with objects which can be seen and handled. Later experiences may be semi-concrete; they may deal with pictures of objects and with diagrams. Still later experiences will be abstract; they may deal with symbols with no objects, or pictures or diagrams.

Of course, Morton (11:10) says, some children, particularly the slow learners need the concrete phase longer than do others. A child who is ready for the semiconcrete or abstract phases is not helped by repeated experiences at the object level; his eventual progress may actually be impeded by such delays.

Brueckner and Grossnickle (1:464-465) say that instructional adjustments of various kinds should be made for slow learning pupils. Some of the most useful procedures include that of making considerable use of manipulative materials and visual aids in the presentation of a process to assist the pupil to visualize the method of work.

An educational program cannot be carried out without an adequate supply of appropriate materials of instruction, Hickerson (8:55) says. Children from all classrooms should have access to all kinds of measuring instruments when their needs, interests, and abilities warrant. Hickerson (8:56) says that it is desirable to augment experiences with objects in real situation, with experiences with objects, pictures, charts, and so forth, that represent real situations in order to develop certain quantitative concepts.

Stokes (19:54) says that the emphasis on manual activities seems to be the most dynamic type of aid for some children. If they can come forward and manipulate the objects lying or standing on the teacher's desk or on a table, they gain something that visual perception alone does not give them.

No. 8, p. 47, "Encourage students to read simple stories about mathematics or famous mathematicians."

Two of the seven authors who discuss this provision indicate that it may be of interest to rapid learners only; two say all children will be interested, and three do not recommend it.

Brueckner and Grossnickle (1:464) suggest that the rapid learners can be given lists of books to read dealing with the history of numbers. Stokes (19:233) suggests that the school library is a good place for the fast learner while the others catch up on the class activity which he has mastered.

Both Morton and Wheat recommend this procedure for use with all children. Morton (11:421) says that pupils in the seventh grade will be interested in some of the historical aspects of measures in use today. They may also read about some measures formerly used but now discontinued. Wheat (28:432) says that children have a keen interest in numbers. This natural interest should be encouraged and fostered by providing opportunities for telling and illustrating number stories, making number scrapbooks, and displaying cartoons and pictures on the bulletin board.

Among the three authors who do not recommend this provision, Hickerson (8:60) says that since elementary school children have not yet developed a sense of chronology as it applies to historical time and since they are not mature enough yet to see cause and effect relationships in events in history, it would seem that consideration of how people computed in the past would not have much meaning to them. As stories, the use of numbers in the past might be amusing, as historical fact, such use is of little significance to the pre-adolescent.

Spitzer (18:379) says that number historical materials "contribute to a better understanding of arithmetic and are a motivating factor in the study of arithmetic." A survey of the books on the history of numbers, he adds, will reveal, however, that much of the material is not of value to children of elementary school age, even though that material may be very interesting to the teacher. Spitzer says that the areas which seem most significant for historical consideration are (1) counting, (2) numerals and notation, (3) weights and measures, and (4) old ways of reckoning.

Interesting stories on the history of number should not be the concern of the children, Wilson (30:27) says. If bright children raise questions, the teacher should be prepared to answer them, but the explanation should be brief and simple, Wilson says. The teacher should be well versed in the history and philosophy of arithmetic, but she should impose this knowledge on children very sparingly, and only when she is sure it will help, and not confuse, the children. Wilson (30:323-325) suggests many "easy readings" as sources of interesting readings or bases for stories told directly by the teacher.

No. 9, p. 47, "Require all students in a given class to do approximately the same amount of work and type of work for the same mark."

All seven texts which mention this provision disapprove of it. Morton (11:4) says that the teacher personalizes the arithmetic program and makes it a living and vital experience for the pupil. She adapts it to his previous experiences and to his level of maturation. (See Item No. 2, p. 17).

Spitzer (18:402) points out that while this practice is a common instructional practice, it is not the result of a carefully thought out procedure of caring for individual differences.

When children are classified more or less according to their chronological age, social adjustment, and common interests, as is the tendency, Hickerson (8:15) says, there is bound to be a wide range of native ability for acquiring various knowledges, skills, and understandings. Each child, then, Hickerson says, would have his own potential to fulfill--

there would be no mass standard to fail to meet, and to be successful in meeting, or to excel.

The teacher thinks about groups of children as she teaches the entire class, Clark and Eads (4:246-247) say, and she makes plans for them to be thinking on different levels as she teaches the same topic to all of them.

Brueckner and Grossnickle (1:97) maintain that a differentiated program is absolutely necessary, especially in the teaching of the basic computational skills, since there is such a wide variation in the levels of advancement of the pupils in any class in this phase of arithmetic.

No. 10, p. 47, "Encourage students to compete for awards given for superior scholarship."

Three of the four texts which mention this practice do not recommend it. Only Wilson appears to favor this practice. He says (30:53-54) that if the children's interests are to be the center of school work, the teacher must know what the basic interests are. Wilson refers to a list of types of motives from The Motivation of School Work by Wilson and Wilson: "Earning money and acquiring property, competing for results, a reward, or an honor, playing games, making things...." The basic law of motivation, Wilson says, is that the work undertaken shall connect directly with the child's present interests.

Morton (11:58-59) says that a serious mistake is sometimes made in pitting one pupil against another with whom he cannot be expected to compete successfully. Morton says that the pupil is in school to learn, not to compete with other pupils.

Stokes (19:204), in reference to problem solving, says that some children have a liking for problem solving because in the successful solution of problems they feel that "goals are their own rewards."

Brueckner and Grossnickle (1:107) indicate the importance of intrinsic motives, such as felt needs, wants, and a desire to learn, rather than extrinsic motives such as marks or awards.

No. 11, p. 47, "Encourage able students to assist slower students."

Only three of the textbooks mention this practice. Clark and Eads (4:251) say that bright children, if they can profit from such a relationship, might be asked to help less mature children. However, they (4:248) point out that it is generally unwise to use children as helpers unless they themselves are learning.

Wilson (30:57) suggests that this practice may be effective in motivating drill. Drill periods in which children form small groups with pupil leaders prove interesting because each child is taking part frequently and is working at his own level, Wilson says.

Brueckner and Grossnickle (1:99-100) include this practice among suggested activities suitable for gifted children not only to enrich their experiences but also offer a challenge to them. Brueckner and Grossnickle suggest having the better pupils assist slower pupils or others who are encountering difficulties.

No. 12, p. 47, "Encourage study of the applications of mathematics to science."

Six of the eight texts which mention this practice favor its use for all students. Clark and Eads and Stokes emphasize its use for rapid learners. Clark and Eads (4:250) suggest that bright children might report on the results of science experiments, putting their data in writing so that the data may be used for computation by the other children.

Stokes (19:233) in discussing pacing instruction says that it may be that the fast learner has an interest in science or some other field of applied work. Perhaps he should be given a chance to experiment or discover, Stokes says. Make his life full, rich, and happy in the doing of things at his level and within his scope of interests.

Among the authors who recommend this practice for all students, Spitzer (18:194-195) says that when the procedure of having pupils formulate problems is used in the upper grades, the data to be used for the problems may be derived from social studies, science, health and current events.

Taylor and Mills (20:359) say that mathematics is a prerequisite to the study of science. In the introduction of Algebra and Geometry in the seventh and eighth grades they emphasize that pupils should be made proficient in the use of formulas; there should be enough practice in the solution of equations, and practice in making and interpreting graphs as well as simple geometric constructions. (20:360-381). Some exercises suggested by Taylor and Mills include finding the horsepower of a Buick 6-cylinder car and how far a bomb will fall in five seconds.

Wilson (30:347-348) suggests many interesting science projects as appreciation units for class work in which there must be free choice on the part of the individual child. By this procedure, Wilson says, no child is injured or repressed or develops antagonism. Some children will be reached effectively with a desire for further work. Wilson (30:339-340) suggests an interesting study pertaining to the speed of light and the nature of the universe and astronomy.

Van Engen (26:115) suggests science as one of the areas in which problems of value and interest to a junior high school class might arise. These include: 1) The relations between the elevation of the sun and the seasons of the year. 2) What conditions influence the dehyrdration of vegetables? 3) How could one fly from New York to Mexico City? 4) The relationship between soil erosion, the slope of the hill, type of soil, and kind of coverage. 5) The principle of the lever (a laboratory problem). 6) Determining the mechanical advantages of pulleys.

Hickerson (8:305) suggests the utilization of number concepts in the study of aviation in the fifth, sixth, or seventh grades.

No. 13, p. 47, "Encourage students to make aids to instruction for classroom."

The six authors who discuss this practice suggest it for all students although it may be of greater interest to rapid learners. Stokes (19:69) says that sensory aids made by the students are the most useful of all. He (19:234) says that faster learners might be given a chance to do creative work, be it writing, painting, or woodworking, to experiment or discover, in relation to the project under study.

Clark and Eads (4:268-269) suggest that when the school year begins the teacher should plan with the children the making of representative materials for arithmetic and the uses of these materials.

Brueckner and Grossnickle (1:537-538) say that construction activities provide many opportunities for teaching meanings in arithmetic. They suggest that whatever is constructed should be authentic and so constructed that it will actually function. Brueckner and Grossnickle (1:463-464) say that suggestions of construction work may be utilized to enrich the work in arithmetic, especially for gifted children.

Taylor and Mills (20:17) say that pupils will enjoy making their own abacus.

Wilson (30:232) suggests as an appreciation unit for the division of fractions the use of fractional disks, pieces of paper or string, or a fraction scale or chart to objectify the division of a fraction by a whole number and the division of a whole number by a fraction. The scale or chart has more meaning, he says, if it is developed with the class rather than presented to them.

It is suggested by Morton (11:425) that pupils may make line graphs of hour-by-hour temperatures during the day.

No. 14, p. 47, "Display student's work on bulletin board."

The eight texts which mention this practice suggest the use of a bulletin board for display of enrichment materials of interest to the class. Only Spitzer suggests the bulletin board specifically for the display of student's work as well as class enrichment materials. He says (18:192) in reference to the use of drawings and diagrams as an aid in problem solving that by putting examples of pupils' diagrams on the bulletin board, teachers can give prestige to the procedure. Spitzer (18:391) says that the display of good work of every kind is, of course, a legitimate use of the bulletin board even if the work displayed contributes little in the way of enrichment.

Wilson (30:341) says that a special bulletin board for mathematics can inspire interest in mathematics if well handled. It could inspire capable pupils to take an occasional look into professional magazines, in which the highly specialized uses of mathematics are reported.

It is desirable, according to the ages and interests of the children, Hickerson (8:57) says, to have an arithmetic "corner" or table or bulletin board for displays of current interest. The other five authors agree on this.

No. 15, p. 47, "Provide a Mathematics Laboratory."

This provision is recommended by the eight textbooks which mention it. While Taylor and Mills refer to laboratory work (See Item No. 7, p. 24) they do not specifically mention the provision of a mathematics laboratory. Wheat also makes no comment on this provision.

Brueckner and Grossnickle (1:535) say that in the modern school, the classroom is regarded a learning laboratory in which pupils have concrete direct experiences and use manipulative materials which enable them to discover facts, processes and principles and to arrive at meaningful generalizations.

Suggestions to the teacher for individualizing the arithmetic program, Morton (11:6) says, include supplementary materials for the faster learners and suggestions for equipping an arithmetic cabinet of table with learning aids.

