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ABSTRACT

This report contains both a summary of research and an annotated list of research on the teaching of mathematics to disadvantaged pupils. Particular implications from the research summary are presented and include: (1) the disadvantaged profit from special attention, either from the teacher, the content of the program, the instructional materials, or the organization for instruction, (2) the mathematical characteristics which distinguish disadvantaged from advantaged pupils appear to exist in degree rather than kind, (3) social relevance appears to be more crucial to consider in the case of disadvantaged students, (4) active physical involvement with manipulative materials may be even more important for the disadvantaged than for the advantaged, (5) there is as much need for individualized instruction for disadvantaged students as for other groups of students. The list of references is divided in two major areas: educationally disadvantaged and academically disadvantaged. The latter section is sub-divided into four categories low achievers, remediation, slow learners, and mentally retarded. Citations are listed in alphabetical order by author and indicate sources, availability, and major ideas of the document. (JG)

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MATHEMATICS EDUCATION REPORTS

TEACHING MATHEMATICS TO DISADVANTAGED PUPILS:

A SUMMARY OF RESEARCH

by Marilyn N. Suydam

ERIC Information Analysis Center for
Science and Mathematics Education
1460 West Lane Avenue
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April, 1971

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This paper, which reviews research related to the teaching of mathematics to disadvantaged students, was commissioned by the ERIC Information Analysis Center for Science and Mathematics Education. Accompanying the paper is an extensive annotated bibliography on the teaching of mathematics to disadvantaged students. The paper was presented by Professor Suydam at a Research Symposium session of the 49th Annual Meeting of the National Council of Teachers of Mathematics on April 17, 1971. It is with great pleasure that we make this paper available to the wider mathematics education community as a Mathematics Education Report.

F. Joe Crosswhite
and
Jon L. Higgins
editors

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Mathematics Education Reports

Mathematics Education Reports are being developed to disseminate information concerning mathematics education documents analysed at the ERIC Information Analysis Center for Science and Mathematics Education. These reports fall into three broad categories. Research reviews summarize and analyze recent research in specific areas of mathematics education. Resource guides identify and analyze materials and references for use by mathematics teachers at all levels. Special bibliographies announce the availability of documents and review the literature in selected interest areas of mathematics education. Reports in each of these categories may also be targeted for specific sub-populations of the mathematics education community. Priorities for the development of future mathematics Education Reports are established by the advisory board of the Center, in cooperation with the National Council of Teachers of Mathematics, the Special Interest Group for Research in Mathematics Education, the Conference Board of the Mathematical Sciences, and other professional groups in mathematics education. Individual comments on past Reports and suggestions for future Reports are always welcomed by the editors.

Teaching Mathematics to Disadvantaged Pupils:

A Summary of Research*

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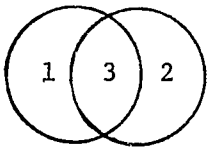
I. Organization of the research

It is necessary, as we attempt to organize the research evidence on any topic, to define the scope of that topic. Who are the "disadvantaged"? The word is used in a variety of ways, to suit a variety of situations. We will use it in connection with two intersecting sets of pupils:



1 - Environmentally disadvantaged students: Cultural factors such as socioeconomic level (SES) or migrant status determine inclusion in this set. In common usage, the term may be synonymous with the "culturally disadvantaged" or "culturally deprived".

2 - Academically disadvantaged students. Factors such as intellectual ability and achievement also cause students to be disadvantaged. This set includes several subsets. First, there is the "low achiever" (e.g., the pupil who ranks in the lower third of the student population on mathematics or general achievement), and the "underachiever", who appears to have the ability to achieve at a higher level, but fails to

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* Portions of this paper were drawn from: Suydam, Marilyn N. and Weaver, J. Fred, "Mathematics and the 'Disadvantaged'". Columbus, Ohio: ERIC Information Analysis Center for Science and Mathematics Education, The Ohio State University, 1971.

do so. There is the student who needs remediation, because of lack of achievement. Another subset includes the "slow learner" (e.g., the student with an IQ of 75 to 90). And there is the mentally retarded child, with an IQ below 75.

3 - The above two sets are not disjoint: some students are both environmentally and academically disadvantaged.

Even when we have defined the sets, there are still a number of confounding factors which create difficulties as we try to summarize the research. Not the least of these is the fact that in research reports it is very often difficult to ascertain the set or subset of pupils which is being discussed. Some writers use the word "disadvantaged", for instance, and go no further in defining how the pupils involved are disadvantaged. In other cases, the term "slow learner" is used, with no clarification of the basis on which the term was selected. In some studies, slow learners are those who have IQ's lower than other children in the group; e.g., other pupils have IQ's from 125 to 150; the "slow learners" in that case have IQ's from 100 to 125. Whenever it was possible to determine that such a definition was being used, the study was not included on the list of references. The situation with "low achievers" is similarly confusing: very often these are merely the children who achieved less than other children on a particular test -- and the amount of agreement between this test and others is not noted (that is, whether these children are usually "low achievers" in other phases of mathematical or general achievement is unknown). When it was determined that those labeled "low achievers" were in fact low only in comparison with their own group (e.g., when the total group involved children with achievement two or more years above grade

level, and the "low achievers" were those who were only attaining one year above grade level), the study was not included.

As you scan the list of references, you will notice that it includes relatively few studies done with students in the secondary school. This is a function of two factors: (1) my files are less complete (by far) at the secondary school level, and my search for articles was not as thorough as it might have been; and (2) there are not as many slow learners or low achievers or otherwise disadvantaged students still enrolled in mathematics courses in the secondary school. The process of selection or tracking precludes most students in any of the subsets of the disadvantaged from going beyond a general mathematics course. (You might also notice that another limitation was made for the list of references: it does not include studies with any population beyond the secondary school years.)

II. What we have learned from research

I would venture to say that, when techniques for teaching the disadvantaged are considered, we've learned as much from non-controlled exploration as we have from controlled research. (This is also true for research with non-disadvantaged groups.) We've affirmed what we have pragmatically found to work, rather than discovered a whole new set of behaviors or techniques and materials.

From research we've learned that certain procedures are effective -- or not effective -- for learners at all levels. Here we're considering studies in which the disadvantaged -- whether environmentally disadvantaged, academically disadvantaged, or both -- were specifically considered, as an identifiable group, either in separate classes or as one level of a class. There are many procedures beyond those cited here which are undoubtedly

effective for the disadvantaged, as they are for the advantaged; here we'll attempt to identify only procedures which have been studied to ascertain their effectiveness specifically for the disadvantaged.

Evaluation of results is a necessity as we seek to interpret results. It has been applied here, but in little depth: it was considered primarily in selection, and those studies which are poorest have not been cited. Many of the studies would probably be evaluated as "average" to "poor" on a five-point scale. Sampling procedures, control of variables, and design are frequently questionable (as in most studies). This should be kept in mind as we explore the findings.

The work of many who have developed and tried out programs for the various groups of disadvantaged is not included; their findings have not always been published in a readily accessible form. The ERIC Information Analysis Center for Science and Mathematics Education at Ohio State has a listing of many of the funded projects, however, and materials are available directly from many others. Among such projects are those in Oakland County, Michigan; Des Moines, Iowa; Jefferson and Douglas Counties, Colorado; Miami, Florida; Los Angeles, California: in fact, most cities of any size could be listed. Most of these projects include some formative evaluation; for instance, the Oakland County, Michigan, project has not only ascertained that their innovative materials may be equally appropriate for white and black students, but has data on the effectiveness of each unit, to be used in revising the materials. (The programs of Martin Deutsch and of Bereiter and Engelmann for young children also contain mathematical components, but are not cited here.)

Research has served in a valuable way, beyond providing affirmation: it has also raised questions about some of our beliefs about the

disadvantaged. For instance, we believe that the disadvantaged profit from the use of manipulative materials -- but little research has been done on this specific topic with specific sets of disadvantaged pupils. We believe that meaningful methods are essential, yet the little research that has been done on the role of meaning for disadvantaged pupils indicates that learning by rule is more efficient. We need more definitive research on such points!

All in all, research has given us limited guidance in knowing how to provide the most effective mathematics program and instruction for disadvantaged students. Little of the knowledge we do have regarding such students comes from research conducted explicitly within the context of mathematics education. Rather, mathematics was one of several subjects tested — or mathematics was never tested, but we have learned that a procedure is effective in other subject areas, or that a non-subject-specific finding is true (e.g., children learn better when they are "motivated".)

But let us consider: what do we know from research about teaching the disadvantaged?

A. What is the mathematical status of the environmentally disadvantaged?

The majority of studies with the environmentally disadvantaged provide descriptive information on how students were achieving at the time of the study. Many have also compared the achievement of pupils from two or more levels.

In general, it has been found that:

(1) Children with low SES come to school with less mathematical background than pupils with higher SES (Dunkley, 1965; Mascho, 1961; Montague, 1964; Searle, 1968).

(2) Children with low SES achieve less during each school year than those with higher SES; there may be a cumulative effect attributable to being disadvantaged (Dunkley, 1965).

(3) Regardless of SES level, similar stages of development were indicated, but students of low SES may proceed through the stages at a slower pace (Johnson, 1970).

(4) Low SES pupils achieved conservation less frequently (Baker and Sullivan, 1970; Bozarth, 1968; Skypek, 1967) and demonstrated less ability to categorize and classify (Johnson, 1970; Raven, 1967-68).

(5) SES appears to be correlated with achievement (Cleveland, 1962; Husen, 1967; Passy, 1964; Unkel, 1966a, 1966b; Wilson, 1963).

(6) SES appears to be correlated with IQ (Bozarth, 1968; Curry, 1960; Houston, 1969; Rose and Rose, 1961).

(7) Children with low SES had less favorable attitudes (Spickerman, 1970).

(8) Evidence on the racial factor is conflicting. In some studies, white pupils achieved more when compared with Indians (Hansen, 1937), Negroes (Binkley, 1967; Harris, 1968; Prichard, 1970), or Mexican-Americans (Coers, 1935). In other studies, no differences were found between white pupils and Indians (Sams, 1969), Negroes (Asbury, 1970), or Mexican-Americans (Smart, 1969).

(9) Mobility does not have a significant effect on achievement (Evans, 1966; Gilchrist, 1968; Hand, 1969; Miller, 1967; Perrodin and Snipes, 1966; Snipes, 1966).

B. What are the components of effective programs for the environmentally disadvantaged?

It is not at all surprising to find studies which report that special programs designed to provide special treatments and emphases for disadvantaged pupils result in higher achievement, when compared with "regular" programs which include no special provisions for such pupils! In these by-and-large recent studies, the following are reported to be effective for the environmentally disadvantaged:

(1) Team-planned instruction, departmentalization, individualization, and contracts based on diagnosis (Dethmers, 1969).

(2) A "specially designed" program emphasizing success experiences, careful development of concrete to abstract levels, use of simple language, reduced reading level and load, such techniques as discovery, inquiry, and experiments (Hankins, 1969).

(3) A special program which took into account the need to progress from (a) perceptual to conceptual levels, (b) sensory to language conceptualization, and (c) lower- to higher-order concepts, with the intrinsic motivation of success capitalized upon, and with provision for individual differences (Castaneda, 1968a, 1968b).

(4) A program in which intra-class grouping and a topical approach adjusted to individual needs were used (Lerch and Kelley, 1966).

(5) A special program which included activities such as field trips, individual and small group work, weekly evaluation by counselors, programmed texts, records, tapes, tutor help, and guest speakers (Dreyfuss, 1969).

(6) SMSG materials for the disadvantaged (to a certain extent) (Chinn and Summerfield, 1967; Leiderman, Chinn and Dunkley, 1966).

(7) A Head Start program (Mackey, 1969). (While most Head Start programs are not by intention academically oriented, some studies have attempted to measure the effects of such programs on later achievement.)

(8) Experimental materials designed "to promote readiness and enhance the curriculum" (Goolsby and Frary, 1970).

(9) A "concept" method using models and aids (Hall, 1967).

(10) Consumable materials with a quasi-programmed teaching procedure (Winzenread, 1970).

(11) Lesson plans, video tapes, and filmstrips (Knowlden, 1967).

(12) Opportunity and an "ego-supporting" teacher (Paschal, 1966).

(13) Individualized instruction using programmed materials and other aids (Kneitz and Creswell, 1969).

(14) Remedial help from floating teachers (Newman and Seiser, 1967), or a learning resource teacher (Nowell, 1970).

(15) Mathematics laboratory experiences "planned to facilitate learning a hierarchy of needed concepts" (Howard, 1970).

(16) A laboratory approach in which pupils manipulated actual models or representations of mathematical principles (Schippert, 1965).

(17) A program which emphasized real-world applications and use of flow charts, calculators, and other materials (Broussard, Fields, and Reusswig, 1969).

(18) Non-verbal (programmed) materials (Kaplan, 1968, 1969, 1970).

(19) A rule-example method (Anastasiow, et al., 1970).

(20) Use of plastic reinforcement tokens (Heitzman, 1970).

(21) Inservice education for teachers (Harper, 1970; Mahaffey, 1969).

C. How are low achievers different from high achievers?

Certain studies have focused on the characteristics of low achievers. While many of the findings are "obvious", a few curricular changes which could be tried are indicated. In general, low achievers:

(1) Were poorer on tests of computation, relationships, vocabulary, estimating, and analysis (Hansen, 1944).

(2) Made more types of errors (Grossnickle, 1941) and corrected fewer errors (Ramharter and Johnson, 1949).

(3) Had lower ability (Hamza, 1952; Capps, 1962).

(4) Read less well (Eagle, 1948).

(5) Solved problems with unnecessary data, no numbers and missing data less well (Beldin, 1960).

(6) Had a consistent pattern of errors in six areas: interpretation of pictures and diagrams, complex and involved questions, numerals and number systems, measurement, fraction concepts, and geometry (Schacht, 1967).

(7) Had less difficulty with computation than with concepts involving reasoning (Schacht, 1967).

(8) Had poorer attitudes (Degnan, 1967; Aiken, 1970b).

(9) Were less motivated (Snellgrove, 1961).

(10) Were withdrawn and defeated, with emotional causes for under-achievement (Ross, 1962, 1964).

(11) Had problems of personal adjustment, related to over-protection, rigid demands, and high expectations (Plank, 1950).

(12) Had other specific personality factors related to achievement (Capps, 1962; Cleveland, 1962).

D. What procedures have been found to be effective with low achievers?

The procedures cited here were taught in many ways, and the use of other non-specified materials and techniques confound the results. Nevertheless, there is evidence on the effectiveness of each of these:

(1) A program incorporating daily worksheets, partially programmed lessons, and the use of tables to aid in computation (on some tests) (DeVenney, 1968, 1969).

(2) A combined SMSG and traditional program, with small group study (Easterday, 1964).

(3) Use of instructional aids such as drawings, counters, and number lines and charts (Sherer, 1968).

(4) Immediate knowledge of results, with or without candy reinforcement (Hillman, 1970).

(5) A modified programmed lecture approach and mathematical games (Jones, 1968).

(6) Non-discovery strategies (Kleckner, 1969).

(7) Verbal praise, physical contact, and similar reinforcement from the teacher (Masek, 1970).

(8) Making the divisor a whole number when placing the decimal point in quotients (Flournoy, 1959).

(9) Programmed instruction (Meadowcroft, 1965; Scott, 1970).

(10) Regular use of mathematical games (Burgess, 1970).

(11) Use of tutors (Ackerman, 1970; Burrow, 1970).

(12) Correcting errors and reteaching (Morrell, 1970).

(13) Large class (70-85 students) instruction (Madden, 1966). (The findings of research on grouping on the basis of achievement have been much more variable than those for grouping on the basis of ability. Differentiated instruction generally appears, however, to be more effective than total class instruction.)

E. What are the components of effective remedial programs?

Not surprisingly, only remedial programs which were successful are generally reported! Diagnosis and individualization are key words in

defining remedial programs. The programs differ in specifics, but these were rarely reported.

(1) Special practice material based on diagnosis of individual errors (Bernstein, 1956b).

(2) An individual diagnostic and remedial program (Callahan, 1962).

(3) Motivated individual remedial work (Randall, 1937).

(4) Diagnosis of needs and individualized group instruction (Guiler and Edwards, 1943).

(5) Remedial work based on diagnosis (Guiler, 1929).

(6) A mathematics clinic with individual instruction (Bernstein, 1956b).

(7) Three to 15 minutes per day of extra computational practice (Crawford, 1970).

(8) Help in both arithmetic and reading (Gilmary, 1967).

(9) Use of volunteer tutors (at one of three grade levels (Olsen, 1969).

(10) Stress on meaning, concrete materials, and use (Holinger, 1958).

F. How do slow learners differ from faster learners?

Few of the findings about the characteristics of slow learners are surprising. It has been found, for instance, that slow learners:

(1) Have a slower rate of learning and a more restricted range of achievement (Feldhusen and Klausmeier, 1959; Feldhusen, Check, and Klausmeier, 1961; Jarvis, 1964; Nicholls, 1963).

(2) Make more errors, correct fewer mistakes, and fail to verify solutions (Klausmeier and Loughlin, 1961; Schane, 1938).

(3) Are less persistent and use a random approach to problem solving (Klausmeier, 1964b).

(4) Have a greater mean anxiety level (Feldhusen and Klausmeier, 1962).

G. What procedures are effective with slow learners?

While much is written about slow learners, research findings are limited in scope. It has been concluded that these procedures are effective with slow learners:

(1) Problems and tasks at individual levels of achievement (Check, 1959; Jones, 1948; Klausmeier, 1964a; Klausmeier and Check, 1962; Klausmeier and Feldhusen, 1959).

(2) Use of computer assisted instruction (Suppes and Morningstar, 1969).

(3) More time and thus a slower pace to complete a course (Herriot, 1967, 1968).

(4) Methods emphasizing "rules" (Miller, 1957).

(5) Limited-range ability grouping (Savard, 1960) and heterogeneous grouping (Koontz, 1961). (Grouping on the basis of ability has been found to be less effective for those at lower ability levels than for those at upper ability levels. Perhaps this finding is confounded by the use of materials and methods that are not differentiated for these groups.)

(6) Differentiated instruction involving team learning (McHugh, 1960).

(7) The decomposition method of subtraction (Rheins and Rheins, 1955).

(8) Review lessons on multiplication (for retention) (Gibney, 1962).

(9) Use of a (more concrete) wanted-given technique in solving problems (Wilson, 1967).

(10) Use of the subtractive algorithm for division (for understanding) (Van Engen and Gibb, 1956).

H. What are the mathematical characteristics of mentally retarded children?

Most of us do not teach mentally retarded pupils, and much of the research on their learning is never explored by us. Consider a few ways in which they differ from non-retarded pupils:

(1) Less ability to name the process and to actually solve a problem (especially with the named operation) (Cruickshank, 1948c).

(2) Less ability to solve problems with superfluous material (Cruickshank, 1948b).

(3) Lack of understanding, immature and poor habits, and carelessness (like that found in the non-retarded!) (Cruickshank, 1948a).

(4) A lag in attainment, or fixating at lower stages, in Piaget's hierarchy (though the stages occur in the usual order) (McGettigan, 1970; Quick, 1967; Whyte, 1970).

(5) Less understanding of time concepts (Gothberg, 1949).

I. What are the components of effective programs for the mentally retarded?

Those who work with retarded pupils use a variety of specialized strategies. There is evidence that such components as these, which are also used in programs for other pupils, are effective:

(1) Teaching machines (Blackman and Capobianco, 1965).

(2) Programmed materials (Jenkins, 1968; Johnson, 1967; Rainey and Kelley, 1967).

(3) Cuisenaire rods (Callahan and Jacobson, 1967).

(4) Materials which teach reading, writing, arithmetic, and social experiences concurrently (Pfaeffle, 1969).

(5) Training with yes-no feedback plus verbal mediation (Reitz, 1970.)

(6) Test items presented symbolically (rather than with concrete materials) (Finley, 1962a, 1962b).

(7) Enrollment in regular classes (but self-image was better in special classes) (Hoeltke, 1967).

III. What we can imply from research

If we ignore discussion of the need to do more and better and coordinated research, we can nevertheless make certain implications from the research with disadvantaged pupils. Among the most important of these are:

A. The disadvantaged, as well as all other pupils, profit from special attention. This may be in the form of attention from the teacher,

the content of the program, the instructional materials, or the organization for instruction.

B. The mathematical characteristics which distinguish disadvantaged from advantaged pupils appear to exist in degree rather than kind. That is, disadvantaged and advantaged pupils have similar abilities and skills, but differ in depth or level of attainment.

C. Rate of learning is but one variable to be considered in providing effective instruction for slower learners. Methods and materials of instruction also must be adapted to these pupils.

D. Social relevance appears to be more crucial to consider in the case of disadvantaged students; however, little research has attended to this topic.

E. The degree of mathematical meaning which is optimal for disadvantaged students is an unknown factor. While there is some evidence that "discovery" approaches are not as effective as "rule" approaches with the disadvantaged, it may be merely that more-closely-guided discovery and lower levels of meaning are appropriate for these groups.

F. Active physical involvement with manipulative materials, which is believed to be important for all children, may be even more so for the disadvantaged.

G. Pupils who are disadvantaged mathematically may also be disadvantaged on other factors which are related to their mathematical learning (e.g., reading ability). Such things must be taken into account in planning the curriculum for the disadvantaged child.

H. Groups of disadvantaged pupils are not all disadvantaged in the same way. There is as much need to individualize instruction for disadvantaged students as for other groups of students.

Right Hand Bag

TEACHING MATHEMATICS TO DISADVANTAGED PUPILS:

B I B L I O G R A P H Y

MATHEMATICS AND THE "DISADVANTAGED": ANNOTATED LIST OF RESEARCH REFERENCES

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I. Environmentally Disadvantaged

Aiken, Lewis R., Jr. Nonintellective Variables and Mathematics Achievement: Directions for Research. J. Sch. Psychol. 8: 28-36; Mar. 1970.

This selective review of research on attitudes includes findings related to sociocultural background. (grades K-12)

Anastasiow, Nicholas J.; Sibley, Sally A.; Leonhardt, Teresa M.; and Borich, Gary D. A Comparison of Guided Discovery, Discovery and Didactic Teaching of Math to Kindergarten Poverty Children. Am. Ed. Res. J. 7: 493-510; Nov. 1970.

The rule-example method may be most efficient for mastery of simple classification tasks, while guided discovery appears to be more efficient for mastery of more complex classification tasks. Those with low scores on a picture vocabulary test learned best with the rule-example method, while others did well under either treatment. (grade K; 41 pupils)

Asbury, Charles Alexander. Factors Associated with Discrepant Achievement in Rural Economically Deprived White and Negro First Graders. (University of North Carolina at Chapel Hill, 1969.) Dis. Abst. 31A: 208-209; July 1970.

Arithmetic overachievers were superior to underachievers on subtests measuring numerical and sensory concept activation. Girls were superior to boys on subtests of perception and association vocabulary, but there were no differences between white and Negro pupils. (grade 1; 225 pupils)

Baker, Nancy E. and Sullivan, Edmund V. The Influence of Some Task Variables and of Socioeconomic Class on the Manifestation of Conservation of Number. J. Genet. Psychol. 116: 21-30; Mar. 1970.

Conservation appears to be more likely to occur with high interest materials than with low interest materials, and with smaller aggregate sizes. It was manifested significantly more often by middle-class than by lower-class girls, with no difference for boys. A positive correlation was found between performance on conservation and addition/subtraction tasks. (grade K; 156 pupils)

Binkley, Marvin Edward. First Grade Entrance Variables Related to Achievement and Personality, a Study of Culturally Deprived Fourth Graders. (University of Tennessee, 1967.) Dis. Abst. 28A: 2065-2066; Dec. 1967.

Significant differences between levels of readiness were found on all nine analyses of achievement adjustment and on six of nine analyses of personality adjustment. Race differences were found on all achievement analyses but on no personality analyses. Some sex differences and one age difference were noted. (grade 4; 1,110 pupils)

Bozarth, James Oliver. The Ability to Conserve Quantity of Liquid and Its Relationship to Socio-Economic Background, Intelligence, and Achievement Among Selected Fourth Grade Pupils. (University of Arizona, 1968.) Dis. Abst. 29A: 1127; Oct. 1968.

Conservers scored significantly higher than non-conservers on tests of computation and problem solving; those of high SES level scored significantly higher on conservation and quantitative achievement tests, when adjustments were made for IQ. (grade 4; 209 pupils)

Broussard, Vernon; Fields, Albert; and Reusswig, James M. A Comprehensive Mathematics Program. AV Instruction 14: 43-44, 46; Feb. 1969.

A program for low achievers from disadvantaged areas which emphasized real-world applications and use of flow charts, calculators, and other materials, resulted in significant achievement gain. Sixty per cent of the students who had participated in the program continued to take mathematics courses, compared with forty per cent in a control group. (grades 7-9; 12 classes)

Brudenell, Gerald Alfred. Predicting Achievement of Head Start Children Using Personal, Testing, and Rating Data. (Colorado State College, 1969.) Dis. Abst. 30A: 4269; Apr. 1970.

In a study of the predictive ability of 24 variables on achievement in Head Start programs, the arithmetic subtest of the Wechsler Preschool and Primary Scale of Intelligence appeared to be somewhat predictive of "numerical concept activation." (age 5; 74 pupils)

Castaneda, Alberta Maxine Mondor. The Differential Effectiveness of Two First Grade Mathematics Programs for Disadvantaged Mexican-American Children. (The University of Texas, 1967.) Dis. Abst. 28A: 3878-3879; Apr. 1968.

Students taught by special program on selected mathematics concepts and activities showed greater gains in mathematics achievement than those taught by the textbook-oriented mathematics program. Better provision for individual differences was found in the special program. (grade 1)

Castaneda, Alberta M. A Mathematics Program for Disadvantaged Mexican-American First-Grade Children. Arith. Teach. 15: 413-419; May 1968.

The rationale and content of the program is presented. Children using the program made significantly higher gains in achievement than those using a regular program. (grade 1)

Chinn, William G. and Summerfield, Jeanette O. The Special Curriculum Project: 1965-1966 Pilot Program on Mathematics Learning of Culturally Disadvantaged Primary School Children. SMSG Reports, No. 4. Stanford, CA: School Mathematics Study Group, 1967. 72 pp.

Kindergarteners using SMSG materials scored significantly higher than those using other materials on four of seven tests (vocabulary, counting, identifying and writing number symbols). First graders using SMSG materials scored significantly higher than others on two of seven tests (naming and identifying shapes). (grades K, 1)

Clem, Orlie M. and Hovey, Chester W. Comparative Achievement of Village-School Pupils and Rural-School Pupils. El. Sch. J. 34: 269-272; Dec. 1933.

Village-school pupils were superior to rural-school pupils in arithmetic; mean marks were higher than those in the majority of subjects. Village girls exceeded village boys, but in rural schools the reverse was true. (grades 1-8; 389 pupils)

Cleveland, Gerald Arthur. A Study of Certain Psychological and Sociological Characteristics as Related to Arithmetic Achievement. (Syracuse University, 1961.) Dis. Abst. 22: 2681-2682; Feb. 1962.

High socioeconomic level was found to have a positive correlation to achievement in fundamentals, concepts, and problem solving at all IQ levels studied. Significant relationships were found between personality characteristics and achievement when SES was controlled. (grade 6)

Cleveland, Gerald Arthur and Bosworth, Dorothy L. A Study of Certain Psychological and Sociological Characteristics as Related to Arithmetic Achievement. Arith. Teach. 14: 383-387; May 1967.

SES was positively related to such factors as Social Standards, Social Skills, School Relations, and Self-Reliance. Positive attitudes toward arithmetic appeared to be correlated with achievement in computation among children in the two lower IQ ranges; low SES children who achieve on concept and problem solving tests also have positive attitudes toward arithmetic. (grade 6; 282 pupils)

Coers, Walter C. Comparative Achievement of White and Mexican Junior High School Pupils. Peabody J. Ed. 12: 157-162; Jan. 1935.

White children achieved significantly higher scores on achievement tests than Mexican children. When mental ability was considered, Mexican children were found to be achieving more for their level. Achievement of Mexican children was greatest on the arithmetic computation test. (grades 6-8; 194 pupils)

Curry, Robert Lee. The Effect of Intelligence on the Scholastic Achievement of Sixth-Grade Children of Comparable Socio-Economic Status. (The University of Oklahoma, 1960.) Dis. Abst. 20: 3995; Apr. 1960.

Intellectual ability was found to be related to arithmetic achievement for those in the low socioeconomic class. (grade 6; 360 pupils)

Dethmers, Claer. Self-Concept, Value Orientation, and Achievement Level of Lower Class Elementary School Children in Two Types of Educational Programs. (University of Minnesota, 1968.) Dis. Abst. 30A: 579-580; Aug. 1969.

Children in a school using team planning, departmentalization, individualized instruction, and contracts scored significantly higher on an arithmetic test than those in self-contained classrooms using conventional materials. (grades 5, 6; 92 pupils)

Dickerscheid, Harold. Curricular Implications of Mathematical Concepts of the Preschool Child. (The Ohio State University, 1969.) Dis. Abst. 30A: 4326-4327; Apr. 1970.

Children who scored higher on the inventory exhibited more use of mathematics. While the order of learning concepts was similar, those in a Head Start group scored lower than those in Laboratory classes. (ages 3, 4; 68 pupils)

Dreyfuss, Gerald Orange. A Study of a Special Educational Program for the Disadvantaged Student with a High Academic Potential. (University of Miami, 1968.) Dis. Abst. 29A: 3356; Apr. 1969.

Those in the special activity program achieved significantly higher test scores, though grades in mathematics were not different from those in the control group. (junior high)

Dunkley, M. E. Some Number Concepts of Disadvantaged Children. Arith. Teach. 12: 359-361; May 1965.

Preliminary analysis of data from SMSG study shows that achievement of pupils from disadvantaged areas is generally below that of children from middle-class areas. Differences were greater in first grade than in kindergarten. (grades K, 1; 19 classes)

Dunson, Charles Kenneth. A Descriptive Analysis of the Mathematics Curriculum in the Predominantly Negro High Schools in the State of Georgia. (Colorado State College, 1969.) Dis. Abst. 30A: 4138-4139; Apr. 1970.

Among other findings, it was reported that all 81 schools offered general mathematics, algebra I, and geometry; only large schools offered courses beyond trigonometry. (high school; 27,156 students)

Dutton, Wilbur H. Teaching Time Concepts to Culturally Disadvantaged Primary-Age Children. Arith. Teach. 14: 358-364; May 1967.