The following laboratory materials and instructional aids are suggested by Spitzer (18:330-339), Stokes (19:64) and Wilson (30:287-290, 341-342):

abacus
adding machines
angle-mirror
automobile speedometers
barometer
bottle caps
calculating devices
calendars
counting devices
fractional equivalence boards
gas and electric meters
geometric forms (spheres, cubes, prisms, etc.)
globe

graph board
number charts
paper cutting, paper folding, paper pie plates
pictures of mathematical interest
scales
sets of cubes, rectangles and squares
slide rules
slogans
special exhibits of astronomy, airplanes, chemistry, electronics, etc.
tables of powers and roots
tape measures
thermometers
wooden pegs.

The above mentioned are only some of the many laboratory materials and instructional aids suggested by the texts.

Wilson (30:287-291) points out that all work in weights and measures is appreciation or reference work. Whether a collection or laboratory, he says, it offers opportunity for extra work by an interested pupil on a voluntary basis and can be utilized by the teacher to connect with pupil interests and actual needs for measuring.

Van Engen (26:106) says that it would be to the advantage of the pupils in the lower-ability group to be placed in a laboratory situation. In the laboratory the pupil can usually be placed in a more realistic and interesting situation. Furthermore, a greater variety of motivating techniques are available in a laboratory situation than are available in the usual mathematics classroom equipped only with paper, pencils, and workbooks.

No. 16, p. 47, "Make individual assignments based on student's ability."

Six of the eight texts which mention this provision recommend it for both rapid and slow learners. Clark and Eads and Stokes disagree with the others. Clark and Eads (4:245) maintain that because of the wide differences among the children in her class the teacher plans for group teaching. She knows that individual teaching of 30 or more children is impossible, they say, if children are to receive guidance in their growth in mathematical thinking and mathematical power. Stokes (19:232) says that adapting instruction to individual differences does not mean the child working alone at his own rate of progress. In group procedure, Stokes says, the child works with other children at tasks which are placed at the proper level. Interest and insight are taken into full account.

Among the six authors who agree on this practice, Wilson (30:32) says that for the most part tasks in arithmetic should be individual rather than class, and they should be set by each pupil for himself. (The exception to this is the functional problem unit, in which group work is the rule, each child contributing according to his ability.)

Spitzer (17:129) suggests that the teacher can take a more effective step toward meeting the problem of individual differences when each pupil's best effort is accepted as evidence of achievement.

No. 17, p. 47, "Encourage each student to work at his own rate, but require the students to confine his work to the same topic as the other students."

The seven authors who mention this practice rank it high for use with both rapid and slow learners.

Clark and Eads (4:247-248) suggest that the teacher should plan to have different children deal with the topic of the day at various stages in concept development. More mature children do the demonstrating with representative materials, may be thinking orally or in writing without materials, or keeping mathematical records for the class. The least mature children may perhaps re-enact an experience situation to help all children become oriented to the problem under consideration by the class.

Spitzer (18:403) suggests that for the most part pupils work on the same area in arithmetic with distinct provision for different levels of work in the area and that where differentiation in the area of instruction takes place, it be on an individual basis.

Wilson (30:36) urges that activities for the arithmetic period shall be meaningful, shall further the purposes of arithmetic, and shall be open to all children. Meaningful activities for all children are more and more replacing the old assignment of ten extra examples for the bright children as the only modification of a drudgery routine, Wilson says.

No. 18, p. 47, "Encourage each student to work at his own rate and to complete as many topics as his ability will permit."

Five of the six texts which comment on this practice, do not recommend it. Only Hickerson recommends the use of this practice for both rapid and slow learners. He (8:3) says that no matter what the class's range of ability may be in learning to compute, each member should have the appropriate kinds and amounts of practice to enable him to compute with as much meaning and efficiency as his capabilities permit.

Spitzer (18:400) points out that the individual instruction plan "has not been too successful partly because of lack of material but primarily because class spirit quickly reaches a point of no consequence when members of the class are not working on the same area of the subject."

According to Brueckner and Grossnickle (1:451) there are those who appear to believe that the expression "individualization of instruction" implies that instruction must be so organized that each individual works by himself on a specific task, not as a part of the group. This is an erroneous conception of the meaning of individualization, Brueckner and Grossnickle say. There is actually no inherent opposition between working as an individual and working with others. Certain capacities of the individual are stimulated by association with others — creativeness, leadership, and initiative.

No. 19, p. 47, "Assign the same homework to each student."

Five of the six texts which mention this provision do not appear to favor it. Spitzer (18:191-192) suggests the use of diagrams or drawings as homework assignments. In those situations where homework is desired, he says, this situation will be appropriate.

Among the authors who disapprove of this practice, Stokes (19:182) says that practice in terms of homework is often unprofitable, even harmful. If the readiness point has not been attained, the pupil is likely to stumble confusedly through an assignment. In making homework practice assignments, the teacher must see to it that meaning and significance are in evidence. Then the chances are good that homework may be profitable, because it provides supplementary experiences for growth where schooltime is not available, Stokes says.

According to Clark and Eads (4:270) homework should be interpreted as bringing materials, bringing information from home and bringing data that will be used for teaching in the classroom.

No. 20, p. 47, "Permit students to use class time for other subjects when mathematics assignment is completed."

Only Morton recommends this practice and suggests it for rapid learners. He says (11:191-192) that it is being recognized more and more today that the extra time of more able pupils can better be spent in some field of endeavor other than arithmetic. Some schools allow the superior pupils to spend their spare time on science, the social studies, art, music, dramatics or some form of creative work which may be dictated by the special talents and interests of the individual pupil.

No. 21, p. 47, "Provide students experiences in group work."

Seven of the nine texts which discuss this provision agree on the importance of grouping pupils by pairs of individuals or in small groups. They favor this practice for both rapid and slow learners. Spitzer, in his own book and in The Fiftieth Yearbook of the National Society for the Study of Education, does not recommend it. He says (17:129) that sometimes the class is divided into many subgroups. Each subgroup is then given work supposedly suited to its ability, Spitzer says. The net result is a teacher directing many classes, not one class, in arithmetic. Some groups receive more of the teacher's time than others, but since there is only one teacher, no group receives adequate teacher guidance. Spitzer (18:400-401) says that grouping children at different levels in arithmetic parallels the situation found in two-and-three-teacher eight grade elementary schools.

Wilson (30:110-111) suggests grouping in drill work. The teacher can arrange "buddie" pairs, small groups with captains, and enlist the more capable children as group leaders.

Wheat (28:54-55) says that in instruction in small groups, the teacher forms the groups according to convenience -- the pupils at this table or the pupils in that row. The purpose of grouping is not primarily for group work but for individual work. The purpose is to make possible the close supervision, guidance and inspection needed to get each pupil started and moving ahead doing his own studying and thinking.

All seven authors agree with Clark and Eads that there is some danger in group work. Clark and Eads (4:245) say that the teacher who places her children in groups that she may call bright, average, and slow may discover that soon these children, too, differ markedly from each other.

No. 22, p. 47, "Provide students self-evaluation."

This practice is recommended for both rapid and slow learners by the seven texts which discuss it. Wheat (28:271) suggests that the work of the seventh year in arithmetic may begin with a thoroughgoing inventory of the methods of work the pupils have learned to use. The teacher needs to know what the pupils have learned to do in order to direct the work ahead. The pupils re-examine the arithmetic they have learned, and they become aware of weaknesses as well as successful performance.

Brueckner and Grossnickle (1:449) say that the most effective evaluation of learning is that which the learner himself makes. The teacher should do all in her power to assist the pupil to appraise his progress and to improve the efficiency of his methods of learning and study.

Self-evaluation, self-testing, and self-direction on the part of the learner should be among the major goals of the guidance program, Hickerson (8:47) says.

Taylor and Mills (20:43) say that pupils should develop a critical attitude toward accuracy and learn how to check results. The teacher should check pupils' errors; also, each pupil should correct his own errors. The pupil should feel the responsibility for discovering and correcting his own errors. They (20:45) also say that games give group drill which affords opportunity for observation of pupils' actual working habits. The observation of good and bad habits of computation offers pupils an excellent opportunity for self-criticism. The handicap of a bad habit is usually better appreciated when observed in someone else. Observing pupils at work gives the teacher the best opportunity for locating difficulties, Taylor and Mills say.

Wilson (30:416) suggests that the teacher should aid each child with diagnosis of his needs and abilities through individual conferences.

Teacher pupil consultation, Stokes (19:263) says, can also be one of the most effective methods in child education. He (19:211) suggests that the teacher help the individual pupil to see wherein he is weak and what must be done to overcome his weaknesses.

Morton (11:59) also recommends the practice of encouraging student self-evaluation.

No. 23, p. 47, "Provide field trips related to classwork."

The seven authors who mention this provision emphasize the importance of including all members of the class. Clark and Eads (4:9-10) suggest that trips might be included among the experiences the teacher plans to use to contribute to the arithmetic sequence she is developing. In planning a trip, the teacher should discuss with the children the concepts pertaining to arithmetic.

Field trips are suggested by Stokes (19:180-181) as a part of the progress in class activity experiences. For example, if the activity is to learn the functions of a post office, the first step in the development is a visit to a post office, Stokes says.

Hickerson (8:304) suggests that many community interests offering unlimited opportunity for developing the quantitative relationships could be explored with all children. Among suggested activities for seventh grade children is a visit to a real bank to study its methods and services.

Excursions should always be used when they will make a greater contribution to learning than will any other school activity, Brueckner and Grossnickle (1:539) say. They should be taken only if they will extend the pupil's background of experience.

Grossnickle et al (7:163) point out that since instructional materials are viewed in a broad sense to include anything which affects the learning process, the entire program of learning must be considered. There should be opportunities for excursions and field trips.

No. 24, p. 47, "Encourage solution of mathematical problems from field of students' interests."

This practice is discussed and recommended by nine of the texts. Wilson (30:54) says that the basic law of motivation is that the work undertaken shall connect directly with the child's present interests. It is necessary to know the interests of children as they actually exist in the home and in the community and to identify these with the teaching program.

Hickerson (8:8), Clark and Eads (4:258-265), Morton (11:485), and Spitzer (18:185-186) concur with Wilson.

Wheat (28:281) maintains that the pupils need to study the common problems involving the numbers and number relations they meet in affairs of the home, the community, and through their social studies in the more obvious activities of state and nation.

Stokes (19:17) suggests that the only sound approach to number teaching and learning is that which helps the child to see numbers as they function in his life -- in relation to him as a personality.

The modern school, Taylor and Mills (20:223-224) point out, makes use of the children's activities to stimulate interest in numerical relations. Those interests are as likely to be purely intellectual as they are to be practical. It does not follow, they (20:225) say, that pupils will be more interested in problems that deal with familiar facts than in problems dealing with fields remote from their experience, or with conditions clearly fanciful, provided always that the problems are stated so that they can be understood by the pupils. A boy in a rural school may be much more interested in a problem about stocks and bonds than one about the capacity of a corn crib.

Brueckner and Grossnickle (1:463-465) suggest that the teacher should make use of experience units in which there is a wide variety of activities. In these units special provision can also be made for the talented pupil who has valuable contributions to make to the enrichment of learning through creative production. (Slow learning pupils could be given assignments that are within their interest and at which they are likely to be successful.)

No. 25, p. 47, "Provide students with experiences in evaluating types of reasoning in newspaper and magazine articles."

This provision was not mentioned by any of the texts.

No. 26, p. 48, "Plan class activities with students."