Instruction on time concepts resulted in increased achievement. For the culturally disadvantaged, sequential instruction appeared necessary. (grades K-3; 100 pupils)

Emmons, Coralie Ann. A Comparison of Selected Gross-Motor Activities of the Getman-Kane and the Kephart Perceptual-Motor Training Programs and Their Effects Upon Certain Readiness Skills of First-Grade Negro Children. (The Ohio State University, 1968.) Dis. Abst. 29A: 3442; Apr. 1969.

Gross-motor training did not improve ability on measures of spatial ability, logical and numerical reasoning, verbal concepts, and readiness more than for those who had no additional training. (grade 1; 121 pupils)

Evans, John W., Jr. The Effect of Pupil Mobility Upon Academic Achievement. Na. El. Prin. 45: 18-22; Apr. 1966.

Mobility appeared to have no adverse effect on achievement when grades and IQ scores were compared. (grades 5, 6; 97 pupils)

Feinberg, Henry. Achievement of a Group of Children in Foster Homes as Revealed by the Stanford Achievement Test. J. Genet. Psychol. 75: 293-303; 1949.

Foster home children were found to achieve on a higher level than maladjusted children in all areas except arithmetic reasoning. (ages 9-16; 100 pupils)

Feinberg, Henry. Achievement of Children in Orphan Homes as Revealed by the Stanford Achievement Test. J. Genet. Psychol. 85: 217-229; 1954.

Children in orphan homes were found to achieve better than children in maladjusted groups, but not as well as those in foster homes. Arithmetic was found to be one of the most difficult subjects. (ages 9-15; 138 pupils)

Finley, Carmen J. and Thompson, Jack M. A Comparison of the Achievement of Multi-Graded and Single-Graded Rural Elementary School Children. J. Ed. Res. 56: 471-475; May/June 1963.

There was no difference in the achievement of rural children, whether they were educated in a single- or multi-graded school. Arithmetic fundamentals was the only subtest area which showed a significant difference, and this was not consistent. (grades 3, 5; 212 pupils)

Gilchrist, Mary Alice. Geographic Mobility and Reading and Arithmetic Achievement. (University of Colorado, 1968.) Dis. Abst. 29A: 497; Aug. 1968.

Mobility was not found to be significantly related to achievement. (grade 6; 314 pupils)

Goolsby, Thomas M., Jr. and Frary, Robert B. Effect of Massive Educational Intervention on Achievement of First Grade Students. J. Exp. Ed. 39: 46-52; Fall 1970.

Use of experimental materials designed "to promote readiness and enhance the curriculum" for disadvantaged students resulted in significantly greater achievement than that attained by students using conventional materials. (grade 1; 200 pupils)

Graubard, Paul S. The Extent of Academic Retardation in a Residential Treatment Center. J. Ed. Res. 58: 78-80; Oct. 1964.

There was no significant difference between reading comprehension and arithmetic scores. (grades 5-11; 21 pupils)

Green, Robert Wesley. A Survey of the Mathematical Instructional Materials Used in Teaching Culturally Disadvantaged Children Grades 1 Through 6 Throughout the United States. (Indiana University, 1969.) Dis. Abst. 31A: 1101; Sept. 1970.

Of 59 materials listed, an average of 38 per cent were furnished to teachers, with lower grades receiving more than upper grades. Sixth grade teachers used materials more for demonstration, while they were used more for manipulation in other grades. (grades 1-6; 232 teachers)

Hall, E. Leona. Methods and Materials of a Mathematics Program for the Disadvantaged and Underachieving Child. (Michigan State University, 1966.) Dis. Abst. 28A: 154-155; July 1967.

Teaching by a "concept" method using models and aids in a summer camp environment was more effective for fifth graders than fourth when achievement scores are considered, while attitude changed positively for both groups. Retention data were confounded by intervening instruction, especially since no control group was used. (grades 4, 5; 82 pupils)

Hand, Charles Reginald. A Comparison of Permanent Pupils and Transient Military Pupils in Grades Four, Five, and Six in Relation to Mathematical Mastery. (Boston University School of Education, 1967.) Dis. Abst. 30A: 207-208; July 1969.

No significant difference in mathematical mastery was found between permanent and transient pupils. (grades 4-6; 426 pupils)

Hankins, Donald David, Jr. A Fourth Grade Mathematics Program for Children from Impoverished Areas and Its Effect Upon Learning. (United States International University, 1969.) Dis. Abst. 30A: 2249; Dec. 1969.

A program designed for disadvantaged pupils (stressing success, concrete-to-abstract development, simple language, reduced reading, and activity) resulted in significant differences from a control group in learning concepts and in overall achievement. (grade 4; 400 pupils)

Hansen, Harvey C. Scholastic Achievement of Indian Pupils. (University of Oklahoma, 1935.)

Hansen, Harvey C. Scholastic Achievement of Indian Pupils. J. Genet. Psychol. 50: 361-369; 1937.

Mean arithmetic scores were highest for white pupils followed closely by half-blood Indians in boarding schools. Full-blood Indians in boarding schools ranked next, then half-blood Indians in public schools, and finally full-blood Indians in public schools. (ages 9-10; 1,552 pupils)

Harper, E. Harold. The Identification of Socio-Economic Differences and Their Effect on the Teaching of Readiness for 'New Math Concepts' in the Kindergarten. Paper presented at 48th Annual Meeting, National Council of Teachers of Mathematics, 1970. In Science and Math Education Information Report. Columbus, OH: SMAC/Science and Mathematics Education Information Analysis Center, Apr. 1970. pp. 5-8.

Conservation of numerousness was taught to low SES pupils most effectively when teachers met weekly for inservice instruction on the use of specified lessons. (grade K; 484 pupils)

Harris, Gary Reeves. A Study of the Academic Achievement of Selected Negro and White Fifth-Grade Pupils When Educational Ability Is Held Constant. (The University of North Carolina at Chapel Hill, 1967.) Dis. Abst. 28A: 4375-4376; May 1968.

White pupils generally performed better on achievement tests even when educational ability (IQ) was held constant. At lower IQ levels, achievement was approximately the same for the two groups, with increasing difference at each higher ability level. Differences were found to be greater in reading, language arts, and science than in social studies and arithmetic. (grade 5; 1,161 pupils)

Harrison, Forest I. Opportunity As It Is Related to Home Background and School Performance. Sch. R. 77: 144-151; June 1969.

Analysis of data resulting from a recent international study revealed that advantaged-successful students generally had more opportunity to learn than disadvantaged or advantaged-unsuccessful groups. (age 13; 6 countries)

Heitzman, Andrew J. Effects of a Token Reinforcement System on the Reading and Arithmetic Skills Learnings of Migrant Primary School Pupils. J. Ed. Res. 63: 455-458; July/Aug. 1970.

A group of migrant pupils who received plastic tokens (exchangeable for toys, candy, etc.) to reward skills learning responses achieved significantly higher scores on a skills test than those attained by a group not receiving tokens. (ages 6-9; 60 pupils)

Holloway, Regina Hempler. The Effect of Special In-Service Training for Teachers of the Educationally Disadvantaged on Pupil Attitudes and Achievement. (The University of Tulsa, 1969.) Dis. Abst. 30A: 1335; Oct. 1969.

No significant difference in computational skills was found for groups whose teachers did or did not have a special in-service program. (grade 4, teachers; 226 pupils)

Howard, Vivian Gordon. Teaching Mathematics to the Culturally Deprived and Academically Retarded Rural Child. (University of Virginia, 1969.) Dis. Abst. 31A: 294-295; July 1970.

Mathematics laboratory experiences, planned to facilitate learning a hierarchy of needed concepts, were successful, resulting in both achievement and attitudinal gains. (elementary; 12 pupils)

Hudgins, Bryce B. and Smith, Louis M. Group Structure and Productivity in Problem-Solving. J. Ed. Psychol. 57: 287-296; Oct. 1966.

The productivity of low SES groups does not differ from that of the most able members, but groups solve more problems than the less able members. (grades 5-8; 144 pupils)

Husen, T. (Editor). International Study of Achievement in Mathematics, volumes 1 and 2. New York: John Wiley and Sons, 1967.

Throughout the world, student achievement in mathematics was related to parents' education and socioeconomic status.

Hutton, Jerry Bob. Relationships Between Preschool Screening Test Data and First Grade Academic Performance for Head Start Children. (University of Houston, 1970.) Dis. Abst. 31B: 395; July 1970.

A group readiness test (STAR) and a teacher rating given at the end of a Head Start program were found to be usable predictors of first grade achievement. (grade 1; 108 pupils)

Johnson, Roger Thornten, Jr. A Comparison of Categorizing Ability in High and Low Socioeconomic Kindergarteners. (University of California, Berkeley, 1969.) Dis. Abst. 31A: 225; July 1970.

High SES children demonstrated more ability to consistently categorize on attribute resemblance than low SES children did. A similar cognitive development in categorizing was indicated, with the possibility of a slower pace for those with low SES. (grade K; 100 pupils)

Kaplan, Jerome David. Teaching Number Conservation to Disadvantaged Children. (Columbia University, 1967.) Dis. Abst. 28B: 3492-3493; Feb. 1968.

On the immediate posttests, non-conservers who were trained to conserve out-performed pupils who did not receive training. However, two to three weeks later, those trained did only slightly better than those not trained. (grade 1; 40 pupils)

Kaplan, Jerome D. An Example of a Mathematics Instructional Program for Disadvantaged Children. Ed. Technology 9: 40-43; Aug. 1969.

After using non-verbal programmed materials, scores on a criterion-referenced test increased. (grade 1; 6 pupils)

Kaplan, Jerome D. An Example of a Mathematics Instructional Program for Disadvantaged Children. Arith. Teach. 17: 332-334; Apr. 1970.

Six pupils who used programmed material on addition and subtraction with zero increased their scores 45 per cent. (grade 1; 6 pupils)

Keough, John J. The Relationship of Socio-Economic Factors and Achievement in Arithmetic. Arith. Teach. 7: 231-237; May 1960.

The relationships between such factors as father's occupation, parents' birthplace, newspapers read, and type of concern, and arithmetic achievement were considered and discussed. (grade 8; 7 classes)

Kneitz, Margaret H. and Creswell, John L. An Action Program in Mathematics for High School Dropouts. Math. Teach. 42: 213-217; Mar. 1969.

Individualized instruction using programmed materials and other aids resulted in increased achievement scores, with an average gain of seven months in the two months of instruction. (ages 16-21; 60 students)

Knowlden, Gayle Elizabeth. Teaching English Language and Mathematical Symbolism to Verbally Disadvantaged Kindergarten Children. (University of California, Los Angeles, 1966.) Dis. Abst. 27A: 3623-3624; May/June 1967.

Four treatments were used: (1) teacher and lesson plan; (2) teacher with plan and filmstrip; (3) teacher with plan and video tape; and (4) teacher with plan, video tape, and filmstrip. Treatment (4) produced the greatest average gain. (grade K; 100 pupils)

Lehew, Charmon. The Performance of Four- and Five-Year-Old Children in Operation Head Start on Selected Arithmetic Abilities. Arith. Teach. 15: 53-59; Jan. 1968.

Wide variability in performance on counting, matching, and addition and subtraction tasks was noted. In many cases, children were as proficient as children from higher SES areas. (ages 4-5; 50 pupils)

Leiderman, Gloria F.; Chinn, William G.; and Dunkley, Mervyn E. The Special Curriculum Project: Pilot Program on Mathematics Learning of Culturally Disadvantaged Primary School Children. SMSG Reports, No. 2. Stanford, CA: School Mathematics Study Group, 1966. 131 pp.

Achievement data from the use of SMSG materials with disadvantaged children were reported. Variability within classes was consistently large, but there was also much variability between classes. (grades K, 1)

Mackey, Beryl Floyd. The Influence of a Summer Head Start Program on the Achievement of First Grade Children. (East Texas State University, 1968.) Dis. Abst. 29A: 3500-3501; Apr. 1969.

Children who had a Head Start program scored significantly higher on an arithmetic test at the end of first grade than qualified pupils who did not participate in Head Start. Much of the difference could be attributed to white girls. (grade 1; 190 pupils)

Mahaffey, Michael Lee. An Experimental Comparison of Students and Teachers in Culturally Deprived and Non-Culturally Deprived Schools in a Mathematics In-Service Training Program. (Southern Illinois University, 1968.) Dis. Abst. 29A: 2589-2590; Feb. 1969.

The in-service program appeared to be effective in producing significant gain scores for pupils in both types of schools, and also increased teacher achievement scores. (grades 3, 5, 7, teachers; 4 centers)

Manuel, H. T. A Comparison of Spanish-Speaking and English-Speaking Children in Reading and Arithmetic. J. Appl. Psychol. 19: 189-202; Apr. 1935.

The average arithmetic score of the Spanish-speaking children was greater than that of the English-speaking children in grades 2, 3, 4, and 6. Differences between reading and arithmetic scores were greater for Spanish-speaking children. (grades 2-8; 3,200 pupils)

Mascho, George. Familiarity with Measurement. Arith. Teach. 8: 164-167; Apr. 1961.

Low SES children were less familiar with measurement terms than were high SES children. (grade 1; 150 pupils)

Matulis, Robert S. A Survey of the Understandings of Selected Concepts of Logic by 8-18-Year-Old Students. Paper presented at 48th Annual Meeting, National Council of Teachers of Mathematics, 1970. In Science and Math Education Information Report. Columbus, OH: SMAC/Science and Mathematics Education Information Analysis Center, Apr. 1970. pp. 44-48.

Matulis, Robert Stanley. A Survey of the Understandings of Selected Concepts of Logic by 8-18-Year-Old Students. (The University of Florida, 1969.) Dis. Abst. 31A: 1079; Sept. 1970.

Age, intelligence, and SES were significant factors in students' understanding of deductive logic, but sex was not significant. Variability of scores increased as age increased. (grades 4-12; 860 pupils)

McGrath, Robert T. Achievement in One-Room Schools. Sch. Exec. 56: 438-439; July 1937.

No decided advantage for either standard or non-standard schools was found on tests of arithmetic reasoning. Standard schools ranged from 48 per cent to 75 per cent below normal. No outstanding difference between the two types of schools was found on tests of computation. Ranges for standard schools were 62 per cent to 94 per cent below normal, while those for non-standard schools were 42 per cent to 93 per cent below normal. (grades 4-8; 290 pupils)

McIntosh, H. W. and Schrammel, H. E. A Comparison of the Achievement of Eighth Grade Pupils in Rural Schools and in Graded Schools. El. Sch. J. 31: 301-306; Dec. 1930.

Scores on scholarship tests of pupils from graded and rural schools were similar, though somewhat less variability existed for the rural group. When the scores of the highest 31 per cent were compared, scores of graded school pupils were higher, with the greatest differences found in arithmetic, reading, and spelling. (grade 8; 3,532 pupils)

Miller, Joe Hal. The Relationship Between School Mobility and Academic Achievement of Sixth Grade Students of Culturally Disadvantaged and Middle Socio-Economic Neighborhoods. (Indiana University, 1966.) Dis. Abst. 27A: 3231-3232; Mar./Apr. 1967.

Mobility did not seem to play a significant role in the academic achievement of culturally disadvantaged students. The influence of mobility on middle socioeconomic students seemed limited to language and arithmetic concepts. (grade 6; 448 pupils)

Montague, David O. Arithmetic Concepts of Kindergarten Children in Contrasting Socioeconomic Areas. El. Sch. J. 64: 393-397; Apr. 1964.

Kindergarteners from a high socioeconomic area scored significantly higher on an inventory of mathematical knowledge than pupils from a low socioeconomic area. The difference was significant for each sex. (grade K; 82 pupils)

Mueller, Siegfried Gene. A Comparison of Two Programmed Methods of Teaching Measurement Conversion to Fifth and Sixth Grade Children of the Middle and Lower Socio-Economic Classes. (Southern Illinois University, 1968.) Dis. Abst. 29A: 3336; Apr. 1969.