Five of the six authors who mention this provision agree with Brueckner and Grossnickle (1:152) that pupil cooperation should be sought by the teacher in the planning and selection of activities. Spitzer, in The Fiftieth Yearbook of the National Society for the Study of Education, points out that the value of this practice has not yet been shown. He (17:134) says that it is claimed that, by pupil participation in identification of processes and in the formulation of assingments, pupils acquire and exhibit an enthusiasm for learning in arithmetic and that because he helped in its formulation, the pupil has a feeling or partnership, a desirable motivating factor. Whether actual practice will substantiate the claim remains to be seen, Spitzer (17:135) says.

Wilson (30:44) says that the teacher of arithmetic should work out all assignments with the children cooperatively on a unit basis - not on a day-to-day basis. Pupils should always fully understand the teaching-learning plan.

Clark and Eads (4:266) suggest that in a daily program the teacher and the children together plan how much time they should take for specific activities. Slow children are encouraged to engage in tasks they can finish within the planned time or to continue their work at another time.

According to Hickerson (8:59), the situations and problems described in textbooks can suggest to the teacher the kinds of first-hand situations and problems his own children might have. The teacher might be able to arrange for his children to have similar experiences in school or he might help the children plan to have such experiences out of school.

No. 27, p. 48, "Give students experience in group evaluation."

This provision is recommended by the five authors who discuss it. Clark and Eads (4:249) suggest that all children may work together in pairs to check each other as they work, as they manipulate materials, as they think out solutions, as they compute. These pairs may be matched so that both members of each pair are stimulated to do better thinking and more effective work.

Hickerson (8:51) says that when children thus make up computations for each other to perform, they reveal that they have an understanding of the computational processes involved; they provide themselves with their own practice material; they "correct" each others papers and acquire practice in self-evaluation, self-testing, and self-direction, Hickerson says.

No. 28, p. 48, "Encourage students to make up problems by securing data from own reading or experiment."

This practice is recommended by nine of the ten texts. Taylor and Mills make no comment on this practice. Hickerson (8:9) says that the alert teacher can have his children prepare written descriptions of a great variety of out-of-school experiences involving the solution of arithmetical problems. The children are thus learning to write word-problems for others to read as well as read word-problems others have written.

A suggestion for an excellent objective approach to percentage is made by Wilson (30:307). He suggests encouraging children to figure baseball league averages and batting averages of individual players from information listed in daily newspapers during the baseball season.

Brueckner and Grossnickle (1:523) say that original problems prepared by pupils and concrete applications growing out of local situations and experiences are valuable means of developing in the pupil the ability to sense number relations and generalize his number concepts. When children do not seem to grasp the meaning of a process, Brueckner and Grossnickle (1:527) say, or of some application of arithmetic, the need of direct experience with concrete situations is indicated. This kind of activity can be extended by having the pupils give original problems illustrating the process or application, Brueckner and Grossnickle say.

No. 29, p. 48, "Provide students with experiences in a Mathematics Club."

This provision is recommended by the two authors who comment on it. Brueckner and Grossnickle (1:99-100) suggest mathematics clubs and similar interest groups as an activity to enrich the work in arithmetic for rapid learners. Wilson (30:341) suggests the mathematics club as an activity for any child who really enjoys arithmetic.

No. 30, p. 48, "Give students experiences in applying the principles of mathematical reasoning in social problems."

This procedure is recommended by the six authors who discuss it. Morton (11:12) says that the pupil in the upper grades should discover that he cannot expect to be a good citizen if he is incompetent in arithmetic. No one can judge correctly the worth of a suggestion for improving the conditions under which he lives unless he is able to appreciate the numbers involved and the relationships existing among them.

Rapid learners should be encouraged to use problems growing out of problem units that require research, reading and local inquiry, Brueckner and Grossnickle (1:464-465) say. If possible, slow learners should be assigned only those activities and problems in textbooks that are not likely to frustrate them.

Wilson (30:31) says that the most significant part of the work in arithmetic is the activity usage and the functional problem units.

These call for thinking and understanding, for objective social significance, and ultimately for judgment in business.

Activities or problem situations in social living serve to initiate problem solving work in arithmetic, Stokes (19:199) says. Curricular materials, so far as problem solving in arithmetic is concerned, he says, should include additional mathematical experiences as well as these concrete first-hand social situations.

This concludes the analysis of the ten methodology textbooks. Tables I and II on the following pages summarize the extent of use recommended for the 30 questionnaire items.

The analysis of the four teachers' manuals which accompany state adopted textbooks in Oklahoma follows the tables.

TABLE I

SUMMARY OF THE MEAN* EXTENT TO WHICH THE TEN TEXTBOOKS RECOMMEND EACH OF THE 30 ITEMS

ITEM	A		B		C		D		E		F		G		H		I		J		MEAN	
NO.	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	RAPID	SLOW
1.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO OPINION	
2.	s	s	n	s	s	m	s	s	-	-	m	m	s	s	m	m	s	m	s	n	1.111	1.333
3.	s	m	s	s	s	m	s	m	s	m	s	m	m	m	m	m	s	s	s	s	1.200	1.700
4.	m	m	m	m	m	m	m	m	m	m	m	m	m	m	n	n	s	s	m	m	1.700	1.700
5.	m	m	m	s	m	s	m	m	m	s	m	m	m	m	m	m	m	m	m	m	2.000	1.700
6.	s	-	s	m	-	-	s	m	m	m	s	s	-	-	-	-	-	-	-	-	1.200	1.750
7.	s	m	m	m	s	m	s	m	s	m	s	m	m	m	-	-	-	-	s	s	1.250	1.875
8.	s	-	-	-	n	n	s	s	n	n	m	n	-	-	m	m	n	n	-	-	.857	.500
9.	n	n	n	n	n	n	n	n	n	n	n	n	-	-	-	-	n	n	-	-	0.000	0.000
10.	n	n	-	-	-	-	n	n	-	-	n	n	-	-	-	-	s	s	-	-	.250	.250
11.	s	-	s	-	-	-	-	-	-	-	-	-	-	-	-	-	s	s	-	-	1.000	1.000
12.	-	-	s	-	m	s	s	s	m	m	s	n	s	s	-	-	m	m	m	s	1.500	1.142
13.	m	s	m	m	-	-	s	s	-	-	m	m	s	s	-	-	s	s	-	-	1.500	1.333
14.	n	n	n	n	n	n	n	n	s	s	n	n	-	-	-	-	n	n	n	n	1.000	1.000
15.	m	m	m	m	m	m	m	m	m	m	m	m	-	-	-	-	m	m	m	m	2.000	2.000
16.	m	m	n	n	m	m	s	s	m	m	n	n	-	-	-	-	m	m	m	m	1.375	1.375
17.	m	m	m	m	-	-	s	s	m	m	m	m	-	-	-	-	m	m	m	m	1.855	1.855
18.	n	n	n	n	m	m	n	n	n	n	n	n	-	-	-	-	-	-	-	-	.333	.333
19.	-	-	n	n	n	n	-	-	s	s	n	n	-	-	-	-	n	n	n	n	.166	.166
20.	-	-	-	-	-	-	m	n	-	-	-	-	-	-	-	-	-	-	-	-	2.000	0.000
21.	m	m	m	m	m	m	m	m	n	n	m	m	-	-	s	s	m	m	n	n	1.444	1.444
22.	m	m	-	-	s	s	m	m	-	-	m	m	m	m	m	s	m	m	-	-	1.857	1.714
23.	m	m	s	s	s	s	-	-	s	s	m	s	-	-	-	-	s	s	s	s	1.285	1.142
24.	m	m	m	m	m	m	m	m	m	m	m	m	s	s	m	m	m	m	-	-	1.888	1.888
25.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO OPINION	

TABLE I (CONTINUED)

ITEM	A		B		C		D		E		F		G		H		I		J		MEAN	
NO.	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	RAPID	SLOW
26.	m	m	m	m	m	m	-	-	-	-	m	m	-	-	-	-	m	s	n	n	1.666	1.500
27.	m	m	m	m	m	m	-	-	-	-	m	s	-	-	-	-	s	s	-	-	1.800	1.600
28.	m	m	m	m	m	m	m	s	m	m	m	n	-	-	m	s	m	m	m	m	2.000	1.555
29.	m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	s	s	-	-	1.500	1.000
30.	m	m	-	-	-	-	m	n	m	n	m	n	-	-	-	-	m	n	m	m	2.000	.666

EXPLANATION OF TABLE:

ITEM NO. Number of provision as listed on the questionnaire.

LETTERS
A - Brueckner and Grossnickle
B - Clark and Eads
C - Hickerson
D - Morton
E - Spitzer
F - Stokes
G - Taylor and Mills
H - Wheat
I - Wilson
J - Yearbook (Fiftieth) of the National Society for the Study of Education

R and S R represents Rapid Learners. S represents Slow Learners.
s, m, n, - Represent some, much, none, no opinion.

*See Method and Procedure, pp. 15 and 16 for determination of Mean.

TABLE II

SUMMARY OF THE TEN ARITHMETIC METHODOLOGY TEXTBOOKS' RANK*

FOR EACH OF THE 30 ITEMS FOR RAPID AND SLOW LEARNERS

ITEM NO.	RANK RAPID	RANK SLOW	PRACTICE OR PROVISION
1.	29.5	29.5	Give individual assistance to pupils after school hours.
2.	21.0	15.5	Provide individual supervision and guidance during class.
3.	19.5	8.0	Assign simple drill problems.
4.	10.0	8.0	Assist students in learning vocabulary and reading skills peculiar to mathematics.
5.	3.0	8.0	Emphasize the social uses of mathematics.
6.	19.5	5.0	Encourage students to make scrapbooks and prepare graphic materials showing the uses of mathematics.
7.	18.0	3.0	Emphasize manual activities which illustrate mathematical principles.
8.	24.0	23.0	Encourage students to read simple stories about mathematics or famous mathematicians.
9.	28.0	27.5	Require all students in a given class to do approximately the same amount of work and type of work for the same mark.
10.	26.0	25.0	Encourage students to compete for awards given for superior scholarship.
11.	22.5	20.0	Encourage able students to assist slower students.
12.	13.0	17.0	Encourage study of the applications of mathematics to science.
13.	13.0	15.5	Encourage students to make aids to instruction for classroom.
14.	22.5	20.0	Display student's work on bulletin board.
15.	3.0	1.0	Provide a Mathematics Laboratory.

TABLE II (CONTINUED)

ITEM NO.	RANK RAPID	RANK SLOW	PRACTICE OR PROVISION
16.	16.0	14.0	Make individual assignments based on student's ability.
17.	8.0	4.0	Encourage each student to work at his own rate, but require the student to confine his work to the same topic as the other students.
18.	25.0	24.0	Encourage each student to work at his own rate and to complete as many topics as his ability will permit.
19.	27.0	26.0	Assign the same homework to each student.
20.	3.0	27.5	Permit students to use class time for other subjects when mathematics assignment is completed.
21.	15.0	13.0	Provide students experiences in group work.
22.	7.0	6.0	Provide students self-evaluation.
23.	17.0	18.0	Provide field trips related to classwork.
24.	6.0	2.0	Encourage solution of mathematical problems from field of students' interests.
25.	29.5	29.5	Provide students with experiences in evaluating types of reasoning in newspaper and magazine articles.
26.	11.0	12.0	Plan class activities with students.
27.	9.0	10.0	Give students experience in group evaluation.
28.	3.0	11.0	Encourage students to make up problems by securing data from own reading or experiment.
29.	13.0	20.0	Provide students with experiences in a Mathematics Club.
30.	3.0	22.0	Give students experiences in applying the principles of mathematical reasoning in social problems.

*See Method and Procedure, pp. 15 and 16 for determination of Rank.

Analysis of the Four Teachers Manuals' Recommended Use of the 30 Teaching Provisions

Each of the four teachers' manuals (See p. 3) was carefully analyzed to determine how and to what extent it recommended the use of each of the 30 items on the questionnaire. Results of the analysis are listed by item in the same sequence that they appear on the questionnaire sent to Oklahoma teachers (See Appendix A, p. 90).

No. 1, p. 69, "Give individual assistance to pupils after school hours."

None of the manuals specifically mention this practice. Two manuals suggest giving individual assistance to pupils, but do not specify whether it should be during or after school hours. Patton-Young (14:21) suggest that the teacher should have individual conferences after work in fractions to ascertain if understandings have been achieved. Wheat and Douglass (29:50) say that the teacher may help each student in line with his needs and prescribe the appropriate remedial instruction and practice.

No. 2, p. 69, "Provide individual supervision and guidance during class."

All of the four manuals recommend this provision. Brueckner, Grossnickle and Merton (2:13) say that their manual's comprehensive testing program enables the teacher to secure accurate measures of the abilities of the pupils and to locate their strengths and weaknesses. The essential practice and remedial measures are all provided by the textbook contents, Brueckner, Grossnickle and Merton say. These materials provide an excellent basis for adapting the review work and practice to develop skills fitted to the needs of individual children in the class.

The materials for all levels of ability within the class, Morton et al (12:8) say, will make it possible for the teacher to teach more flexibly and with greater attention to individual needs.

Patton-Young (14:33) suggest that weaknesses in understandings of decimals must be strengthened by individual conferences and experimentation.

Wheat and Douglass (29:45) say that successful work on the part of all pupils is a function of good teaching. The teacher must study the plans and adjust and apply them for the guidance of pupils so that each will pursue his answer till he gets it. They (29:50) also say that the teacher should assist individual pupils in the light of their particular weaknesses.

No. 3, p. 69, "Assign simple drill problems."

There is unanimous agreement among the four manuals on the use of this provision. Brueckner, Grossnickle and Merton (2:11) say that the Winston Arithmetics provide a wealth of practice to develop and maintain skills. These materials, Brueckner, Grossnickle and Merton (2:13) say, provide an excellent basis for adapting the review work and practice to develop skills to the needs of individual children in the class.

Morton et al (12:8) furnish new developmental and practice material in three separate parts - part one for the slower learners, part two for the average pupils who may need less remedial practice, and part three for the exceptionally able children who have demonstrated real aptitude in arithmetic.

Patton-Young (14:5) say that their manual gives the child ample, scientifically-constructed practice with the use of all basic number facts in all the fundamental processes.

Wheat and Douglass (29:31) say that they have provided in each book the exercises for practice in thinking that the pupil needs as he moves along.

No. 4, p. 69, "Assist students in learning vocabulary and reading skills peculiar to mathematics."

This provision is recommended by all four manuals. Brueckner, Grossnickle and Merton (2:15) provide for the vocabulary of arithmetic at all grade levels. Meanings of words are developed through illustrations, definitions, and concrete applications. They (2:51) say that the vocabulary of arithmetic should be kept as easy as possible without impairing its effectiveness.

Morton, et al (12:5) say that reading arithmetic content may in itself be a serious learning problem and therefore they use a simple controlled vocabulary with planned repetition of new words as in reading. New terms appear in boldface type. Sentence structure is simple and sentences are short, they say. Necessary arithmetical terms are defined when introduced and used thereafter and unnecessary technical language is avoided.

Meaningful development requires also that the number experiences and explanations be in words that the child knows and uses, Patton-Young (14:5) say. There are a few words, of course, peculiar to arithmetic and these should be introduced only after the ideas they represent have been made clear so that the child thoroughly understands the number terms.

Wheat and Douglass (29:29) say that the writers of the manual address the pupil, they speak the pupil's language, and they take special care to expand the pupil's language as he makes progress from one stage of his work to the next.

No. 5, p. 69, "Emphasize the social uses of mathematics."

This practice is unanimously recommended by all four manuals. Brueckner, Grossnickle and Merton (2:1) say that one of the two major objectives of the modern program that is presented in the Winston Arithmetics is to provide rich variety of experiences that will assure the ability of the pupils to apply quantitative procedures effectively in social situations in school and in life outside the school.

Morton, et al (12:38) utilize "social situation" pages in the manual that deal with some specific social, civic, or economic topic of lively interest. These "social situation" pages serve to enrich the pupils' learning experiences outside the field of arithmetic, they say, as well as to provide opportunities to use arithmetic effectively in connection with everyday realities.

Each new number process is introduced through a social situation which provides a problem whose settlement requires the use of the new number process, Patton-Young (14:5) point out. The problem is actual and practical. It grows out of the social setting, which is part and parcel of the child's own living.

The teacher should provide for pupil development of number meaning, then carry it to the interpretation of social situation, Wheat and Douglass (29:25) say. Unless the pupils are able to apply computational skills to genuine problem situations, Wheat and Douglass (29:54-55) say, the skills are of little value. Therefore, emphasis should be placed on their understanding of the social background of the applications and the problems involved as well as the steps they use in problem solving and the mistakes they make in setting up, interpreting, and solving a problem.

No. 6, p. 69, "Encourage students to make scrapbooks and prepare graphic materials showing the uses of mathematics."

All four manuals recommend this provision. Patton-Young make many suggestions for the use of this provision. They (14:16) suggest that pupils make their own line graphs from facts which the pupils can find in The World Almanac or other reference book; (14:38) the use of a notebook for listing formulas and accompanying drawings, and (14:54-55) the use of a notebook for entering formulas for finding discounts. They (14:59) also suggest that the teacher have the class draw and identify as many geometric forms as they can; (14:71) let them collate a scrapbook of original problems based on actual experiences, and (14:80) make posters.

Brueckner, Grossnickle and Merton (2:73) say that the teacher should have every student keep a graphic record of the number of problems he has solved correctly on each of his progress tests in problem solving.

Wheat and Douglass (29:106) suggest that the pupils be given ample practice in reproducing, identifying, and naming the different kinds of angles. They (29:118) suggest that the study of graphs be introduced by graphic representations of items of familiar information selected from papers and magazines. Pupils should be encouraged to provide such graphic illustrations as they may have noted, and to make their own graphs. Wheat and Douglass (29:119) also suggest that pupils make model drawings, or blueprints, when the dimensions and scales are given. The teacher should encourage the pupils to make their own pictographs from data collected about their school and community, Wheat and Douglass (29:120) suggest.

Morton et al (12:107) suggest the construction of posters or scrapbooks for illustrating the origin and evolution of measures. They

(12:148) say that pupils should be encouraged to make their own pictographs during the study of graphs, charts and ratios. Some children, they (12:161) say, may wish to make scrapbooks on themes such as "Geometry in Nature," "Early Dwellings of Man," "Snowflake Patterns," and so on in relation to the study of form and measurement. Other pupils may become interested in creating their own geometric designs; still others, in geometric puzzles.

No. 7, p. 69, "Emphasize manual activities which illustrate mathematical principles."

All four manuals favor this practice for all children. Brueckner, Grossnickle and Merton (2:22) say that doing and discovery are two requisites for effective learning. Doing suggests activity of some kind, such as that represented by the manipulation of materials. Discovery consists in understanding number relationships. They emphasize the use of manipulative materials to help the student discover the meaning conveyed by visual and symbolic materials.

Morton et al (12:11) point out that the aim in using concrete materials is to get the pupil to use abstract numbers successfully and intelligently just as soon as he can do so. Concrete materials are used, at first, when they make the process or concept easier to understand. The goal is always to proceed from the concrete toward the abstract. Morton et al say, however, that continuing at the concrete stage after the need for concrete materials has passed may postpone or block normal progress in arithmetic.

Patton-Young (14:16) suggest the use of measuring units in the study of measures. They (14:40) suggest the use of chalk boxes and other boxes to demonstrate dimension, and (14:65) concrete things such as scissors opened variedly or a child's arm to illustrate the concept of angle.

Wheat and Douglass (29:105) suggest the use of models of various solids to familiarize the pupils with the characteristics of common solids, as cone, cylinder, cube, and so on. They (29:64) suggest that pie plates be marked or cut into various sized fractions to demonstrate what fractions are.

No. 8, p. 69, "Encourage students to read simple stories about mathematics or famous mathematicians."

Only two manuals mention this provision. Morton et al (12:17) encourage its use with rapid learners. They say that the more able pupils may make a study in reference to the history of numbers. Morton et al (12:41) list sources for historical material on the abacus, the tally, counter-reckoning, and early methods of computation.

Wheat and Douglass (29:61) recommend books on number curiosities, games, and puzzles. They (29:80) suggest that the pupils learn about the historical development of measures of weight for interest and better understanding.

No. 9, p. 69, "Require all students in a given class to do approximately the same amount of work and type of work for the same mark."

Neither of the two manuals which mention this provision recommend it. Morton et al (12:8) state that whether the class is grouped periodically or on the basis of fluid progress groups, the organization of Making Sure of Arithmetic and the materials for various ability levels make it possible to deal more successfully than ever before with the groups within the class.

Wheat and Douglass (29:46) point out that immature pupils require more time and possibly a different type of instruction, but the ideas to be gained and the materials studied are the same for all. For instance, the immature, the average, and the superior must first learn about teen numbers, then about tens, and the powers of ten. The ground covered is essentially the same for all, but the ideas gained and the time required to acquire them will vary with the abilities of the learners.

No. 10, p. 69, "Encourage students to compete for awards given for superior scholarship."

None of the manuals specifically mention this practice.

No. 11, p. 69, "Encourage able students to assist slower students."

Only Patton-Young mention this provision. They (14:15) say that other children may volunteer help (to the children who still find long division difficult) if you can be sure they do so in the spirit of comradeship and not superiority.

No. 12, p. 69, "Encourage study of the applications of mathematics to science."

The three manuals which comment on this practice favor it. Brueckner, Grossnickle and Merton (2:15) say that the arithmetic that is needed in other curriculum areas, such as social studies, health, science, and the fine arts form the basis of much of the problem work. These units contain a wealth of accurate and significant information of interest to children.

Morton, et al (12:6) say that arithmetic should be related frequently to other subjects in the curriculum. They include many problems which draw upon the subject matter of science, and other subject fields.

According to Patton-Young (14:9), the pupils must understand the place of numbers in science, social studies, health and safety, the arts, sports, and all their learning and living.

No. 13, p. 69, "Encourage students to make aids to instruction for classroom."

This practice is recommended by three of the four manuals. Brueckner, Grossnickle and Merton (2:106) suggest that the students should be assigned to bring to class geometric designs from books or magazines and then the class should be encouraged to make copies of some of these designs. Large poster designs and displays to be made by the students are also suggested (2:111). Among other suggestions is the construction of a cardboard model of an electric meter. They (2:119) say that a movable hand should be attached at each space marked to represent a dial.

Handwork with cardboard or other materials, Morton, et al (12:162) say, will help to familiarize pupils with basic characteristics of some of these solids (cubes, rectangular prisms, spheres, cones, triangular prisms, etc.).

Patton-Young (14:59) suggest that the class be encouraged to cut paper folding designs which they may study for geometric details.

No. 14, p. 69, "Display student's work on bulletin board."