Pupils taught a "dimensional analysis" method (converting by multiplying by factors which represent unity) scored significantly higher, on both posttest and retention test, than those taught a "traditional" method (substituting equivalent units). (grades 5, 6; 478 pupils)

Newman, Thomas B. and Seiser, William. The Floating Teacher--Help for the Mathematically Disadvantaged. Math. Teach. 60: 753-755; Nov. 1967.

Students given remedial help made significant gains in achievement and attitude. (grades 7-9; 1,028 pupils)

Nowell, Willis Cullen. The Effectiveness of the Learning Resource Teacher as a Treatment Component of Elementary and Secondary Education Act, Title I, Programs for Culturally Disadvantaged Children. (The University of Tennessee, 1969.) Dis. Abst. 30A: 3198-3199; Feb. 1970.

For groups in which a learning resource teacher was used, significant differences in computation and problem solving scores were attained, attributable to gains made by Negro students. (elementary; 339 pupils)

Olsen, Clarence Randall. The Effects of Enrichment Tutoring Upon Self-Concept, Educational Achievement, and Measured Intelligence of Male Underachievers in an Inner-City Elementary School. Dis. Abst. 30A: 2404; Dec. 1969.

There were no significant differences between tutored and non-tutored boys on most measures of self-concept, achievement, and intelligence. At the third grade level, however, those tutored in arithmetic achieved significantly more than those not tutored. (grades 2-4; 60 boys)

Paschal, Billy J. A Concerned Teacher Makes the Difference. Arith. Teach. 13: 203-205; Mar. 1966.

Disadvantaged children learned as much as middle-class children when given opportunity and an "ego-supporting" teacher.

Passy, Robert A. The Effect of Cuisenaire Materials on Reasoning and Computation. Arith. Teach. 10: 439-440; Nov. 1963.

Children using the Cuisenaire program achieved significantly less on arithmetic subtests than those in two other programs. Interesting patterns of achievement were indicated by consistently descending means, no matter what the program of instruction in arithmetic, on the various descending levels of mental ability, reading ability, and socioeconomic status. No pattern of achievement was discernible for the teacher-oriented variables and the length of attendance in the school district for the child. (grade 3; 1,800 pupils)

Passy, Robert A. Socio-Economic Status and Mathematics Achievement. Arith. Teach. 11: 469-470; Nov. 1964.

Significant differences were found among the various levels of socio-economic status regardless of which program of instruction was being used. Mean scores increased with increasing level of education and skill of parents. (grade 3; 1,800 pupils)

Pattison, Sylvia J. and Fielder, W. R. Social Class and Number Concepts Among Young Children. Calif. J. Ed. Res. 20: 75-84; Mar. 1969.

Children who attended non-Title I schools scored significantly higher than those disadvantaged pupils in Title I schools, on tests of underlying concepts using manipulative materials. Differences between bilingual and monolingual children on three of five subtests were also significant. Almost all tested could count by rote to ten or beyond, while only one-third could count ten objects correctly. (grade K; 2 classes)

Perrodin, Alex F. and Snipes, Walter T. The Relationship of Mobility to Achievement in Reading, Arithmetic, and Language in Selected Georgia Elementary Schools. J. Ed. Res. 59: 315-319; Mar. 1966.

The number of moves did not seem to affect academic achievement, except for students from other states who manifested higher arithmetic reasoning achievement. (grade 6; 438 pupils)

Pickering, Charles Thomas. A Study of Intellectual Abilities of Culturally Disadvantaged Children as Predictors of Achievement in Reading, Mathematics, and Listening in Grade One. (Ohio University, 1969.) Dis. Abst. 31A: 1085; Sept. 1970.

A correlation of .78 was found between scores on tests on spatial relations, understanding mathematics, communication skills, and logical reasoning, and achievement scores. (grade 1; 170 pupils)

Pitts, Raymond J. Relationship Between Functional Competence in Mathematics and Reading Grade Levels, Mental Ability, and Age. J. Ed. Psychol. 43: 486-492; 1952.

A positive relationship was found between mathematical competence and both reading level (.53) and MA (.46) for Negro girls. (grade 11; 210 girls)

Pitts, Vera L. An Investigation of the Relationships Between Two Preschool Programs on the Adjustment and Readiness of Disadvantaged Pupils. Childhd. Ed. 44: 524-525; Apr. 1968.

Length of preschool attendance was related to facilitating some dimensions of social growth, but was not related to academic or total readiness. (grade K; 87 pupils)

Prichard, Paul Newton. The Effects of Desegregation on Selected Variables in the Chapel Hill City School System. (University of North Carolina at Chapel Hill, 1969.) Dis. Abst. 30A: 3697; Mar. 1970.

White students achieved significantly higher than Negro students, but there were no significantly negative effects of desegregation for either group. Significant positive changes in mathematics achievement were found in grades 5 and 7 for Negroes and in grade 5 for whites. (grades 5, 7, 9)

Raven, Ronald J. The Development of Classification Abilities in Culturally Disadvantaged Children. J. Res. Sci. Teaching 5: 224-229; 1967-1968.

Low SES pupils scored lower than middle SES pupils on all six classification tasks at each age level. (ages 6, 8, 10; 192 pupils)

Rose, Alvin and Rose, Helen. Intelligence, Sibling Position, and Sociocultural Background as Factors in Arithmetic Performance. Arith. Teach. 8: 50-56; Feb. 1961.

Low SES children from diverse cultural backgrounds, when compared with high SES children, had a lower correlation between IQ and arithmetic grades. (grade 3; 456 pupils)

Sams, Orval J., Jr. The Ability to Conserve Volume of a Solid Among Selected Indian and Caucasian Pupils. (University of Arizona, 1969.) Dis. Abst. 30A: 1344; Oct. 1969.

No significant differences between Indian and Caucasian pupils were found on measures of conservation of volume. (grades 5, 6; 64 pupils)

Schippert, Frederick Arthur. A Comparative Study of Two Methods of Arithmetic Instruction in an Inner-City Junior High School. (Wayne State University, 1964.) Dis. Abst. 25: 5162-5163; Mar. 1965.

Use of a laboratory approach in which pupils manipulated actual models or representations of mathematical principles resulted in significantly higher achievement than for pupils taught with verbal or written descriptions of those principles. (grade 7)

Schnur, James O. A Study of the Possible Improvement of Problem Solving Ability in Migrant Children. Sch. Sci. Math. 69: 821-826; Dec. 1969.

Use of attribute blocks did not enhance a reflective learning style. (ages 4-14; 18 pupils)

Scott, Ralph and Lighthall, Frederick F. Relationship Between Content, Sex, Grade, and Degree of Disadvantage in Arithmetic Problem Solving. J. Sch. Psychol. 6: 61-67; Fall 1967.

No statistically significant relationship was found between "need content" of problems and degree of disadvantage of pupils. (grades 3, 4; 132 pupils)

Searle, Robert Eli. Mathematical Abilities Possessed by Kindergarten Children from Disadvantaged Communities. (University of California, 1968.) Dis. Abst. 29: 1735-1736; Dec. 1968.

Children from advantaged communities possessed a significantly greater amount of mathematical information than did children from disadvantaged areas. Pre-school training, sex and age influence levels of ability to manipulate quantitative relationships. (grade K; 296 pupils)

Skypek, Dora Helen. The Relationship of Socio-Economic Status to the Development of Conservation of Number. (University of Wisconsin, 1966.) Dis. Abst. 28A: 1012-1013; Sept. 1967.

The relationship of socioeconomic status to concept-test scores on discontinuous quantity and correspondence was highly significant in favor of middle-class children. The relationship of race to scores was not significant, except for one test of correspondence which favored low-status whites. (grades K-12; 121 pupils)

Smart, Margaret Ellis. The Responses of Mexican-American Socio-Economic Groups to Selected Intellectual Tasks. (University of Arizona, 1969.) Dis. Abst. 30A: 1927; Nov. 1969.

On four of six tasks (e.g., ability to conserve), there were no significant differences between children from middle and lower classes. Predictions derived from considering 12 covariates are cited. (age 6; 32 pupils)

Snipes, Walter T. Mobility on Arithmetic Achievement. Arith. Teach. 13: 43-46; Jan. 1966.

In an investigation of the relationship of number, duration and place of moves to arithmetic achievement, it was found that students from other states had higher arithmetic reasoning achievement. (grade 6; 483 pupils)

Spickerman, William R. A Study of the Relationships Between Attitudes Toward Mathematics and Some Selected Pupil Characteristics in a Kentucky High School. (University of Kentucky, 1965.) Dis. Abst. 30A: 2733; Jan. 1970.

Low SES students tended to have less favorable attitudes toward mathematics. Little relationship was found between attitude and achievement or IQ. (grades 8-12; 713 students)

Stendler, Celia Burns. Social Class Differences in Parental Attitude Toward School at Grade 1 Level. Child Develop. 22: 37-46; Mar. 1951.

As social level decreased, the percentage of parents who taught their children to count increased. (grade 1; 212 pupils)

Unkel, Esther Ruth. A Study of the Interaction of Socioeconomic Groups and Sex Factors with the Discrepancy Between Anticipated Achievement and Actual Achievement in Elementary School Mathematics. (Syracuse University, 1965.) Dis. Abst. 27A: 59; July/Aug. 1966.

Significant differences in discrepancy scores were found for children in each of three socioeconomic groups on arithmetic reasoning, fundamentals, and total test. (grades 1-9)

Unkel, Esther. A Study of the Interaction of Socioeconomic Groups and Sex Factors with the Discrepancy Between Anticipated Achievement and Actual Achievement in Elementary School Mathematics. Arith. Teach. 13: 662-670; Dec. 1966.

Socioeconomic status was a significant factor in achievement of children of comparable mental ability. Fluctuation of discrepancy scores was greatest for arithmetic reasoning. Discrepancy scores of boys and girls followed approximately the same pattern, except for grade 6 to grade 9, when girls' discrepancy scores surpassed the boys'. (grades 1-9; 918 pupils)

Weber, Audra Wheatly. Introducing Mathematics to First Grade Children: Manipulative vs Paper and Pencil. (University of California, Berkeley, 1969.) Dis. Abst. 30A: 3372-3373; Feb. 1970.

There was no significant difference between reinforcement of concepts through paper-and-pencil activities or with manipulative materials, although a trend favored the use of materials, especially for low-SES children. (grade 1; 6 classes)

Wilson, Alan B. Social Stratification and Academic Achievement. In A. H. Passow (Editor), Education in Depressed Areas. New York: Bureau of Publications, Teachers College, Columbia University, 1963. Pp. 217-235.

Pupils from a lower SES area achieved less and received lower grades than those from higher SES areas. (grade 6; 754 pupils)

Wilson, W. K. and Ashbaugh, E. J. Achievement in Rural and Consolidated Schools. Ed. Res. B. 8: 358-363; Nov. 6, 1929.

Achievement in reading and arithmetic was greater in the consolidated school. (grades 3-8; over 600 pupils)

Winzenread, Marvin Russell. Consumable Materials: A Quasi-Programmed Procedure Experimentally Tested in the Inner-City Junior High School Mathematics Classroom. (Indiana University, 1969.) Dis. Abst. 30A: 4343; Apr. 1970.

Eighth grade classes using consumable materials with a quasi-programmed teaching procedure gained significantly more than a control group only in computation and attitude. Seventh grade groups using regular textbooks gained significantly more in achievement of concepts than those using consumable materials. (grades 7, 8)

II. Academically Disadvantaged: Low Achievers

Ackerman, Arthur Peter. The Effect of Pupil Tutors on Arithmetic of Third-Grade Students. (University of Oregon, 1969.) Dis. Abst. 31A: 918; Sept. 1970.

The use of either low- or high-achieving sixth graders as tutors for low-achieving third graders resulted in significantly higher achievement scores than for those in control groups. (grades 3, 6; 42 pupils)

Aiken, Lewis R., Jr. Attitudes Toward Mathematics. R. Ed. Res. 40: 551-596; Oct. 1970.

This review includes summaries of studies of the relationship of attitude and achievement; generally, these indicate a low positive relationship. (grades K-12)

Alexander, Vincent E. Seventh Graders' Ability to Solve Problems. Sch. Sci. Math. 60: 603-606; Nov. 1960.

Some characteristic differences between high and low achievers in problem solving were analyzed. Conclusions related to mental ability, socioeconomic status, quantitative skills, reading skills, and interpretation of quantitative materials were noted, with implications for planning instruction. (grade 7)

Bassham, Harrell; Murphy, Michael; and Murphy, Katherine. Attitude and Achievement in Arithmetic. Arith. Teach. 11: 66-72; Feb. 1964.

The relationship between attitude and classification as over- or underachieving was found to be significant. (grade 6; 5 classes)

Beldin, Horace Otis. A Study of Selected Arithmetic Verbal Problem-Solving Skills Among High and Low Achieving Sixth-Grade Children. (Syracuse University, 1960.) Dis. Abst. 21: 1418; Dec. 1960.

High and low achievers differed significantly in their ability to solve problems with unnecessary data, no numbers, and missing data, but did not differ on three other types of problems. (grade 6; 224 pupils)

Birr, Donald James. The Effects of Treatments by Parents and Teachers on the Self-Concept of Ability Held by Underachieving Early Adolescent Pupils. (Michigan State University, 1969.) Dis. Abst. 30A: 1354; Oct. 1969.

No significant differences in self-concept were found between groups in which this factor was stressed to parents or teachers. There was no significant association in any group between self-concept and grade point average, but a significant correlation was found between the child's self-concept of ability and the parents' perception of the child's ability. (grades 7, 8; 90 pupils)

Burgess, Ernest Edward. A Study of the Effectiveness of the Planned Usage of Mathematical Games on the Learning of Skills and Concepts and on the Attitude Toward Mathematics and the Learning of Mathematics of Low Achieving Secondary Students. (The Florida State University, 1969.) Dis. Abst. 30A: 5333-5334; June 1970.

Regular use of mathematical games resulted in significantly different attitude scores, but no substantial relationships were found between attitude and achievement or ability, or between SES and achievement or attitude. (secondary; 488 students)

Burrow, Daniel Alfred. Summer Tutoring: An Investigation of Older Volunteer Students Tutoring Younger Students in Arithmetic Computation. (University of Maryland, 1970.) Dis. Abst. 31A: 2244; Nov. 1970.

Low-achieving pupils from grades 3, 4, and 5 who were tutored by high-achieving pupils from grades 6, 7, and 8 achieved higher gain scores on computational skills than did untutored pupils. (grades 3-8; 72 pupils)

Capps, Lelon. A Comparison of Superior Achievers and Underachievers in Arithmetic. El. Sch. J. 63: 141-145; Dec. 1962.

The high achievers did not score significantly higher than the underachievers on a personality test; however, retardation in arithmetic tended to be related to personal adjustment. Higher IQ pupils had the highest arithmetic achievement. (grades 4, 6; 188 pupils)

Cech, Joseph Philip. The Effect the Use of Desk Calculators Has on Attitude and Achievement in Ninth-Grade General Mathematics Classes. (Indiana University, 1970.) Dis. Abst. 31A: 2784; Dec. 1970.

No significant differences were found between the scores of a group of low achievers who were trained to use calculators and another group, on tests of attitude and computational skills. (grade 9; 81 students)

Chase, Clinton I. The Control of Ability to Learn in the Comparison of Extreme Groups. J. Ed. Res. 57: 495-497; May/June 1964.