The two manuals which mention this practice favor its use both for individual and class displays. Brueckner, Grossnickle and Merton (2:74) say that the class should make a collection of uses of decimals as found in newspapers and magazines and make a display of these uses on the bulletin board. They (2:108) also say that the teacher should display on the bulletin board specimens of the best drawings and the best constructions.

In reference to the study of decimals, Patton-Young (14:30) suggest that some children arrange a bulletin board exhibit showing the use of decimals.

No. 15, p. 69, "Provide a Mathematics Laboratory."

Only Brueckner, Grossnickle and Merton specifically mention this provision. They (2:1-2) say that the arithmetic classroom should be regarded as a learning laboratory. In this laboratory the children should engage in a wide variety of concrete meaningful experiences in which number plays an essential role such as solving problems, carrying on discussions of uses of arithmetic, measuring things, constructive activities, grouping and manipulating objects, discovering the meaning of numbers and of number operations through the use of place value charts, reporting about local investigations, and practicing basic skills.

No. 16, p. 69, "Make individual assignments based on student's ability."

All of the manuals except Patton-Young comment on this practice. Brueckner, Grossnickle and Merton (2:13-14) provide a three level program (See Item No. 21 on group work, p. 62) to meet the needs and abilities of accelerated groups, average, or normal groups and slow-moving groups. Brueckner, Grossnickle and Merton suggest that very free use of remedial exercises, manipulative and visual aids, and "Self-Help and Workshop" sections be made in the case of the slower pupils.

Morton et al (12:7) say that in the typical classroom of today, completely individualized teaching is impossible. They suggest specific teaching materials for the slower learners, average learners, and exceptionally able pupils. (See Item No. 18, p. 61)

Wheat and Douglass do not recommend individual assignments. They (29:46) say that they do not provide extra activities for the superior and a minimum of activities for the immature. Certainly, they say, we do not desire pernicious impoverishment for any but rather we desire judicious enrichment for all. (See Item No. 9, p. 57.)

> No. 17, p. 69, "Encourage each student to work at his own rate, but require the student to confine his work to the same topic as the other students."

Only Wheat and Douglass comment on this practice. They (29:47) say that when the children in any group reach the state of independent workers, the problem of individual differences automatically takes care of itself — the superior pupil does more work and at a faster rate, and possibly at a higher level of so called abstractness. They suggest ability grouping with differentiated instruction.

> No. 18, p. 69, "Encourage each student to work at his own rate and to complete as many topics as his ability will permit."

The two manuals which mention this provision do not recommend it. Morton, et al (12:7) say that under ideal circumstances the teaching of arithmetic should be geared to the level of each individual pupil. But in the typical classroom of today, however, completely individualized teaching is considered to be impossible, they say. (See Item No. 16, p. 60.)

Wheat and Douglass (29:46) emphasize that the individuals work in groups, and the groups are kept intact, each child doing his own work and being stimulated by certain capacities and qualities of other members of the group. Under this plan not all children will reach the same level of achievement, but with the wise guidance of a good teacher each child should reach the level of accomplishment which is possible within the limits of his ability, and each should move progressively toward mature levels of performance.

No. 19, p. 69, "Assign the same homework to each student."

Only Wheat and Douglass mention this practice. They (29:55) say that intelligent use of homework should be made by the teacher. While the pupils should hand in quite a bit of work during the year, they say, do not rely too much upon homework, as parents or others may do it for the students.

No. 20, p. 69, "Permit students to use class time for other subjects when mathematics assignment is completed."

None of the manuals mention this practice.

No. 21, p. 69, "Provide students experiences in group work."

The four manuals unanimously recommend this practice. Brueckner, Grossnickle and Merton (2:14) provide the essentials of a three level program -- Level I, an enriched program for accelerated groups; Level II, a core program for average or normal groups, and Level III, a minimum program for slow-moving groups. (See Item No. 16, p. 60.)

Morton, et al (12:7) suggest that individual needs of pupils may be met by the teacher working with groups within the class. Some teachers have found it possible to divide the class into progress groups, they say, where one group proceeds with the next learning step while the other group or groups retrace certain learning steps and receive additional practice. In this way the pupils are allowed to proceed at their own learning rates, they (12:8) point out.

Activities suggested by Patton-Young (14:27) include that of appointing a committee to bring to class from post office, telegraph office, and express office all the information possible. They (14:66) also suggest in reference to work in constructing perpendiculars that several pupils work the same experiment at the blackboard.

Wheat and Douglass (29:54) suggest that the teacher may find it advisable, particularly when the class is working on a number of problems, to let them work cooperatively in several small groups.

No. 22, p. 69, "Provide students self-evaluation."

Three of the four manuals comment on this provision. Brueckner, Grossnickle and Merton (2:33) suggest that test results, and the necessary remedial practice to use, be discussed with the class.

According to Patton-Young (14:8), self-diagnosis tests will help each child to examine his own work and so evaluate what he has learned.

Wheat and Douglass (29:41) provide a progress test at the end of each chapter, which in most cases is a definite block or unit of instruction. Through the use of an inventory or diagnostic test, they (29:57) say, both the teacher and the pupils discover the pupils' abilities and deficiencies.

No. 23, p. 69, "Provide field trips related to classwork."

All four manuals mention this provision. Two suggest it for the entire class and two limit use to a committee or to some of the more able pupils.

Brueckner, Grossnickle and Merton (2:16) suggest that the following places can be visited in order to show the children the direct application of the arithmetic they are studying:

Construction projects
Dairies
Factories
Farms
Gasoline stations
Health facilities
Libraries
License bureaus
Museums
Post Office

Sports centers
Stores
Tax Offices
Transportation facilities
Weather stations.

Patton-Young (14:79) suggests that the teacher should arrange with a bank for a class visit in order to find out how a bank functions, who are the helpers, and what services the bank renders.

Morton, et al (12:187) suggest that the more rapid learners might investigate school banking in their community, make graphs to show the data they collect, and use these graphs in giving a report to the class or at a school assembly.

Wheat and Douglass (29:126) suggest the appointment of a committee to visit a bank and report to the class the details of opening a savings account. They (29:137) also suggest that a committee might call on the local postmaster to determine current rates.

No. 24, p. 69, "Encourage solution of mathematical problems from field of students' interests.

All four manuals favor this practice. Patton-Young (14:5) say that arithmetic should be related to the child's actual, everyday experiences. His baseball team gets one run in the 1st inning; three runs in the 4th inning; four runs in the 6th, and two runs in the 8th. Here is an instance where the child has to add as well as to know the meaning of the ordinals, Patton-Young say.

Morton, et al (12:184) point out that the last chapter of the text is planned to help pupils appreciate better how indispensable arithmetic is in the affairs of life. Real problems of everyday life are organized around affairs which the pupils will recognize as important to them personally.

All four manuals suggest assignments utilizing this practice. Some of the suggestions are as follows:

> Urge the students to watch for and bring up in class applications in everyday life of the arithmetic they are learning. (29:54)

> Have the pupils bring number puzzles to class to try on the other pupils. (29:84)

> Encourage the pupils to make their own pictographs from data collected about their school and community. (29:120)

> Pupils who have taken trips in automobiles or on their bicycles may furnish data for other problems involving average rates. These problems may be presented to the class for discussion and further practice. (12:50)

> Some of the boys may want to report on actual baseball averages as found in the newspaper or the World Almanac. (12:134)

> The teacher should have some of the students who are interested in football, bring to class the record of some great high school or college football star and compare this record with that in the lesson. (2:108).

No. 25, p. 69, "Provide students with experiences in evaluating types of reasoning in newspaper and magazine articles."

Two manuals comment on this provision. As a follow-up for the study of percentage, Morton, et al (12:120) suggest that pupils may be asked to bring to class clippings from newspapers showing similar ways of using percents. They suggest this may further motivate interest.

In discussing mental or oral arithmetic, Wheat and Douglass (29:53) suggest that at least several times a week 5 or 10 minutes be devoted to oral or mental arithmetic: exercises and problems to be worked without pencil and paper. They point out that a large percentage of the needs for computation in everyday life are of this type; among them are the quick calculations that confront the consumer when reading advertisements in the newspaper to determine which are the better buys; when estimating the amount of time to make a trip, or figuring the cost of a given number of items.

No. 26, p. 70, "Plan class activities with students."

None of the manuals mention this provision.

No. 27, p. 70, "Give students experience in group evaluation."

Two manuals recommend this practice. Brueckner, Grossnickle and Merton (2:53) suggest that in testing, students exchange papers for marking as it is much easier to detect an error on the paper belonging to another student than to find it on his own paper. The students derive good training from marking papers, Brueckner, Grossnickle and Merton say.

In reference to the review of addition and subtraction facts, Patton-Young (14:12) say that the class should be encouraged to self-analysis of mistakes.

No. 28, p. 70, "Encourage students to make up problems by securing data from own reading or experiment."

This practice is recommended by all four manuals. Brueckner, Grossnickle and Merton (2:51) suggest that among the characteristics of "Number Quickies," it may be necessary for the student to supply the data for solving the problem. A good assignment for supplementary work for enrichment purposes, they (2:67-68) say, is to have each student in this special group find in a dictionary or in a reference book a drawing or a picture of an object or an animal. The illustration may be drawn on a scale which can be represented mathematically by a fraction expressing the ratio of the size of the picture to the true size of the object. Each student should find other illustrations in which each picture is larger than the object portrayed. Then he should be able to tell how to express the ratio of the size of the picture to the size of the object.

As a follow-up for the study of discount and net price, Morton, et al (12:127) suggest that pupils may tell about their own experiences or observations concerning bargain sales. They may make up problems based upon their experiences.

Patton-Young (14:39) suggest that the pupils experiment with cut-outs of parallelograms after they have studied the diagrams and the text. They (14:53) suggest that the class contribute problems from their own experiences with livestock, farm life, or ranch life as an exercise for a lesson on "Prize Winning Steers."

Problems pupils may make up from data they have secured are recommended by Wheat and Douglass (29:83) in reference to the study of circles. They suggest that the pupils experiment with a bicycle wheel and other circular objects to determine the relationship between the circumference and diameter. As an exercise for a lesson dealing with the "Cost of Heating," they (29:131) suggest the pupils make up problems of their own on this subject.

No. 29, p. 70, "Provide students with experiences in a Mathematics Club."

None of the four manuals comment on this practice.

No. 30, p. 70, "Give students experiences in applying the principles of mathematical reasoning in social problems."

Two manuals mention this provision. Morton, et al (12:6) say that arithmetic provides a unique opportunity to help pupils understand economic patterns of living and economic principles within our own country, and the problem content should take full advantage of this opportunity.

In reference to a textbook lesson on "The Red Cross in America," Patton-Young (14:34) suggest that students be invited to discuss the work of this organization and then, have the problems analyzed for procedures and worked. They (14:58) recommend that provocative and practical situations in the business world be presented to the students for discussion at home prior to class discussion. They (14:71) also suggest that the teacher should invite a discussion of ways and means to tackle some current plans, together with the arithmetic which would be involved.

This concludes the analysis of the four manuals. The following tables III and IV summarize the recommended extent of use of the 30 questionnaire items by the four manuals. These tables are followed by the results of the questionnaire sent to teachers of seventh grade arithmetic classes in Oklahoma.