The selection of groups on the basis of wide differences in achievement appeared also to result in differences between those groups on variables such as Numbers and Reasoning, which are components of intelligence tests. (grade 5; 40 pupils)

Cobb, Margaret V. The Limits Set to Educational Achievement by Limited Intelligence. J. Ed. Psychol. 13: 546-555; Dec. 1922.

Pupils who took algebra were in general more intelligent than those who did not, and those who passed algebra were in general more intelligent than those who failed. Wide ranges in median scores were reported for various geographical areas. (grade 9)

Degnan, J. A. General Anxiety and Attitudes Toward Mathematics in Achievers and Underachievers in Mathematics. Graduate Research in Education and Related Disciplines 3: 49-62; 1967.

Low achievers were generally less anxious and had less positive attitudes toward mathematics than high achievers. (grade 8; 44 pupils)

DeVenney, William S. Preliminary Report on an Experiment with Junior High School Very Low Achievers in Mathematics. SMSG Reports, No. 6. Stanford, CA: School Mathematics Study Group, 1968. 114 pp.

A program incorporating daily worksheets, partially programmed lessons, and the use of tables to aid in computation was developed with low achieving seventh and eighth graders. The materials were then used with seventh graders; students using conventional textbooks made greater gains on standardized achievement tests than did those using the experimental materials, while the latter group did significantly better on most SMSG tests and on attitude scales. (grade 7)

DeVenney, William S. Final Report on an Experiment with Junior High School Very Low Achievers in Mathematics. SMSG Reports, No. 7. Stanford, CA: School Mathematics Study Group, 1969. 53 pp.

The program described in DeVenney (1968) was studied as it was used by eighth graders. At the end of the year, students in the conventional program scored higher on a test of computational skills; no meaningful differences were found on a test of applications. The experimental group achieved significantly higher on SMSG tests, and showed a highly positive attitude toward mathematics, while the conventional group seemed more negatively oriented than they had been when entering junior high. (grade 8)

Easterday, Kenneth E. An Experiment with Low Achievers in Arithmetic. Math. Teach. 57: 462-468; Nov. 1964.

"Modern" mathematics (SMSG) and "traditional" mathematical programs were organized into a program for low achievers. Achievement made on a standardized test indicated these students made a normal increase over the school year. (grades 7, 8; 4 classes)

Faust, Claire Edward. A Study of the Relationship Between Attitude and Achievement in Selected Elementary School Subjects. (State University of Iowa, 1962.) Dis. Abst. 23: 2752-2753; Feb. 1963.

A correlation of .19 was found between attitude and arithmetic achievement scores. Many low achievers had high attitude scores. The relationship between teacher and pupil attitudes tended to be high. (grades 4-6; 2,633 pupils, 149 teachers, 302 parents)

Feinberg, Henry. Achievement of a Group of Socially Maladjusted Boys as Revealed by the Stanford Achievement Test. J. Soc. Psychol. 26: 203-212; 1947.

The boys were achieving one to two years below grade level, with achievement in arithmetic poorest. (ages 10-17; 872 pupils)

Flournoy, Frances. A Consideration of Pupils' Success with Two Methods for Placing the Decimal Point in the Quotient. Sch. Sci. Math. 59: 445-455; June 1959.

For below-average arithmetic achievers, the subtractive method was decidedly more difficult than making the divisor a whole number. (grade 6; 137 pupils)

Grossnickle, Foster E. Comparison of Achievement of Pupils Who Are Good and Poor in Learning Division with a Two-Figure Divisor. J. Ed. Res. 34: 346-351; Jan. 1941.

Good achievers made no more than five types of errors, while 18 types were listed for poor achievers. Good and poor achievers did not differ significantly in intelligence. Mean differences between good and poor achievers were significant on the first test, but after a period of drill plus diagnosis of errors, differences were not significant. On the whole, as pupils progressed from fourth to ninth grade, mean differences in marks achieved by the good and poor achievers in division decreased. (grades 4-9; 94 pupils)

Hamza, Mukhtar. Retardation in Mathematics Amongst Grammar School Pupils. Br. J. Ed. Psychol. 22: 189-195; Nov. 1952.

Significant differences were found between groups composed of (1) students achieving normally in all subjects including mathematics, and (2) students who were achieving well in all subjects except mathematics. The group that was retarded in mathematics achievement had significantly lower ability scores than those showing normal achievement. Factor analysis of the matrix of correlations revealed a general intelligence factor as primary. Secondary factors were "visual imagery," "number," and "attitude." (ages 12-14; 272 pupils)

Hansen, Carl W. Factors Associated with Successful Achievement in Problem Solving in Sixth Grade Arithmetic. J. Ed. Res. 38: 111-118; Oct. 1944.

Low achievers were significantly poorer on tests of computation, relationships, vocabulary, estimating, and analysis. (grade 6; 688 pupils)

Hervey, Margaret A. Children's Responses to Two Types of Multiplication Problems. Arith. Teach. 13: 288-292; Apr. 1966.

Cartesian product problems could be conceptualized and solved more often by high achievers than by low achievers. (grade 2; 64 pupils)

Hicks, John Simpson. Introversion and Extraversion and Their Relationship to Academic Achievement Among Emotionally Disturbed Children. (Columbia University, 1968.) Dis. Abst. 29A: 3462; Apr. 1969.

No significant relationships were found between better achievement and introversion. Low-achieving introverts tended to have low ability, super-ego strength, and assertiveness; low-achieving extroverts seemed to be very sensitive, anxious, and lacking individuality. Reading achievement was not significantly higher than arithmetic achievement. (ages 9-16; 60 pupils)

Hillman, Bill W. The Effect of Knowledge of Results and Token Reinforcement on the Arithmetic Achievement of Elementary School Children. Arith. Teach. 17: 676-682; Dec. 1970.

Pupils given per-item knowledge of results, either with or without candy reinforcement, scored significantly higher than pupils given knowledge of results 24 hours later. Low achievers may profit more than high achievers. (grade 5; 101 pupils)

Hoffman, Carl Bentley. The Relationship of Immediate Recall, Delayed Recall, and Incidental Memory to Problem-Solving Ability. (University of Pennsylvania, 1960.) Dis. Abst. 21: 813-814; Oct. 1960.

Little relationship was found between immediate or delayed recall and problem solving, for good and poor achievers in problem solving. Incidental memory was found to be related. (grade 8; 60 pupils)

Holmes, Darrell and Harvey, Lois. An Evaluation of Two Methods of Grouping. Ed. Res. B. 35: 213-222; Nov. 14, 1956.

Flexible grouping did not result in significantly greater gain for low achievers than did permanent grouping. (grades 3, 4, 6; 6 classes)

Houston, Thomas Andrew. The Relationship of Attitude and Achievement Scores to Sex, Intelligence, and Grade Level of a Selected Group of Junior High School Pupils. (Wayne State University, 1968.) Dis. Abst. 29A: 3325; Apr. 1969.

IQ and sex have a significant relationship to performance in arithmetic computation for pupils who were previously enrolled in a compensatory education program in inner city schools. (grades 7, 8; 240 pupils)

Isaacs, Ann F. A Gifted Underachiever in Arithmetic - A Case Study. Arith. Teach. 6: 257-261; Nov. 1959.

A study of a child of superior mental ability, poor attitude toward arithmetic, and low achievement was presented. Background information was used to plan instruction. (grade 6; 1 pupil)

Jacobs, James N. and Bollenbacher, Joan. Teaching Seventh Grade Mathematics by Television. Math. Teach. 53: 543-547; Nov. 1960.

Low achievers achieved equally well whether taught by television or by conventional procedures. (grade 7; 27 classes)

Jacobs, James N.; Bollenbacher, Joan; and Keiffer, Mildred. Teaching Seventh-Grade Mathematics by Television to Homogeneously Grouped Below-Average Pupils. Math. Teach. 54: 551-555; Nov. 1961.

Televised and conventional instruction were equally effective in teaching computational skills to pupils initially below the norm in achievement and grouped homogeneously. With respect to achievement in problem solving and concepts, a significant interaction between methods and teachers occurred, resulting in two significant differences favoring television and three non-significant differences. Television instruction seemed more effective when pupils are grouped homogeneously rather than heterogeneously. (grade 7; 524 pupils)

Jones, Thomas. The Effect of Modified Programmed Lectures and Mathematical Games Upon Achievement and Attitude of Ninth-Grade Low Achievers in Mathematics. Math. Teach. 61: 603-607; Oct. 1968.

Use of a modified programmed lecture approach and mathematical games resulted in significant achievement and attitude gains, with no differences found between two IQ levels (above or below 85). (grade 9; 38 students)

Kleckner, Lester Gerald. An Experimental Study of Discovery Type Teaching Strategies with Low Achievers in Basic Mathematics I. (The Pennsylvania State University, 1968.) Dis. Abst. 30A: 1075-1076; Sept. 1969.

The non-discovery classes of slow learners achieved significantly more than classes taught by discovery-type strategies in a mathematics laboratory setting. Attitude changes were also more positive for the non-discovery group. (grades 9, 10; 127 students)

Koenker, Robert H. Certain Characteristic Differences Between Excellent and Poor Achievers in Two-Figure Division. J. Ed. Res. 35: 578-586; Apr. 1942.

Excellent and poor achievers differed significantly on all 14 general and specific factors associated with ability in two-figure division. When effects of mental and chronological age were statistically controlled, differences (with the exception of three reading tests) still significantly favored the excellent achievers. (grade 6; 180 pupils)

Lewis, Bill. Underachievers Measure Up. Am. Ed. 5: 27-28; Feb. 1969.

A program involving field trips and use of calculators and other materials in a mathematics laboratory resulted in achievement gains. (grade 9; 700 students)

Madden, Joseph Vincent. An Experimental Study of Student Achievement in General Mathematics in Relation to Class Size. (Arizona State University, 1966.) Dis. Abst. 27A: 631-632; Sept./Oct. 1966.

Instruction for those in a class of 70-85 students was found to result in significantly higher achievement than for those in a class of 25-40 students, with low-ability students doing poorest. (grade 9)

Masek, Richard Martin. The Effects of Teacher Applied Social Reinforcement on Arithmetic Performance and Task-Orientation. (Utah State University, 1970.) Dis. Abst. 30A: 5345-5346; June 1970.

Significant increases in arithmetic performance and task-orientation of underachieving students were reported during periods when teachers emphasized reinforcement such as verbal praise, physical contact, and facial expression. Reduced performance rates were noted when reinforcement was withdrawn, with increased rates when reinforcement was reinstated. (grades 1, 2; 12 pupils)

Maynard, Freddy Joseph. A Comparison of Three Methods of Teaching Selected Content in Eighth and Ninth Grade General Mathematics Courses. (University of Georgia, 1969.) Dis. Abst. 30A: 5347; June 1970.

Significant differences between "discovery," "guided discovery," and expository methods were found only for girls; the "discovery" method was inferior to the other two, for units on formulas, graphs and patterns, and geometry. (grades 8, 9; 18 classes)

Maynard, Freddy J. and Strickland, James F. A Comparison of Three Methods of Teaching Selected Mathematical Content in Eighth and Ninth Grade General Mathematics Courses. USOE Cooperative Research Project 8-0-035. Athens, GA: University of Georgia, 1969.

Meadowcroft, Bruce A. Comparison of Two Methods of Using Programmed Learning. Arith. Teach. 12: 422-425; Oct. 1965.

Low achievers achieved equally well whether taught by the teacher with, or preceding and followed by, programmed instruction. (grade 7; 303 pupils)

Micklich, John Robert. An Experimental Study on the Effect of Highly-Directed Versus Non-Directed Homework Assignments on Student Achievement. (The University of New Mexico, 1969.) Dis. Abst. 30A: 5348; June 1970.

General mathematics students did not differ significantly in achievement when taught by directed or non-directed procedures. (grade 9; 304 students)

Mix, Harry Herman. An Examination of a Program Designed to Advance the Academic Progress of Underachieving Elementary School Pupils. (Columbia University, 1969.) Dis. Abst. 30A: 3642-3643; Mar. 1970.

While the arithmetic performance of normal to bright underachievers improved when special (unspecified but varied) educational approaches were provided, it was not possible to identify any specific factors which promoted the change. (grades 4-6; 60 pupils)

Morrell, James E. A Comparison of Four Methods of Instructional Teacher Feedback from Practice Worksheets in Fifth Grade Arithmetic. (Lehigh University, 1970.) Dis. Abst. 31A: 2794; Dec. 1970.

Pupils who corrected errors or who were retaught frequently missed problems, either with or without written comments, retained more than pupils who only had written comments on their practice work. High-achieving boys scored higher on the practice work than high-achieving girls, but girls were better at medium and low achievement levels. (grade 5; 75 pupils)

Otto, Wayne. Inhibitory Potential in Good and Poor Achievers. J. Ed. Psychol. 56: 200-207; Aug. 1965.

On a digit-printing task, good achievers made proportionately greater gains than poor achievers, apparently because of intrinsic motivation. (grades 4-8; 100 pupils)

Plank, Emma N. Observations on Attitudes of Young Children Toward Mathematics. Math. Teach. 43: 252-263; Oct. 1950.

Low achievement in arithmetic seemed strongly related to problems of personal adjustment. Overprotection seemed to play an important role, as did rigid demands and high expectations. (grades K-6; 20 pupils)

Powell, Marvin; O'Connor, Henry A.; and Parsley, Kenneth M., Jr. Further Investigation of Sex Differences in Achievement of Under-, Average-, and Over-Achieving Students Within Five IQ Groups in Grades Four Through Eight. J. Ed. Res. 57: 268-270; Jan. 1964.

At lower IQ levels, underachieving girls generally achieved more than underachieving boys on arithmetic tests. (grades 4-8; 3,551 pupils)

Ramharter, Hazel K. and Johnson, Harry C. Methods of Attack Used by "Good" and "Poor" Achievers in Attempting to Correct Errors in Six Types of Subtraction Involving Fractions. J. Ed. Res. 42: 586-597; Apr. 1949.

Tests were analyzed to compare "good" and "poor" achievers, chosen on the basis of number of errors made initially. The percentage of errors corrected on a repetition of the initial test, on a transfer test, and on a retention test was consistently higher for "good" achievers. Analysis of comments indicated patterns of behavior differed between the two groups. (grade 6; 10 pupils)

Ridding, L. W. An Investigation of Personality Measures Associated with Over and Under Achievement in English and Arithmetic. Br. J. Ed. Psychol. 37: 397-398; Nov. 1967.

No significant relationship was found between stability or anxiety and over- or underachievement. Extraversion was correlated with over-achievement, and introversion with underachievement. (age 12; 600 pupils)

Ross, Ramon Royal. A Case Study Description of Underachievers in Arithmetic. (University of Oregon, 1962.) Dis. Abst. 22: 2294; Jan. 1962.

Ross, Ramon. A Description of Twenty Arithmetic Underachievers. Arith. Teach. 11: 235-241; Apr. 1964.

To measure various dimensions of behavior among underachievers of average or above average IQ, a battery of tests, interviews, check-lists, and screening devices was used. Students evidenced satisfactory reasoning in word problems involving addition and subtraction, but made frequent errors with others. They characteristically were withdrawn and defeated in attitudes toward school and society. Sixty-three per cent of the causes of underachievement seemed emotional in nature. Parents tended to be of lower SES, and many held teachers responsible for the child's inadequacies. (grades 6, 7; 20 pupils)

Schacht, Elmer James. A Study of the Mathematical Errors of Low Achievers in Elementary School Mathematics. (Wayne State University, 1966.) Dis. Abst. 28A: 920-921; Sept. 1967.

A consistent pattern of errors in six areas (interpretation of pictures and diagrams, complex questions, numerals and number systems, measurement, fraction concepts, and geometry) was found among all low achievers studied, with less difficulty occurring with fundamentals than with concepts involving reasoning. (grade 6; 83 pupils)

Schilling, Frank Charles. A Description of the Development and Implementation of a Curriculum-Materials Package for Teaching Mathematics to Low Achievers. (University of Pittsburgh, 1969.) Dis. Abst. 30A: 1925-1926; Nov. 1969.

"A Systems Approach on Improving Mathematics Instruction" (SAM) was described, with favorable teacher reactions noted. (grade 4; 18 schools)

Scott, Allen Wayne. An Evaluation of Prescriptive Teaching of Seventh-Grade Arithmetic. (North Texas State University, 1969.) Dis. Abst. 30A: 4696; May 1970.

Underachievers using programmed materials appropriate to meet diagnosed needs made a significantly greater gain in computation scores than did students in the regular classroom. Differences on concepts and applications were not significant. (grade 7; 50 pupils)

Shapiro, Esther Winkler. Attitudes Toward Arithmetic Among Public School Children in the Intermediate Grades. (University of Denver, 1961.) Dis. Abst. 22: 3927-3928; May 1962.

No significant changes in attitude were found from grades 4 through 6 for the total group and for boys. Fifth grade girls disliked arithmetic more than girls in grades 4 or 6. Those liking arithmetic had higher achievement and IQ scores. (grades 4-6; 90 pupils)

Sherer, Margaret Turner. An Investigation of Remedial Procedures in Teaching Elementary School Mathematics to Low Achievers. (The University of Tennessee, 1967.) Dis. Abst. 28A: 4031-4032; Apr. 1968.

Pupils taught by author-developed materials, using instructional aids such as drawings, counters, and number lines and charts, showed significantly greater gain in arithmetic achievement than those taught by a traditional procedure. Tutors had a more favorable attitude toward arithmetic by special method. (grades 3-7; 47 pupils)

Snellgrove, John Louis. A Study of Relationships Between Certain Personal and Socio-Economic Factors and Underachievement. (University of Alabama, 1960.) Dis. Abst. 21: 1859; Jan. 1961.

Among other findings, there was a positive relationship between grades of underachievers and motivation in mathematics. Personality maladjustment decreased between grades 7 and 12. (grades 7-12; 196 pupils)

Stiglmeier, John Joseph. A Longitudinal Study of Growth and Achievement of Academically-Talented and Non-Academically-Talented Public Elementary School Children in Three Basic Skill Areas. (Fordham University, 1964.) Dis. Abst. 25: 1761; Sept. 1964.

The achievement of non-academically-talented pupils in regular classes was significantly lower than that of academically-talented pupils. (grades 3, 4; 315 pupils)

Strickland, James Fisher, Jr. A Comparison of Three Methods of Teaching Selected Content in General Mathematics. (University of Georgia, 1968.) Dis. Abst. 29A: 4392; June 1969.

No significant differences were found between "discovery," "guided discovery," and expository methods for students average and low in achievement and IQ. (grades 8, 9; 18 classes)

Tamkin, Arthur S. A Survey of Educational Disability in Emotionally Disturbed Children. J. Ed. Res. 54: 67-69; Oct. 1960. (duplicate: J. Ed. Res. 53: 313-315; Apr. 1960.

Arithmetic scores were found to be significantly lower than reading scores. Thirty-two per cent demonstrated some degree of educational disability, 27 per cent were at grade level, and 41 per cent were advanced. (age 9; 34 pupils)

Tanner, Glenda Lou. A Comparative Study of the Efficacy of Programed Instruction with Seventh Grade Low Achievers in Arithmetic. (University of Georgia, 1965.) Dis. Abst. 26: 6458-6459; May 1966.

No significant difference was found in gains in arithmetic fundamentals made by groups taught by programed instruction or conventional procedures, while conventional groups made greater gains in arithmetic reasoning and problems. Students liked programed instruction better than regular instruction, but liked it better during the first month than during the last month. (grade 7; 179 pupils)

Traweek, Melvin W. The Relationship Between Certain Personality Variables and Achievement Through Programmed Instruction. Calif. J. Ed. Res. 15: 215-220; Nov. 1964.

Programmed instruction appeared to be a promising method of teaching those students whose personality test reports indicated poorer adjustment. Successful students reported more tendencies to be test-anxious than did unsuccessful students; unsuccessful students scored significantly higher on subtests indicating greater withdrawal tendencies and less self-reliance. No significant differences were found for general anxiety, nervous symptoms, or IQ. (grade 4; 186 pupils)

Weiss, Sol. What Mathematics Shall We Teach the Low Achiever? Math. Teach. 62: 571-575; Nov. 1969.

Leading mathematics educators rated 47 possible topics for inclusion in a program for low achievers. Only "vectors," "linear programming," and "truth tables" were rejected. A division of opinion on "social arithmetic" was evident. (junior high; 155 educators)

III. Academically Disadvantaged: Remediation

Bemis, Eaton O. and Trow, William Clark. Remedial Arithmetic After Two Years. J. Ed. Res. 35: 443-452; Feb. 1942.

Pupils achieved an average gain of nine months after a semester of remedial instruction. When 12 pupils were compared after a two-year period with a group given no remedial instruction, the instructed group had gained five months more than the non-instructed group. Individual variations made interpretation difficult, but it appeared that the remedial work definitely helped the lower intelligence pupils. (grade 6; 24 pupils)

Bernstein, Allen L. A Study of Remedial Arithmetic Conducted with Ninth Grade Students. (Wayne University, 1955.) Dis. Abst. 15: 1567-1568; 1955.

Bernstein, Allen. A Study of Remedial Arithmetic Conducted with Ninth Grade Students. Sch. Sci. Math. 56: 25-31; Jan. 1956.

A diagnostic checklist of 45 items was developed from a previously administered test. Coding of the diagnostic items on report cards (to check interrelationships) resulted in 78 relationships: 42 were significant. (grade 9; 326 students)

Bernstein, Allen. A Study of Remedial Arithmetic Conducted with Ninth Grade Students. Sch. Sci. Math. 56: 429-437; June 1956.

Special practice material based on diagnosis of individual student error produced significant gain in achievement. During the second phase of the study, students needing remedial instruction attended a mathematics clinic for one semester of individualized instruction. (grade 9; 103 students)

Bernstein, Allen. Library Research - A Study in Remedial Arithmetic. Sch. Sci. Math. 59: 185-195; Mar. 1959.

The author reports common themes found upon reviewing selected articles on remedial arithmetic. The studies reported on are grouped in three areas: remedial teaching projects, error diagnosis study, and studies in learning theory.

Brownell, W. A. Remedial Cases in Arithmetic. Peabody J. Ed. 7: 100-107; Sept. 1929.

Data from Gabbert (1929), Evans (1930), Trousdale (1930) and Whitson (1930) are summarized. (grades 3, 4; 4 pupils)

Burton, F. H. Remedial Arithmetic. Texas Outlook 30: 28-30; Jan. 1946.

Remedial work on the fundamental operations and percentage resulted in significant gains. (grades 9-12; 226 students)

Callahan, Leroy. Remedial Work with Underachieving Children. Arith. Teach. 9: 138-140; Mar. 1962.

A trend toward increased underachievement seemed to have been reversed by an individual diagnostic and remedial program. (grade 8; 20 pupils)

Cooke, Dennis H. Diagnostic and Remedial Treatment in Arithmetic. Peabody J. Ed. I. 9: 143-151; Nov. 1931; II. 10: 167-171; Nov. 1932.

Pupils given remedial treatment decreased in total number of errors. Eight months later, it was found that 16 per cent of the errors had recurred; 13 per cent had never been eliminated; while 71 per cent were eliminated permanently. (grade 5; 5 pupils)

Crawford, Alan N. A Pilot Study of Computer-Assisted Drill and Practice in Seventh Grade Remedial Mathematics. Calif. J. Ed. Res. 21: 170-181; Sept. 1970.

Underachieving, disadvantaged pupils who had 3-15 minutes per day of extra computational practice gained significantly; however, scores were not significantly different from those with no extra practice. (grade 7; 2 classes)

Evans, Roy. Remedial Cases in Arithmetic, Case 2. Peabody J. Ed. 7: 208-217; Jan. 1930.

Errors which the pupil made were cited, and procedures used to improve his achievement were presented. He made an overall gain of 1-2 years on the test. (grade 4; 1 pupil)

Gabbert, M. L. Remedial Cases in Arithmetic, Case 1. Peabody J. Ed. 7: 147-155; Nov. 1929.

Specific difficulties were noted, and remedial procedures were presented in some detail. The pupil made a gain of two years on the test. He worked faster, with no loss in accuracy. (grade 4; 1 pupil)

Gilmary, Sister. Transfer Effects of Reading Remediation to Arithmetic Computation When Intelligence Is Controlled and All Other School Factors Are Eliminated. Arith. Teach. 14: 17-20; Jan. 1967.

Pupils receiving remedial help in both arithmetic and reading showed significantly greater gain in arithmetic computation than those who received help in arithmetic only. (elementary; 60 pupils)

Guiler, Walter Scribner. Improving Computational Ability. El. Sch. J. 30: 111-116; Oct. 1929.

Pupils achieving below grade level gained when remedial work on fundamental was given following diagnosis. (grade 7; 10 pupils)

Guiler, W. S. and Edwards, Vernon. An Experimental Study of Methods of Instruction in Computational Arithmetic. El. Sch. J. 43: 353-360; Feb. 1943.

Diagnosis and individualized group instruction for needs of pupils resulted in greater gain than for pupils who did not have such help. (grades 7, 8; 412 pupils)

Higgins, Conwell and Rusch, Reuben. Remedial Teaching of Multiplication and Division: Programmed Textbook Versus Workbook - A Pilot Study. Arith. Teach. 12: 32-38; Jan. 1965.

The low-SES group using programmed texts did not achieve more than a low-SES group using workbooks. (grades 5, 6; 78 pupils)

Holinger, Dorothy. Helping the Non-Learner in Grade 1. Arith. Teach. 5: 15-24; Feb. 1958.

The procedures used with a child who had no understanding or retention in arithmetic at grade 1.5 were explained in some detail. Stress was placed on meaning, concrete materials, and use. (grade 1; 1 pupil)

Mary Jacqueline (Sister). An Experiment in Remedial Teaching in Arithmetic. El. Sch. J. 41: 748-755; June 1941.

Pupils who were given remedial help in arithmetic showed achievement gains in all except three cases. (grade 7; 11 pupils)

McMaster, Dale. Case Studies of Failing Pupils in Seventh Year Reading and Arithmetic. Pittsburgh U. Sch. Ed. J. 5: 39-46; Dec. 1929.

Comparative interpretations of the arithmetic tests were not possible because of absence of grade norms, but it was noted that total scores on the initial test ranged from 7 to 47 per cent; improvement was noted on the final test, after remedial treatment. (grade 7; 27 pupils)

Nutting, Sue Ellis and Pikaart, Len. A Comparative Study of the Efficiency of the Flash-Math Program with Second and Fourth Graders. Practical Paper No. 7. Athens, GA: Research and Development Center in Education Stimulation, University of Georgia, 1969.

Otto, H. J. Remedial Instruction in Arithmetic. El. Sch. J. 28: 124-133; Oct. 1927. (see: Otto, J. NEA 17: 87-89; Mar. 1928.)

Improvement in rate and accuracy resulted from diagnostic and remedial treatment, with retention after pupils returned to their regular room. (grade 4; 9 pupils)

Pieters, Gerald Ross. Pictorial Rote Learning as a Predictor of Remedial Academic Criteria. (Southern Illinois University, 1968.) Dis. Abst. 29B: 3123; Feb. 1969.

While order and pacing were found to be significant effects, and type of (rote) learning was not significant in predicting achievement in English and mathematics, use of pictorial rote learning tests did not appear promising. (secondary; 75 students)

Randall, Joseph H. Corrective Arithmetic in Junior High School. Ed. Meth. 16: 182-185; Jan. 1937.

Pupils with higher than average intelligence were able to correct faults in factual knowledge and process skills of addition of whole number and decimals, with motivated individual remedial work. (grade 8; 8 pupils)

Shaw, Carl Neil. Effects of Three Instructional Strategems on Achievement in a Remedial Arithmetic Program. (The Florida State University, 1968.) Dis. Abst. 29A: 1479-1480; Nov. 1968.

Three drill strategies, which varied on immediacy of feedback, all resulted in significant gain scores. All, including a control group, had significantly higher scores on the retention test. (junior high)

Smith, James H. Individual Variations in Arithmetic. El. Sch. J. 17: 195-200; Nov. 1916.

Median scores in grade 5 increased 94 per cent when class drill with individual assistance was used. In grade 7, extra drill for slow pupils resulted in an increase of 78 per cent. In grade 6, class drill with class assistance resulted in an increase of 73 per cent. (grades 5-7; 88 pupils)

Soth, M. R. A Study of a Pupil Retarded in Arithmetic. El. Sch. J. 29: 439-442; Feb. 1929.

An account of procedures used to aid a child in increasing arithmetic achievement was presented. (grade 7; 1 pupil)

Trousdale, Mattie S. Remedial Cases in Arithmetic, Case 3. Peabody J. Ed. 7: 290-298; Mar. 1930.

Specific errors made by the pupil were cited, and procedures used to help him were discussed. A gain of 2 1/2 years resulted. (grade 4; 1 pupil)

Whitson, Willie E. Remedial Cases in Arithmetic, Case 4. Peabody J. Ed. 7: 362-372; May 1930.

Initial achievement, types of errors, and procedures used in remedial instruction were cited. The pupil increased his score on the arithmetic test by 1 year 3 months, and decreased in number and types of errors. (grade 3; 1 pupil)

IV. Academically Disadvantaged: Slow Learners

Balow, Bruce and Curtin, James. Ability Grouping of Bright Pupils. El. Sch. J. 66: 321-326; Mar. 1966.

Homogeneity of achievement was not evident when achievement scores were compared by IQ levels. (grade 3; 150 pupils)

Balow, Irving H. and Ruddell, Arden K. The Effects of Three Types of Grouping on Achievement. Calif. J. Ed. Res. 14: 108-117; May 1963.

Grouping children homogeneously by IQ or in clusters did not result in significant differences in achievement. (grade 6; 6 classes)

Beamer, Robert Harlan. Transfer After Training with Single vs. Multiple Tasks by Individuals and Pairs of Low and High Ability Fifth Graders. (Illinois State University, 1970.) Dis. Abst. 31A: 2730; Dec. 1970.

Students who worked in pairs to multiply fractions achieved more when a single method was taught, while those who worked individually achieved more when three or five methods were used. (No findings related to ability were presented, except for the statement that intelligence was significant.) (grade 5; 96 pupils)

Bowman, Herbert Lloyd. Reported Preference and Performance in Problem Solving According to Intelligence Groups. J. Ed. Res. 25: 295-299; Apr./May 1932.

Pupils of lower intelligence preferred problems involving little or no complex situations or descriptive analysis. Pupils of higher intelligence tended to report no distinct preference as to type. Problems dealing with child life activities were consistently well-liked, as was computation only. (junior high; 413 pupils)

Brown, Andrew W. and Lind, Christine. School Achievement in Relation to Mental Age - A Comparative Study. J. Ed. Psychol. 22: 561-576; Nov. 1931.