TABLE III

SUMMARY OF THE MEAN* EXTENT TO WHICH THE FOUR STATE TEACHERS' MANUALS

RECOMMEND THE USE OF EACH OF THE 30 ITEMS

ITEM	I		II		III		IV		MEAN	
NO.	RAPID	SLOW	RAPID	SLOW	RAPID	SLOW	RAPID	SLOW	RAPID	SLOW
1.	--	--	--	--	--	--	--	--	NO OPINION	
2.	some	much	much	much	some	some	some	much	1.250	1.750
3.	much	much	much	much	much	much	much	much	2.000	2.000
4.	much	much	much	much	much	much	much	much	2.000	2.000
5.	much	much	much	much	much	much	much	much	2.000	2.000
6.	some	some	much	much	much	much	much	much	1.750	1.750
7.	much	much	some	much	some	some	some	some	1.250	1.500
8.	--	--	much	none	--	--	much	much	2.000	1.000
9.	--	--	none	none	--	--	none	none	0.000	0.000
10.	--	--	--	--	--	--	--	--	NO OPINION	
11.	--	--	--	--	some	some	--	--	1.000	1.000
12.	much	much	much	much	much	much	--	--	2.000	2.000
13.	some	some	some	some	some	some	--	--	1.000	1.000
14.	much	some	--	--	some	some	--	--	1.500	1.000
15.	much	much	--	--	--	--	--	--	2.000	2.000
16.	much	much	none	none	--	--	none	none	.666	.666
17.	--	--	--	--	--	--	much	much	2.000	2.000
18.	--	--	none	none	--	--	none	none	0.000	0.000
19.	--	--	--	--	--	--	some	some	1.000	1.000
20.	--	--	--	--	--	--	--	--	NO OPINION	
21.	much	much	much	much	some	some	much	much	1.750	1.750
22.	some	some	--	--	much	much	much	much	1.666	1.666
23.	some	some	much	none	some	some	some	some	1.250	1.750
24.	some	some	some	some	much	much	some	some	1.250	1.250
25.	--	--	some	some	--	--	some	some	1.000	1.000

TABLE III (CONTINUED)

ITEM NO.	I RAPID	I SLOW	II RAPID	II SLOW	III RAPID	III SLOW	IV RAPID	IV SLOW	MEAN RAPID	MEAN SLOW
26.	--	--	--	--	--	--	--	--	NO OPINION	
27.	some	some	--	--	some	some	--	--	1.000	1.000
28.	much	some	some	some	some	some	some	some	1.250	1.000
29.	--	--	--	--	--	--	--	--	NO OPINION	
30.	--	--	much	much	much	much	--	--	2.000	2.000

EXPLANATION OF TABLE:

ITEM NO. Number of provision as listed on the questionnaire.

ROMAN NUMERALS
I. Brueckner, Grossnickle and Merton, Teachers Guide for Thinking With Numbers.
II. Morton, Et Al, Teacher's Edition: Making Sure of Arithmetic, Grade Seven.
III. Patton-Young, A Teacher's Manual for Numbers In Your Life.
IV. Wheat and Douglass, Manual With Answer Key for Row-Peterson Arithmetic Book Seven.

TWO DASHES -- represents No Opinion.

*See Method and Procedure, pp. 15 and 16 for determination of Mean.

TABLE IV

SUMMARY OF THE FOUR STATE TEACHERS MANUALS' RANK* FOR

EACH OF THE 30 ITEMS FOR RAPID AND SLOW LEARNERS

ITEM NO.	RANK RAPID	RANK SLOW	PRACTICE OR PROVISION
1.	28.0	28.0	Give individual assistance to pupils after school hours.
2.	15.0	9.0	Provide individual supervision and guidance during class.
3.	4.5	4.0	Assign simple drill problems.
4.	4.5	4.0	Assist students in learning vocabulary and reading skills peculiar to mathematics.
5.	4.5	4.0	Emphasize the social uses of mathematics.
6.	9.5	9.0	Encourage students to make scrapbooks and prepare graphic materials showing the uses of mathematics.
7.	15.0	12.0	Emphasize manual activities which illustrate mathematical principles.
8.	4.5	17.5	Encourage students to read simple stories about mathematics or famous mathematicians.
9.	24.5	24.5	Require all students in a given class to do approximately the same amount of work and type of work for the same mark.
10.	28.0	28.0	Encourage students to compete for awards given for superior scholarship.
11.	20.0	17.5	Encourage able students to assist slower students.
12.	4.5	4.0	Encourage study of the applications of mathematics to science.
13.	20.0	17.5	Encourage students to make aids to instruction for classroom.
14.	12.0	17.5	Display student's work on bulletin board.
15.	4.5	4.0	Provide a Mathematics Laboratory.

TABLE IV (CONTINUED)

ITEM NO.	RANK RAPID	RANK SLOW	PRACTICE OR PROVISION
16.	23.0	23.0	Make individual assignments based on student's ability.
17.	4.5	4.0	Encourage each student to work at his own rate, but require the student to confine his work to the same topic as the other students.
18.	24.5	24.5	Encourage each student to work at his own rate and to complete as many topics as his ability will permit.
19.	20.0	17.5	Assign the same homework to each student.
20.	28.0	28.0	Permit students to use class time for other subjects when mathematics assignment is completed.
21.	9.5	9.0	Provide students experiences in group work.
22.	11.0	11.0	Provide students self-evaluation.
23.	15.0	22.0	Provide field trips related to classwork.
24.	15.0	13.0	Encourage solution of mathematical problems from field of students' interests.
25.	20.0	17.5	Provide students with experiences in evaluating types of reasoning in newspaper and magazine articles.
26.	28.0	28.0	Plan class activities with students.
27.	20.0	17.5	Give students experience in group evaluation.
28.	15.0	17.5	Encourage students to make up problems by securing data from own reading or experiment.
29.	28.0	28.0	Provide students with experiences in a Mathematics Club.
30.	4.5	4.0	Give students experiences in applying the principles of mathematical reasoning in social problems.

*See Method and Procedure, pp. 15 and 16 for determination of Rank.

Findings of the Questionnaire Returned by Teachers of Seventh Grade Arithmetic Classes in Oklahoma

The 150 completed questionnaires which were returned represent 49 of the 77 counties sampled, or 67 percent of the counties in the state of Oklahoma. Forty were from elementary schools and 110 from junior high schools, with a total enrollment of 11,076 pupils in 339 classes in seventh grade arithmetic. Of these classes, 1 percent contained fewer than 10 pupils; 7 percent contained 10-19 pupils; 14 percent contained 20-29 pupils; 71 percent contained 30-39 pupils and 7 percent had more than 40 pupils. Thus, in the schools included in this study, 78 percent of the classes in seventh grade arithmetic had 30 or more pupils.

There were no responses to the item on the questionnaire which asked teachers to describe any outstanding programs or provisions they have made successfully for rapid or slow learners, or both.

Tabulations from the responses to the 30 items are set up by mean in Table V, p. 74 and by rank for rapid and slow learners in Table VI, p. 76.

Table VII, p. 78, summarizes the rankings of each of the 30 items by texts, manuals, and teachers.

The next chapter will deal with the summary and interpretation of results.

TABLE V

SUMMARY OF THE MEAN* EXTENT TO WHICH SEVENTH GRADE ARITHMETIC TEACHERS IN OKLAHOMA USE THE 30 QUESTIONNAIRE ITEMS FOR RAPID AND SLOW LEARNERS IN 40 ELEMENTARY** AND 110 JUNIOR HIGH*** SCHOOLS

ITEM	ELEMENTARY SCHOOLS		JUNIOR HIGH SCHOOLS		TOTAL SCHOOL USE	
NO.	RAPID	SLOW	RAPID	SLOW	RAPID	SLOW
1.	.550	.825	.727	1.027	.680	.973
2.	1.400	1.650	1.254	1.672	1.300	1.666
3.	1.150	1.675	.836	1.509	.913	1.553
4.	1.450	1.500	1.418	1.527	1.426	1.520
5.	1.450	1.425	1.463	1.290	1.460	1.326
6.	.650	.475	.672	.590	.666	.560
7.	1.075	.925	.990	.590	1.013	.680
8.	.600	.550	.536	.427	.620	.460
9.	1.250	1.000	1.163	.954	1.186	.980
10.	.775	.650	.900	.372	.866	.446
11.	1.450	.825	1.290	.863	1.333	.853
12.	1.100	.850	1.281	.772	1.233	.793
13.	.975	.875	.927	.727	.940	.766
14.	.950	.775	.963	.800	.960	.793
15.	.150	.250	.254	.254	.226	.253
16.	.975	1.025	.900	1.163	.920	1.100
17.	1.250	1.350	1.409	1.381	1.366	1.366
18.	1.425	1.125	1.209	1.081	1.266	1.093
19.	1.300	1.300	1.418	1.245	1.386	1.260
20.	1.025	.750	.800	.481	.860	.553

TABLE V (CONTINUED)

ITEM NO.	ELEMENTARY SCHOOLS RAPID	SLOW	JUNIOR HIGH SCHOOLS RAPID	SLOW	TOTAL SCHOOL USE RAPID	SLOW
21.	1.025	.950	.900	.881	.933	.900
22.	1.300	1.050	1.081	.981	1.140	1.000
23.	.450	.475	.236	.190	.293	.266
24.	1.025	.950	1.136	.809	1.106	.846
25.	.750	.775	.845	.600	.820	.646
26.	.975	.875	.754	.663	.813	.733
27.	.900	.825	.845	.690	.860	.726
28.	.950	.825	.845	.518	.873	.560
29.	.125	.175	.054	.063	.073	.113
30.	.950	.800	1.000	.781	.986	.786

*See Method and Procedure, pp. 15 and 16 for determination of Mean.

**Forty-five classes with average class enrollment of 24 pupils are represented in the 40 elementary schools.

***Two hundred ninety-four classes with average class enrollment of 34 pupils are represented in the 110 junior high schools.

TABLE VI

SUMMARY OF THE RANKINGS OF THE 30 ITEMS ON THE QUESTIONNAIRE FOR RAPID AND SLOW LEARNERS

BY OKLAHOMA 7TH GRADE ARITHMETIC TEACHERS OF 339 CLASSES IN 150 SCHOOLS

ITEM NO.	RANK RAPID	RANK SLOW	PRACTICE OR PROVISION
1.	25.0	11.0	Give individual assistance to pupils after school hours.
2.	6.0	1.0	Provide individual supervision and guidance during class.
3.	18.0	2.0	Assign simple drill problems.
4.	2.0	3.0	Assist students in learning vocabulary and reading skills peculiar to mathematics.
5.	1.0	5.0	Emphasize the social uses of mathematics.
6.	27.0	23.5	Encourage students to make scrapbooks and prepare graphic materials showing the uses of mathematics.
7.	12.0	21.0	Emphasize manual activities which illustrate mathematical principles.
8.	26.0	26.0	Encourage students to read simple stories about mathematics or famous mathematicians.
9.	9.0	10.0	Require all students in a given class to do approximately the same amount of work and type of work for the same mark.
10.	20.0	27.0	Encourage students to compete for awards given for superior scholarship.
11.	5.0	13.0	Encourage able students to assist slower students.
12.	8.0	15.5	Encourage study of the applications of mathematics to science.
13.	15.0	18.0	Encourage students to make aids to instruction for classroom.
14.	14.0	15.5	Display student's work on bulletin board.
15.	29.0	29.0	Provide a Mathematics Laboratory.

TABLE VI (CONTINUED)

ITEM NO.	RANK RAPID	RANK SLOW	PRACTICE OR PROVISION
16.	17.0	7.0	Make individual assignments based on student's ability.
17.	4.0	4.0	Encourage each student to work at his own rate, but require the student to confine his work to the same topic as the other students.
18.	7.0	8.0	Encourage each student to work at his own rate and to complete as many topics as his ability will permit.
19.	3.0	6.0	Assign the same homework to each student.
20.	21.5	25.0	Permit students to use class time for other subjects when mathematics assignment is completed.
21.	16.0	12.0	Provide students experiences in group work.
22.	10.0	9.0	Provide students self-evaluation.
23.	28.0	28.0	Provide field trips related to classwork.
24.	11.0	14.0	Encourage solution of mathematical problems from field of students' interest.
25.	23.0	22.0	Provide students with experiences in evaluating types of reasoning in newspaper and magazine articles.
26.	24.0	19.0	Plan class activities with students.
27.	21.5	20.0	Give students experience in group evaluation.
28.	19.0	23.5	Encourage students to make up problems by securing data from own reading or experiment.
29.	30.0	30.0	Provide students with experiences in a Mathematics Club.
30.	13.0	17.0	Give students experiences in applying the principles of mathematical reasoning in social problems.

TABLE VII

SUMMARY OF RANKINGS FOR USE OF EACH OF THE 30 ITEMS BY METHODOLOGY TEXTS, MANUALS AND TEACHERS FOR RAPID AND SLOW LEARNERS IN SEVENTH GRADE ARITHMETIC

ITEM NO.	RANK FOR RAPID LEARNERS			ITEM NO.	RANK FOR SLOW LEARNERS		
	TEXTS	MANUALS	TEACHERS		TEXTS	MANUALS	TEACHERS
1.	29.5	28.0	25.0	1.	29.5	28.0	11.0
2.	21.0	15.0	6.0	2.	15.5	9.0	1.0
3.	19.5	4.5	18.0	3.	8.0	4.0	2.0
4.	10.0	4.5	2.0	4.	8.0	4.0	3.0
5.	3.0	4.5	1.0	5.	8.0	4.0	5.0
6.	19.5	9.5	27.0	6.	5.0	9.0	23.5
7.	18.0	15.0	12.0	7.	3.0	12.0	21.0
8.	24.0	4.5	26.0	8.	23.0	17.5	26.0
9.	28.0	24.5	9.0	9.	27.5	24.5	10.0
10.	26.0	28.0	20.0	10.	25.0	28.0	27.0
11.	22.5	20.0	5.0	11.	20.0	17.5	13.0
12.	13.0	4.5	8.0	12.	17.0	4.0	15.5
13.	13.0	20.0	15.0	13.	15.5	17.5	18.0
14.	22.5	12.0	14.0	14.	20.0	17.5	15.5
15.	3.0	4.5	29.0	15.	1.0	4.0	29.0
16.	16.0	23.0	17.0	16.	14.0	23.0	7.0
17.	8.0	4.5	4.0	17.	4.0	4.0	4.0
18.	25.0	24.5	7.0	18.	24.0	24.5	8.0
19.	27.0	20.0	3.0	19.	26.0	17.5	6.0
20.	3.0	28.0	21.5	20.	27.5	28.0	25.0
21.	15.0	9.5	16.0	21.	13.0	9.0	12.0
22.	7.0	11.0	10.0	22.	6.0	11.0	9.0
23.	17.0	15.0	28.0	23.	18.0	22.0	28.0
24.	6.0	15.0	11.0	24.	2.0	13.0	14.0
25.	29.5	20.0	23.0	25.	29.5	17.5	22.0
26.	11.0	28.0	24.0	26.	12.0	28.0	19.0
27.	9.0	20.0	21.5	27.	10.0	17.5	20.0
28.	3.0	15.0	19.0	28.	11.0	17.5	23.5
29.	13.0	28.0	30.0	29.	20.0	28.0	30.0
30.	3.0	4.5	13.0	30.	22.0	4.0	17.0

CHAPTER V

SUMMARY AND INTERPRETATION OF RESULTS

Summary of Findings

It was found that there is a wide difference of opinion among the ten textbooks regarding the method and extent of use of many of the selected procedures; there are differences of opinion among the four manuals; furthermore, authorities and teachers are not in agreement on the extent of use of many of these selected practices (See Summary Table VII, p. 78).

For example: Both authorities and teachers rank item No. 1, "give individual assistance to pupils after school hours," in the lowest 5th of the procedures for use with rapid learners. However, for slow learners, teachers rank it in 11th place as compared to the authorities' ranking of about 29th place.

There is, however, substantial agreement on the part of authorities and teachers on about half of the 30 selected practices. All give high ranking to the use of items No. 3, 4, and 5, "assign simple drill problems," (especially for slow learners) "assist students in learning vocabulary and reading skills peculiar to mathematics," and "emphasize the social uses of mathematics." They also agree on high rankings of items No. 17 and 22, "encourage each student to work at his own rate, but require the student to confine his work to the same topic as the other students," and "provide students self-evaluation."

Authorities and teachers agree somewhat on a middle ranking for items No. 7, 12, 13, and 14, "emphasize manual activities which illustrate mathematical principles," (for rapid learners, although teachers report its use in 21st place for slow learners while texts rank it in 3rd place and manuals in 12th place) "encourage study of the applications of mathematics to science," (emphasis is on use for rapid learners) "encourage students to make aids to instruction for classroom," and "display student's work on bulletin board."

Items ranked low by both authorities and teachers are No. 8, 10, and 25, "encourage students to read simple stories about mathematics or famous mathematicians," "encourage students to compete for awards given for superior scholarship," and "provide students with experiences in evaluating types of reasoning in newspaper and magazine articles."

Item No. 20, "permit students to use class time for other subjects when mathematics assignment is completed," is ranked equally low for use with slow learners by both authorities and teachers. However, for rapid learners, the texts rank it in 3rd place as compared to 21st place by teachers and 28th place by manuals.

Although all agree on the somewhat middle ranking of item No. 16, "make individual assignments based on student's ability," for rapid learners, teachers rank it in 7th place for use with slow learners while texts rank it 14th and manuals 23rd.

Nine of the items are recommended highly by the authorities and not used to any great extent by teachers. Here too there are differences as to extent of use with rapid and slow learners. For example, item No. 30, "give students experiences in applying the principles of mathematical reasoning in social problems," is ranked in 3rd place by textbooks and in 13th place by teachers for rapid learners while textbooks rank it 22nd and teachers 17th for slow learners.

Authorities give very high ranking to items No. 15, 27, and 28 which teachers do not appear to use. These are: "provide a Mathematics Laboratory," "give students experience in group evaluation," and "encourage students to make up problems by securing data from own reading or experiment." Also not used by teachers to as great an extent as the authorities recommend, are items No. 6, 23, 24, 26 and 29. These are: "encourage students to make scrapbooks and prepare graphic materials showing the uses of mathematics," "provide field trips related to class-work," "encourage solution of mathematical problems from field of students' interests," "plan class activities with students," and "provide students with experiences in a Mathematics Club."

Procedures used to a great extent by teachers which are not recommended by the authorities include No. 1, "give individual assistance to pupils after school hours," (especially for slow learners) No. 2, "provide individual supervision and guidance during class," No. 9, "require all students in a given class to do approximately the same amount of work and type of work for the same mark," No. 11, "encourage able students to assist slower students," No. 18, "encourage each student to work at his own rate and to complete as many topics as his ability will permit," and No. 19, "assign the same homework to each student."

Listing of Similarities and Differences Between Authorities and Teachers

The following are the items on which authorities and teachers are in agreement as to extent of use (for both rapid and slow learners unless otherwise specified):

a. <u>Agreement on High Ranking</u>

No. 3. (for slow learners) "Assign simple drill problems."

No. 4. "Assist students in learning vocabulary and reading skills peculiar to mathematics."

No. 5. "Emphasize the social uses of mathematics."

No. 17. "Encourage each student to work at his own rate, but require the student to confine his work to the same topic as the other students."

No. 22. "Provide students self-evaluation."

b. <u>Agreement on Middle Ranking</u>

No. 7. (rapid learners) "Emphasize manual activities which illustrate mathematical principles."

No. 12. (rapid learners) "Encourage study of the applications of mathematics to science."

No. 13. "Encourage students to make aids to instruction for classroom."

No. 14. "Display student's work on bulletin board."

No. 16. (rapid learners) "Make individual assignments based on student's ability."

c. <u>Agreement on Low Ranking</u>

No. 1. (rapid learners) "Give individual assistance to pupils after school hours."

No. 8. "Encourage students to read simple stories about mathematics or famous mathematicians."

No. 10. "Encourage students to compete for awards given for superior scholarship."

No. 20. (slow learners) "Permit students to use class time for other subjects when mathematics assignment is completed."

No. 25. "Provide students with experiences in evaluating types of reasoning in newspaper and magazine articles."

Procedures recommended highly by authorities and used to a limited extent by Oklahoma teachers are:

No. 15. "Provide a Mathematics Laboratory."

No. 26. "Plan class activities with students."

No. 27. "Give students experience in group evaluation."

No. 28. "Encourage students to make up problems by securing data from own reading or experiment."

No. 29. "Provide students with experiences in a Mathematics Club."

No. 30. "Give students experiences in applying the principles of mathematical reasoning in social problems."

Those procedures used by Oklahoma teachers which are not recommended by the authorities are:

No. 1. (slow learners) "Give individual assistance to pupils after school hours."

No. 2. "Provide individual supervision and guidance during class."

No. 9. "Require all students in a given class to do approximately the same amount of work and type of work for the same mark."

No. 11. "Encourage able students to assist slower students."

No. 18. "Encourage each student to work at his own rate and to complete as many topics as his ability will permit."

No. 19. "Assign the same homework to each student."

It was found incidentally that Oklahoma teachers' rankings of the 30 procedures are essentially in agreement with teachers' rankings nationally as reported by the U. S. Office of Education (25), see pp. 10 and 11. These include high ranking for item No. 5, "emphasize the social uses of mathematics," and item No. 12, "uses of mathematics in science." Oklahoma teachers rank item No. 2, "provide individual supervision and guidance during class," high among procedures used for rapid and slow learners. They also rank item No. 3, "assign simple drill problems," in second place for use with slow learners, and report little use of item No. 15, "provide a Mathematics Laboratory." Oklahoma teachers report, as do teachers nationally, that they also do not use to any great extent items No. 23, 25, and 30, "provide field trips related to class-work," "provide students with experiences in evaluating types of reasoning in newspaper and magazine articles," and "give students experiences in applying the principles of mathematical reasoning in social problems."

Recapitualtion

There was substantial agreement between the ratings of Oklahoma teachers and textbooks and teachers' manuals on 15 of the 30 items. On the other 15 items there were substantial differences in the ratings of Oklahoma teachers as compared to the ratings of textbooks and manuals. In addition, there was considerable disagreement both between the text-books and the manuals and among the authors of both textbooks and manuals. It was found incidentally that Oklahoma teachers' ratings of the 30 procedures for teaching seventh grade arithmetic to rapid and slow learners are very similar to ratings of teachers reported in the U. S. Office of Education national study (25).

Discussion of Results

A weakness of limitation of the teacher-questionnaire (Appendix A, p. 90) used in this study is that it does not provide for the teachers' reports of how they interpret and apply these 30 selected procedures. This may be worthy of further investigation.

It is beyond the scope of this paper to analyze the factors responsible for the differences between teachers and authorities' ratings of the 30 procedures. However, tentative explanations may be posited for some of the differences between the ratings of authorities and teachers of some of the procedures.

It is possible that teachers confronted with large classrooms, limited school facilities, heavy teaching, administrative, and extra-curricular duties, may not find it practicable (or feasible) to utilize some of the procedures which authorities recommend highly.