It was found that the lower the intelligence, the higher the achievement in relation to the mental age. This was found with both retarded children and those with average and above average intelligence. (MA 4-6)

Burkhart, Lewis Leland. A Study of Two Modern Approaches to the Development of Understanding and Skills in Division of Whole Numbers. (Case Western Reserve University, 1967.) Dis. Abst. 28A: 3877; Apr. 1968.

For low IQ pupils, the multiplicative approach resulted in higher achievement than did the subtractive approach. (grade 4)

Caporale, Josephine. An Associated Subjects Program for the Slow Learner. (University of Pennsylvania, 1952.)

Check, John Felix. A Study of Retention of Arithmetic Learning with Children of Low, Average, and High Intelligence at 127 Months of Age. (The University of Wisconsin, 1959.) Dis. Abst. 20: 955-956; Sept. 1959.

Retention was the same for children of low, average, and high intelligence when the original task for each child was graded to his achievement level. (age 10; 120 pupils)

D'Augustine, Charles H. Topics in Geometry and Point Set Topology--A Pilot Study. Arith. Teach. 11: 407-412; Oct. 1964.

Low IQ pupils had limited success on a geometry-topology test. (grade 6; 26 pupils)

Eagle, Edwin. The Relationship of Certain Reading Abilities to Success in Mathematics. Math. Teach. 41: 175-179; 1948.

Reading comprehension was found to be associated with success in mathematics, but largely associated with mental age. The relationship of reading speed was variable; for students with low MA and low reading comprehension, slower readers tended to be poorer in mathematics, while for those with average MA and comprehension, slow readers tended to excel in mathematics. Mathematics vocabulary, interpreting graphs, and formulas, and data organization were important to mathematics success. Use of materials and models was suggested. (grade 9)

Erickson, Leland H. Certain Ability Factors and Their Affect on Arithmetic Achievement. Arith. Teach. 5: 287-293; Dec. 1958.

Correlations between IQ and arithmetic scores were approximately .7 for the entire sample, but decreased as IQ level decreased. (grade 6; 269 pupils)

Feldhusen, John; Check, John; and Klausmeier, Herbert J. Achievement in Subtraction. El. Sch. J. 61: 322-327; Mar. 1961.

Low IQ children could perform tasks ranging from examples with minuends of 6, to two-digit minuends and borrowing (Levels 1-6). Eighty-three per cent of those with average IQ's were at Level 13, while 65 per cent of the high IQ group were at Level 18. (grade 5; 120 pupils)

Feldhusen, John F. and Klausmeier, Herbert J. Achievement in Counting and Addition. El. Sch. J. 59: 388-393; Apr. 1959.

Low IQ children could count by 2's, with a few able to count by 1's or 3's; the range was less than for those with higher IQ's. (grade 4; 120 pupils)

Feldhusen, John and Klausmeier, Herbert J. Anxiety, Intelligence, and Achievement in Children of Low, Average and High Intelligence. Child Develop. 33: 403-409; 1962.

Significantly greater mean anxiety was found in the low IQ group than in the average or high groups. Significant correlations were found between anxiety and arithmetic achievement only in the low IQ group. (grade 5; 120 pupils)

Gibney, Thomas C. Multiplication for the Slow Learner. Arith. Teach. 9: 74-76; Feb. 1962.

No significant differences in achievement were found between slow learners who had or did not have a set of eight lessons reviewing multiplications, but those who had the review lessons scored significantly higher on a retention test. (grade 7)

Goodnow, Jacqueline J. and Bethon, Gloria. Piaget's Tasks: The Effects of Schooling and Intelligence. Child Develop. 37: 573-582; Sept. 1966.

Previous data from unschooled Hong Kong children and data for U.S. school children matched on MA and CA were combined to investigate the effects of schooling and IQ on Piaget's tasks. Lack of schooling did not seem to affect conservation tasks but did seem to affect combinatorial reasoning. Among school children, all tasks seemed to show a relation to MA. (grades 4, 5)

Grafft, William D. and Ruddell, Arden K. Cognitive Outcomes of the SMSG Mathematics Program in Grades 4, 5, and 6. Arith. Teach. 15: 161-165; Feb. 1968.

Differences between groups at low IQ and arithmetic achievement levels who were using SMSG or conventional materials were not significant, as they were for higher-level groups. (grade 6; 482 pupils)

Grant, Albert. An Analysis of the Number Knowledge of First-Grade Pupils According to Levels of Intelligence. J. Exp. Ed. 7: 63-66; Sept. 1938.

While a smaller portion of the low IQ pupils achieved specified number tasks, there were average and high IQ pupils who also could not complete the tasks. (grade 1; 563 pupils)

Harrison, Morris Glenn. A Study to Determine the Effectiveness of Student Tutors in Promoting Achievement Gain with Slow-Learning Students in Related Math I. (Texas Technological College, 1968.) Dis. Abst. 29A: 3324-3325; Apr. 1969.

The gain for the tutored group for the first ten hours of instruction was significantly higher than that of the non-tutored group, but the latter exceeded the tutored group slightly in total gain over the entire 50-hour experiment. (secondary; 66 students)

Hatch, Ronald LaVern. A Comparison of Slow Learners of Low and Middle Socioeconomic Status on Academic Achievement, Self Concepts, and Intelligence Test Scores. (Syracuse University, 1970.) Dis. Abst. 31A: 2761; Dec. 1970.

No significant differences were found between slow learners of low and middle SES on arithmetic achievement tests. (grade 6; 65 pupils)

Herriot, Sarah T. The Slow Learner Project: The Secondary School "Slow Learner" in Mathematics. SMSG Reports, No. 5. Stanford, CA: School Mathematics Study Group, 1967. 164 pp.

It was concluded that slow learners showed a greater gain in achievement in the "new" mathematics when a "modified modern" text was studied and when the pace of instruction was less rapid. (grades 7, 9)

Herriot, Sarah Florence Tribble. The Secondary School "Slow-Learner" in Mathematics. (Stanford University, 1967.) Dis. Abst. 28A: 3072-3073; Feb. 1968.

When pupils classified as slow learners studied material for two years, they achieved a greater gain than a higher ability control group achieved in one year. Thus the pace of instruction affects the achievement scores of slow learners. (grades 7, 9)

Holowinsky, Ivan. The Relationship Between Intelligence (80-110 IQ) and Achievement in Basic Educational Skills. Training Sch. B. 58: 14-22; Feb. 1961.

Correlations of .30 were found between IQ and arithmetic achievement. Students of low IQ tended to show better achievement in arithmetic than in reading. (ages 12-17; 375 pupils)

Jarvis, Oscar. An Analysis of Individual Differences in Arithmetic. Arith. Teach. 11: 471-473; Nov. 1964.

Low IQ children showed a range of seven years in arithmetic achievement, with 37 per cent above grade level, 14 per cent at, and 49 per cent below. The range for those with average was five years; for high IQ, four years. (grade 6; 713 pupils)

Jerome, (Sister) Agnes. A Study of Twenty Slow Learners. J. Ed. Res. 53: 23-27; Sept. 1959.

A relationship between retardation and low intelligence and between retardation and "tool" subjects was found. Twelve pupils were very low in total adjustment. (grades 3-8; 20 pupils)

Jones, Daisy Marvel. An Experiment in Adaptation to Individual Differences. J. Ed. Psychol. 39: 257-272; May 1948.

Children with low IQ using materials at individual levels of difficulty made significantly greater gains than those using regular grade-level materials. (grade 4; 38 pupils)

Keislar, Evan R. and Stern, Carolyn. Differentiated Instruction in Problem Solving for Children of Different Mental Ability Levels. J. Ed. Psychol. 61: 445-450; Dec. 1970.

Children in the high-MA group who were taught a complex strategy ("hypothesis testing") were superior to those taught a simple strategy ("gambler's"); the reverse was true with the low-MA group. (grades 2, 3; 82 pupils)

Klausmeier, Herbert J. Gear Learning Activities to Achievement Level of Students. Wisc. J. Ed. 96: 28-29; Feb. 1964.

Children with low IQ's got as high a percentage correct of problems at their own difficulty level as children with higher IQ's did at problems at their own level. (grade 5; 120 pupils)

Klausmeier, Herbert. Improving Problem Solving. Wisc. J. Ed. 96: 15-16; Mar. 1964.

The low IQ group was highest in non-persistence and use of a random approach to problem solving.

Klausmeier, Herbert J. and Check, John. Retention and Transfer in Children of Low, Average, and High Intelligence. J. Ed. Res. 55: 319-322; Apr. 1962.

Differences among three IQ groups solving problems at their own level of difficulty were not significant on measures of either retention or transfer, either five minutes or seven weeks later. It was concluded that when children of low, average, and high intelligence receive learning tasks appropriately graded to their levels of achievement, they retain and transfer equally well to new situations of appropriate difficulty. (grade 5; 120 pupils)

Klausmeier, Herbert J. and Feldhusen, John F. Retention in Arithmetic Among Children of Low, Average, and High Intelligence at 117 Months of Age. J. Ed. Psychol. 50: 88-92; Apr. 1959.

Levels of difficulty for counting and addition tasks were established, and each child taught on its own level. Retention was found to be the same for all IQ levels when the task is at each learner's achievement level. (age 9; 120 pupils)

Klausmeier, Herbert J. and Loughlin, Leo J. Behaviors During Problem Solving Among Children of Low, Average, and High Intelligence. J. Ed. Psychol. 52: 148-152; June 1961.

High IQ children showed a greater incidence than those with average and low IQ, and those with average IQ a greater incidence than those with low IQ, to note and correct mistakes independently, verify solutions, and use a logical approach. The high IQ children were superior to low IQ children in efficiency of method. Differences in performances among individuals within IQ groups were also large. (grade 5; 120 pupils)

Koontz, William F. A Study of Achievement as a Function of Homogeneous Grouping. J. Exp. Ed. 30: 249-253; Dec. 1961.

Low achievers in heterogeneous groups achieved more than low achievers grouped homogeneously and given materials on an appropriate level. (grade 4; 192 pupils)

Krich, Percy. Meaningful vs. Mechanical Method, Teaching Division of Fractions by Fractions. Sch. Sci. Math. 64: 697-708; Nov. 1964.

No significant differences were found between low IQ groups taught meaningfully and mechanically. (grade 6; 144 pupils)

Krulik, S. The Use of Concepts in Mathematics New in Teaching the Slow Learner. (Teachers College, Columbia University, 1961.)

Lerch, Harold H. and Kelly, Francis J. A Mathematics Program for Slow Learners at the Junior High Level. Arith. Teach. 13: 232-236; Mar. 1966.

A program, in which intra-class grouping and a topical approach adjusted to individual needs were used, resulted in higher achievement than that attained in a "regular" program. (grade 7; 74 pupils)

Liederman, Gloria F. Mental Development and Learning of Mathematics in Slow-Learning Children. In Report of the Conference on Mathematics Education for Below Average Achievers. Stanford, CA: School Mathematics Study Group, 1964. Pp. 45-66.

Research on slow-learners was summarized; it was concluded that they are deficient in verbal and problem-solving ability and are more likely to come from families of culturally deprived groups.

Lyda, W. J. Direct, Practical Experiences in Mathematics and Success in Solving Realistic Verbal "Reasoning" Problems in Arithmetic. Math. Teach. 40: 166-167; Apr. 1947.

Direct experiences related to "reasoning" problems led to success involving such problems, especially as intelligence level decreased. (grade 7)

MacPherson, Eric Duncan. Some Correlates of Anxiety in Learning Programmed Mathematics. (Washington State University, 1966.) Dis. Abst. 27A: 2948; Mar./Apr. 1967.

There was a high negative correlation, probably greatest for low IQ students, between anxiety and time to complete a program on the language of sets. A low but significant relationship was found between IQ and learning at the lowest taxonomic level, and a higher relationship at other levels. (secondary; 84 students)

Mallory, U. S. The Relative Difficulty of Certain Topics in Mathematics for Slow-Moving Ninth Grade Pupils. New York: Bureau of Publications, Teachers College, Columbia University, 1939.

McHugh, Walter Joseph. Pupil Team Learning in Skills Subjects in Intermediate Grades. (Boston University, 1960.) Dis. Abst. 21: 1460-1461; Dec. 1960.

A differentiated instruction program involving team progress techniques, team discussions, team study guides, varied grouping, and individual activities resulted in significant improvement in arithmetic in grades 5 and 6 at all IQ levels, with improvement greater in problem solving than in computation. (grades 4-6; 35 classes)

Miller, G. H. How Effective is the Meaning Method? Arith. Teach. 4: 45-49; Mar. 1957.

Methods emphasizing "meaning" were less effective than methods emphasizing "rules" for bilingual pupils with low IQ's.

Newmark, Gerald. The Relationship Between Student Characteristics and Work Rate and Between Work Rate and Performance in Programmed Instruction with Two Different Subject Matter Fields. (University of Southern California, 1970.) Dis. Abst. 31A: 1146; Sept. 1970.

Work rates varied considerably within IQ groups, with no significant differences in achievement between low IQ pupils who worked fast and those who worked slowly. (grade 8; 118 pupils)

Nicholls, R. H. Programming Piaget in Practice. Teach. Arith.: Br. Elem. Math. J. 1: 24-38; Autumn 1963.

There is wide variability among slow learners in attainment of developmental characteristics, such as conservation of number. (ages 10-11; 24 pupils)

Nix, George Carol. An Experimental Study of Individualized Instruction in General Mathematics. (Auburn University, 1969.) Dis. Abst. 30A: 3367-3368; Feb. 1970.

Students with low IQ, those with average mathematics ability, and boys achieved significantly more under individualized instruction than under group-oriented instruction. (grade 8; 6 classes)

Rheins, Gladys B. and Rheins, Joel J. A Comparison of Two Methods of Compound Subtraction. Arith. Teach. 2: 63-69; Oct. 1955.

For the less intelligent group, the decomposition method was significantly more accurate; no significant differences were found between decomposition and equal additions methods for the more intelligent group. (grade 8; 70 pupils)

Savard, William G. An Evaluation of an Ability Grouping Program. Calif. J. Ed. Res. 11: 56-60; Mar. 1960.

Limited-range grouping was more effective at lower IQ levels. (grades 4-8; 1,200 pupils)

Schane, Evelyn Bessie. Characteristic Errors in Common Fractions at Different Levels of Intelligence. Pittsburgh Sch. 12: 155-168; Mar. 1938.

Errors made by pupils at three IQ levels were presented. Variance was greater in number of errors than in type of error. (grades 6-8; 274 pupils)

Schmitt, Clara. Extreme Retardation in Arithmetic. El. Sch. J. 21: 528-547; Mar. 1921.

Information about 34 children was presented and discussed. Additional cases were cited which led to a conclusion that retardation in arithmetic was often caused by defects in the educational process, rather than by mental defects. (grades 3-8; 34 pupils)

Sowder, Larry. Discovery Learning: A Status Study, Grades 4-7, and an Examination of the Influence of Verbalizing Mode on Retention. Technical Report No. 99, Wisconsin Research and Development Center for Cognitive Learning. Madison, WI: The University of Wisconsin, 1969. 140 pp.

Sowder, Larry. Performance on Some Discovery Tasks in Grades 4-7. Paper presented at 48th Annual Meeting, National Council of Teachers of Mathematics, 1970. In Science and Math Education Information Report. Columbus, OH: SMAC/Science and Mathematics Education Information Analysis Center, Apr. 1970. Pp. 41-43.