For example, textbooks highly recommend a "Mathematics Laboratory" and teachers report practically no use of this provision. This may be due to the paucity of mathematics laboratories and equipment in the schools surveyed.

On the other hand, teachers do give individual assistance to slow learners after school while authorities rank this provision lowest. This may be because the teachers cannot give enough time to the slower learners during a regular class period. Teachers report that they encourage able students to assist slower students while authorities do not recommend this practice. Here again this may be the most expedient procedure under existing classroom conditions.

This study has indicated the extent to which a sampling of Oklahoma seventh grade mathematics teachers utilize 30 procedures for teaching rapid and slow learners. This study has also analyzed how and to what extent ten mathematics methodology textbooks and four state teachers' manuals recommend the use of these procedures. It should be pointed out that the extent of use of a teaching procedure or the extent to which a procedure is recommended by authorities does not necessarily furnish an index of its efficacy or value. It is not justifiable to assume that a procedure widely used or recommended is of necessity a more valuable procedure than one which is not so widely used or recommended.

It is beyond the scope of this paper to evaluate completely the 30 selected procedures for teaching mathematics. Certainly, there appears to be need for further evaluative studies in this area.

BIBLIOGRAPHY

1. Brueckner, Leo J., and Grossnickle, Foster E. Making Arithmetic Meaningful. Philadelphia: The John C. Winston Co., 1953, pp. 570.

2. ______, Grossnickle, Foster E., and Merton, Elda L. Teacher's Guide for Thinking With Numbers. Philadelphia: The John C. Winston Co., 1953, pp. 127.

3. Buswell, G. T. Chapter VIII, "The Psychology of Learning in Realtion to the Teaching of Arithmetic." The Teaching of Arithmetic. Fiftieth Yearbook, Part II, Ed. Nelson B. Henry. Chicago, Illinois: The National Society for the Study of Education, 1951, pp. 143-154.

4. Clark, John R. and Eads, Laura K. Guiding Arithmetic Learning. New York: World Book Company, 1954, pp. 280.

5. Gibb, E. Glenadine. "A Review of a Decade of Experimental Studies which Compared Methods of Teaching Arithmetic," Journal of Educational Research. 46:603-608; 1953.

6. Grossnickle, Foster E. Chapter XI, "The Training of Teachers of Arithmetic," The Teaching of Arithmetic. Fiftieth Yearbook, Part II, Ed. Nelson B. Henry. Chicago, Illinois: The National Society for the Study of Education, 1951, pp. 203-231.

7. ______, Junge, Charlotte, and Metzner, William. Chapter IX, "Instructional Materials for Teaching Arithmetic," The Teaching of Arithmetic. Fiftieth Yearbook, Part II, Ed. Nelson B. Henry. Chicago, Illinois: The National Society for the Study of Education, 1951, pp. 155-185.

8. Hickerson, J. Allen. Guiding Children's Arithmetic Experiences. New York: Prentice-Hall, Inc., 1952, pp. 322.

9. LeBaron, Walter A. "A Study of Teachers' Opinions in Methods of Teaching Arithmetic in the Elementary School," Journal of Educational Research. 43:1-9; 1949.

10. Lewis, Gertrude M. Educating Children in Grades Seven and Eight. U. S. Department of Health, Education, and Welfare, Office of Education, Washington: Government Printing Office, Bulletin 1954, No. 10, pp. 99.

11. Morton, Robert Lee. Teaching Children Arithmetic. New York: Silver Burdett Co., 1953, pp. 566.

12. ______, Gray, Merle, Springstun, Elizabeth, Schaaf, William L. Teacher's Edition: Making Sure of Arithmetic, Grade Seven. New York: Silver Burdett Company, 1955, pp. 229.

13. National Society for the Study of Education. The Teaching of Arithmetic. Fiftieth Yearbook, Part II. Ed. Nelson B. Henry. Chicago, Illinois: The National Society for the Study of Education, 1951, pp. 302.

14. Patton, and Young, . A Teacher's Manual for Numbers In Your Life. Syracuse: Iroquois Publishing Company, Inc., 1953, pp. 87.

15. Ragan, William B. Modern Elementary Curriculum. New York: The Dryden Press, Inc., 1953, pp. 570.

16. Reeve, William D. "The Problem of Varying Abilities Among Students in Mathematics," Mathematics Teacher. 49:70-78; 1956.

17. Spitzer, Herbert F. Chapter VII, "Learning and Teaching Arithmetic," The Teaching of Arithmetic. The Fiftieth Yearbook of the National Society for the Study of Education, Part II. Chicago, Illinois: The National Society for the Study of Education, 1951, pp. 120-142.

18. ______. The Teaching of Arithmetic (2nd Ed.) Cambridge, Mass.: Houghton Mifflin Company, 1954, pp. 416.

19. Stokes, C. Newton. Teaching The Meanings of Arithmetic. New York: Appleton-Century-Crofts, Inc., 1951, pp. 531.

20. Taylor, E. H. and Mills, C. N. Arithmetic For Teacher-training Classes. (4th Ed.) New York: Henry Holt and Company, 1955, pp. 438.

21. Thorndike, Edward L. Mental Work and Fatigue and Individual Differences And Their Causes. New York: Teachers College, Columbia University, 1914, Part II, pp. 142-388.

22. ______. The New Methods in Arithmetic. (Ed. of 1924) New York: Rand McNally and Company, 1921, pp. 260.

23. ______. Chapter XV, "Individual Differences," The Psychology of Arithmetic. New York: The MacMillan Company, 1922, pp. 285-309.

24. Tyler, Leona E. The Psychology of Human Differences. (2nd Ed.) New York: Appleton-Century-Crofts, Inc., 1956, Parts I and II, pp. 3-244.

25. U. S. Department of Health, Education, and Welfare. Teaching Rapid and Slow Learners in High Schools. Office of Education, Washington, D. C.: United States Government Printing Office, Bulletin No. 5, 1954, pp. 97.

26. Van Engen, H. Chapter VI, "Arithmetic in the Junior-Senior High School," The Teaching of Arithmetic, Fiftieth Yearbook, Part II, Ed. Nelson B. Henry, Chicago, Illinois: The National Society for the Study of Education, 1951, pp. 203-231.

27. Weimar, Bird M. "Ability Grouping of Students in Senior High School Mathematics." Mathematics Teacher. 21:102-106; 1928.

28. Wheat, Harry Grove. How To Teach Arithmetic. Evanston, Illinois: Row, Peterson and Company, 1951, pp. 438.

29. _______, and Douglass, Harl R. Manual With Answer Key for Row-Peterson Arithmetic Book Seven. Evanston, Illinois: Row, Peterson and Company, 1953, pp. 184.

30. Wilson, Guy M. Teaching The New Arithmetic. (2nd Ed.) New York: McGraw-Hill Book Company, Inc., 1951, pp. 483.

31. Wingo, G. Max. Chapter XI, "Implications for Improving Instruction in the Upper Elementary Grades," Learning and Instruction. 49th Yearbook, Part I, Ed. Nelson B. Henry, Chicago, Illinois: The National Society for the Study of Education, 1950, pp. 280-303.

32. Wren, F. Lynwood. "A Survey of Research in the Teaching of Secondary Algebra." Journal of Educational Research. 28:597-610; 1935.

33. _______. "Mathematics, Secondary. Development and Status." Encyclopedia of Educational Research (Revised edition of 1950) Ed. Walter S. Monroe, New York: The MacMillan Co., pp. 717-725.

APPENDIX A

TECHNIQUES, PROVISIONS, AND PROCEDURES

tent of use for apid Learners					Extent of use for Slow Learners		
None	Some	Much			None	Some	Much
			18.	Encourage each student to work at his own rate and to complete as many topics as his ability will permit			
			19.	Assign the same homework to each student			
			20.	Permit students to use class time for other subjects when mathematics assignment is completed			
			21.	Provide students experiences in group work			
			22.	Provide students self-evaluation			
			23.	Provide field trips related to classwork			
			24.	Encourage solution of mathematical problems from field of students' interests			
			25.	Provide students with experiences in evaluating types of reasoning in newspaper and magazine articles			
			26.	Plan class activities with students			
			27.	Give students experience in group evaluation			
			28.	Encourage students to make up problems by securing data from own reading or experiment			
			29.	Provide students with experiences in a Mathematics Club			
			30.	Give students experiences in applying the principles of mathematical reasoning in social problems			
			31.				
			32.				

Please list in order the five most important procedures that you use in terms of frequency: (Use questionnaire number) ___, 2.___, 3.___, 4.___, 5.___.

List in order the five procedures that you consider generally most effective: (Use questionnaire number) 1.___, 2.___, ___, 4.___, 5.___.

DESCRIPTION OF OUTSTANDING PROGRAMS

Note: If you have had unusual success in adapting your mathematics program to rapid learners, to slow learners, or to ı, would you please tell about your provisions and procedures on this paper and on separate sheets of paper which you ɜnd to the questionnaire? Please describe: (1) what is taught, (2) how it is taught, and (3) to whom it is taught. We should to have your permission to use this material for publication purposes, if possible.

ıe of teacher providing information:___

ıol Address:___

(Summary of this questionnaire will be mailed to this address)

Oklahoma
Agricultural and Mechanical College
SCHOOL OF EDUCATION
STILLWATER

Dear Superintendent or Principal:

I am writing this letter on behalf of the research project of Wilbur H. Tanner, a graduate student in Elementary Education.

This study is to locate promising practices which can be used by teachers and administrators interested in problems involved in the education of rapid and slow learners in seventh grade mathematics.

Enclosed is a questionnaire containing thirty items. This questionnaire is reasonably short, therefore the job of completing it should not prove too burdensome.

Please ask each of your seventh grade teachers of mathematics to fill out a questionnaire. Return the completed questionnaires in the enclosed envelope addressed to Mr. Tanner's office. If for any reason some of the questionnaires are not filled out, please return them also.

By carefully completing all items of the questionnaire and returning them as soon as is convenient, you will be furthering a significant research project. Your contribution will be very much appreciated. Results will be made available to those who are interested in them.

Sincerely,

W. Ware Marsden

W. Ware Marsden
Director of Student Teaching

VITA

Wilbur Henry Tanner

Candidate for the Degree of

Doctory of Education

Thesis: TEACHING RAPID AND SLOW LEARNERS IN SEVENTH GRADE ARITHMETIC

Major Field: Elementary Education

Biographical:

Personal data: Born at Alva, Oklahoma, January 10, 1909, the son of Earnest W. and Mary K. Tanner.

Education: Attended grade school in Alva, Oklahoma; graduated from Alva High School in 1926; received the Bachelor of Science degree from Northwestern State College, Alva, Oklahoma, with a major in Chemistry and Education, in May, 1930; received the Master of Science degree from the Oklahoma Agricultural and Mechanical College, with a major in Education, in July, 1941; completed requirements for the Doctor of Education degree in May, 1957.

Professional experience: Has had continuous service as a teacher since receiving his Bachelor of Science degree, with the exception of a five year period from May, 1946 to September, 1951, when he was co-owner of a department store located in Alva, Oklahoma. Has taught junior high school, high school, and college classes; is now Director of Teacher Training and Placement at Northwestern State College, Alva, Oklahoma.

Professional organizations: Is a member of the Association for Student Teaching; Association for Supervision and Curriculum Development; The National Society for the Study of Education, and Phi Delta Kappa.

Typed by:

Mrs. Gordon F. Culver