Sowder, Larry Kenneth. Discovery Learning: A Status Study, Grades 4-7, and an Examination of the Influence of Verbalizing Mode on Retention. (The University of Wisconsin, 1969.) Dis. Abst. 31A: 86-87; July 1970.

Most pupils could form generalizations in the selected numerical situations, although pupils of lower IQ required more instances. The optimal grade level at which to offer generalizing tasks appears to be grade 6 or after. (grades 4-7; 72 pupils)

Stewart, Norman Alton. An Exploratory Study of the Relationship of Length of Time Spent in Special Classes and Selected Aspects of Personality, Behavior, and Academic Achievement of Slow Learning Children. (Case Western Reserve University, 1968.) Dis. Abst. 30A: 3803-3804; Mar. 1970.

Of 27 traits, only two (not including arithmetic achievement) were found to be related to length of time spent in special classes. There was some indication that early placement may adversely affect girls' arithmetic achievement. (secondary; 142 students)

Stone, Beth F. and Rawley, Vinton N. Educational Disability in Emotionally Disturbed Children. J. Excep. Child. 30: 423-426; May 1964.

The mean difference between CA and grade rating in arithmetic was found to be 7.21, and mean difference between MA and grade rating in arithmetic was found to be 6.69, suggesting that achievement is not commensurate with CA or MA for emotionally disturbed pupils. They had lower arithmetic scores than reading scores. (age 12; 116 pupils)

Suppes, Patrick and Morningstar, Mona. Computer-Assisted Instruction: The 1966-67 Stanford Arithmetic Program. New York: Academic Press, 1969.

A CAI tutorial mathematics program for grades 1 and 2 had a statistically significant positive effect only for slow learners in grade 1, in comparison with regular classroom instruction. It was not more successful than a CAI drill-and-practice program for low-ability students. (grades 1, 2)

VanderLinde, Louis F. Does the Study of Quantitative Vocabulary Improve Problem-Solving? El. Sch. J. 65: 143-152; Dec. 1964.

Teaching quantitative vocabulary directly was less effective for low IQ pupils than for those with higher IQ's. (grade 5; 394 pupils)

Van Engen, Henry and Gibb, E. Glenadine. General Mental Functions Associated with Division. Educational Service Studies, No. 2. Cedar Falls, IA: Iowa State Teachers College, 1956.

Low IQ pupils learned the subtractive and distributive algorithms for division equally well, but had less difficulty understanding the subtractive method. (grade 4; 12 classes)

Wilson, John W. The Role of Structure in Verbal Problem Solving. Arith. Teach. 14: 486-497; Oct. 1967.

Pupils with low MA achieved more success (as did pupils with higher MA) when using the wanted-given techniques of solving problems than when using the (presumably less abstract) action-sequence technique. (grade 4; 80 pupils)

Young, James Clark. An Evaluation of a Pontoon Transitional Design - Ninth Grade Low Ability Level Students. (University of Southern California, 1969.) Dis. Abst. 30A: 1931; Nov. 1969.

No significant differences were found between groups taught by a "pontoon-traditional" design or a traditional program, on either achievement or attitude measures. Girls in both groups scored significantly higher on mathematics posttests than did boys. (grade 9)

V. Academically Disadvantaged: Mentally Retarded

Blackman, Leonard S. and Capobianco, Rudolph J. An Evaluation of Programmed Instruction with the Mentally Retarded Using Teaching Machines. Am. J. Ment. Def. 70: 262-269; Sept. 1965.

A group taught on teaching machines did not gain significantly more on standardized tests than a group taught by conventional methods, although both groups gained significantly. On an experimenter-developed test, the group taught on teaching machines gained significantly more. A long-term retention test showed no significant differences, although for shorter retention intervals scores differed. Behavior change was significant for the machine-taught group. (age 14; 36 pupils)

Boersma, Frederic; Wilton, Keri; Barham, Richard; and Muir, Walter. Effects of Arithmetic Problem Difficulty on Pupillary Dilation in Normals and Educable Retardates. J. Exp. Child Psychol. 9: 142-155; Apr. 1970.

Mean change in dilation increased as a function of difficulty; significant differences were observed as a function of time. (ages 10, 11; 20 pupils)

Bonfield, John Ronald. Predictors of Achievement for Educable Mentally Retarded Children. (The Pennsylvania State University, 1968.) Dis. Abst. 30A: 1009; Sept. 1969.

Specifically designated subtests of standardized tests did not predict achievement in mathematics with high validity. (ages 6-12)

Callahan, John J. and Jacobson, Ruth S. An Experiment with Retarded Children and Cuisenaire Rods. Arith. Teach. 14: 10-13; Jan. 1967.

Use of Cuisenaire rods increased knowledge and understanding of number facts and properties. (ages 7-10; 1 class)

Capobianco, Rudolph Joseph. A Comparative Study of Endogenous and Exogenous Mentally Handicapped Boys on Arithmetic Achievement. (University of Illinois, 1954.) Dis. Abst. 14: 794-795; 1954.

It was concluded that exogenous boys need not be confined to special "brain-injured" teaching techniques for them to achieve to their mental age capacity in arithmetic. (MA 6-11; 64 pupils)

Cawley, John F. and Goodman, John O. Interrelationships Among Mental Abilities, Reading, Language Arts, and Arithmetic with the Mentally Handicapped. Arith. Teach. 15: 631-636; Nov. 1968.

Significant correlations were found between: (1) verbal and motor abilities with arithmetic concepts, reasoning, and computation; (2) computation and reading for older subjects, not younger; and (3) primary mental abilities and achievement. (grades 1-8)

Connolly, Austin Jay. An Instrument of Measurement to Appraise the Arithmetic Abilities of Educable Mentally Retarded Children Ages Thirteen Through Sixteen. (Colorado State College, 1968.) Dis. Abst. 29A: 1034; Oct. 1968.

An individual test requiring no reading or writing was found to have a reliability of .97. Correlations with the Iowa Tests of Basic Skills were .38 for total scores and .69 for reasoning scores. (ages 13-16; 400 pupils)

Costello, H. M. Responses of Mentally Retarded Children to Specialized Learning Experiences in Arithmetic. (University of Pennsylvania, 1941.)

Cruickshank, W. M. A Comparative Study of Psychological Factors Involved in the Responses of Mentally Retarded and Normal Boys to Problems in Arithmetic. (University of Michigan, 1946.)

Cruickshank, William M. Arithmetic Vocabulary of Mentally Retarded Boys. J. Excep. Child. 13: 65-69, 91; Dec. 1946.

A group with normal intelligence correctly defined significantly more words than a group of mentally retarded subjects. Differences were greatest on subtraction terms. (MA 10; 30 pupils)

Cruickshank, William M. Arithmetic Work Habits of Mentally Retarded Boys. Am. J. Ment. Def. 52: 318-330; Apr. 1948.

Specific errors in each process were tabulated, with significant differences between normal and mentally retarded groups cited. Mentally retarded pupils made four general types of errors, due to immature habits, lack of understanding, carelessness, and poor work habits. The primary poor habit of the normal group was carelessness. (MA 10; 30 pupils)

Cruickshank, William M. Arithmetic Ability of Mentally Retarded Children: I. Ability to Differentiate Extraneous Materials From Needed Arithmetical Facts. J. Ed. Res. 42: 161-170; Nov. 1948.

Pupils of comparable mental age and arithmetic age, but differing in intelligence, reacted differently to the problems. Mentally retarded pupils were poorer on each type of problem and scored significantly lower on problems with superfluous material than on problems without superfluous material or those requiring only computation. For normal pupils, no significant differences were found on problems which contained superfluous materials and those which did not, though each resulted in significantly lower scores than problems requiring only computation. (MA 10; 30 boys)

Cruickshank, William M. Arithmetic Ability of Mentally Retarded Children: II. Understanding Arithmetic Processes. J. Ed. Res. 42: 279-288; Dec. 1948.

The ability of the retarded group to name the process and to actually solve a problem was significantly lower than that of the normal group. Naming one operation and solving by another was more typical of retarded than non-retarded pupils. For addition, retarded pupils solved 73 per cent correctly; normal pupils, 96 per cent. For subtraction, the respective pupils solved 70 per cent and 93 per cent; for multiplication, 42 per cent and 84 per cent; for division, 47 per cent and 85 per cent. (MA 10; 30 boys)

Davis, William Edmund. A Comparison of Paired-Associate Learning of Retardates Under Auditory and Visual Stimulus Conditions. (The University of Connecticut, 1968.) Dis. Abst. 29A: 2560; Feb. 1969.

Both geometric stimuli required more trials than wordlike stimuli. (age 10; 32 pupils)

Deshpande, Anant Sakharam. Development of a Battery for the Lower Continuum of Basic Achievement of Common Knowledge and Skills. (University of Georgia, 1968.) Dis. Abst. 29A: 2999; Mar. 1969.

An instrument to measure skills required for daily living was developed for use with mentally retarded or educationally backward adolescents. Nine of 11 subtests were found to have reliabilities of .93 to .99. (secondary; 106 students)

Finley, Carmen Joyce. Arithmetic Achievement in Mentally Retarded Children: The Effects of Presenting the Problem in Different Contexts. (Columbia University, 1962.) Dis. Abst. 23: 922; Sept. 1962.

Test items presented with concrete materials tended to be more difficult for retarded pupils than those either pictorially or symbolically presented, but differences were not significant. (grade 3; 108 pupils)

Finley, Carmen J. Arithmetic Achievement in Mentally Retarded Children: The Effects of Presenting the Problem in Different Contexts. Am. J. Ment. Def. 67: 281-286; Sept. 1962.

The context of the problem did not appear to affect the achievement of either retarded or normal children. On a symbolic test of arithmetical skills, the retarded pupils scored significantly higher than normal pupils, while on concrete and pictorial forms no significant differences were found. (grade 3; 108 pupils)

Gothberg, Laura C. The Mentally Defective Child's Understanding of Time. Am. J. Ment. Def. 53: 441-455; Jan. 1949.

Not until the mental age of five was reached could at least 50 per cent of the "mentally defective" children respond to time percepts. Abstract concepts of sequence, historical time, and measurement of duration and chronology were not found to mature until after MA 10, and were beyond the capacity of the majority at MA 12. A correlation of .89 was found between time questions answered and mental age; with mental age partialled out, a correlation of .31 between time questions and CA was found. (ages 5-19; 155 children, 53 adults)

Guertin, Wilson H. The Achievement and Abilities of a Group of Educable Mentally Handicapped. J. Ed. Res. 50: 145-150; Oct. 1956.

Factor analysis of selected aphasia items, MA, CA, and achievement indices resulted in the obtaining of three factors: general experience, mental ability, and literary skill. Correlations of an arithmetic-reading-total achievement score with each of these were .61, .47, and -.46. (age 14, MA 7; 30 pupils)

Hoeltke, Gary Martin. Effectiveness of Special Class Placement for Educable Mentally Retarded Children. (The University of Nebraska Teachers College, 1966.) Dis. Abst. 27A: 3311; Mar./Apr. 1967.

Pupils enrolled in regular classes achieved better in arithmetic, reading, and spelling. Special classes had better self-image. Both groups reflected similar attitudes toward their teachers. (age 11; 112 pupils)

Jaffe, Samuel S. Proposed Modification of the New York City Course of Study in Arithmetic for Dull Normal Pupils in Grades 1-6. (New York University, 1938.)

Jenkins, Offa Lou Harris. A Study of the Effect of Three Methods of Teaching Arithmetic to Mentally Handicapped Pupils. (University of Virginia, 1967.) Dis. Abst. 28A: 3074; Feb. 1968.

Programmed arithmetic materials appeared to be more effective than a social approach or conventional textbook procedures for teaching arithmetic concepts. (ages 13-17; 90 students)

Johnson, Gordon Floyd. An Investigation of Programed Procedures in Teaching Addition and Subtraction to Educable Mentally Retarded Subjects. (University of Oregon, 1966.) Dis. Abst. 27A: 4132; May/June 1967.

Programmed materials, whether experimenter-made or commercial, when used in conjunction with conventional teaching plans, were more effective than conventional instruction alone. (ages 9-14; 72 pupils)

Lister, Caroline M. The Development of a Concept of Volume Conservation in ESN Children. Brit. J. Ed. Psychol. 40: 55-64; Feb. 1970.

A volume conservation concept was taught to retarded pupils who generalized this understanding to weight and substance situations. (ages 9-15; 30 pupils)

McGettigan, James Francis. Conservation of Number in Young Mentally Retarded Children. (Columbia University, 1969.) Dis. Abst. 31A: 2739-2740; Dec. 1970.

The retarded children conserved number, with neither the number of objects (3-8) nor whether pupil or teacher manipulated objects affecting scores. (ages 8-10; 120 pupils)

McKee, Marjorie Ann Brand. The Components of Academic Success Studied in Seventy-Five (75) Educable Retarded Children: A Descriptive Study of Selected Factors. (Wayne State University, 1969.) Dis. Abst. 30A: 3859; Mar. 1970.

Arithmetic achievement was not affected by social level of the community, but those from less affluent homes made more growth yearly than those from more affluent homes. Greater gains in arithmetic were evidenced at older MA levels. (elementary; 30 classes)

McManis, Donald L. Conservation of Identity and Equivalence of Quantity by Retardates. J. Genet. Psychol. 115: 63-69; Sept. 1969.

Occurrence of identity conservation and equivalence conservation was not simultaneous in all children. Identity conservation was necessary, but not sufficient, to insure equivalence conservation. (ages 10-15)

McManis, Donald L. Comparison of Gross, Intensive, and Extensive Quantities by Retardates. J. Genet. Psychol. 115: 229-236; Dec. 1969.

All succeeded in gross quantity comparisons, while success was (1) greater on intensive comparisons (involving seriation through addition) than on extensive comparisons (involving seriation through multiplication), and (2) a positive function of MA. (ages 7-21, MA 5-8)

McManis, Donald L. Conservation, Seriation, and Transitivity Performance by Retarded and Average Individuals. Am. J. Ment. Def. 74: 784-791; May 1970.

Among pupils showing discrepant performance in (1) conservation and seriation or (2) seriation and transitivity, significantly more had acquired conservation without seriation, or seriation without transitivity. Significantly fewer retarded than average subjects had seriation ability. (elementary; 160 pupils)

Nachtman, William Robert. An Instrument of Measurement to Appraise the Quantitative Abilities of the Educable Mentally Retarded Child. (Colorado State College, 1962.) Dis. Abst. 23: 4265; May 1963.

A reliability (internal consistency) of .98 was obtained for the individually administered, 98-item test. (ages 9-12; 334 pupils)

Noffsinger, Thomas and Dobbs, Virginia. Teaching Arithmetic to Educable Mentally Retarded Children (Review). J. Ed. Res. 64: 177-184; Dec. 1970.

Research in eight areas of interest is summarized: general characteristics, concept formation, organicity, implications, MA and computation, learning processes, motivation, special programs, and programmed instruction; 92 references are listed.

Peterson, Daniel Loren. A Study of Mathematical Knowledge Among Young Mental Retardates. (University of Missouri, Columbia, 1967.) Dis. Abst. 29A: 104-105; July 1968.

Positive relationships between mathematical skill and MA, CA, years in school, and type of program were found, but no significant relationship existed between skill and sex or sibling position. (ages 7-9; 60 pupils)

Pfaeffle, Heinz. A Comparison of Two Educational Programs for Beginning Instruction with Educable Mentally Retarded Pupils. (The University of Wisconsin, 1968.) Dis. Abst. 30A: 174-175; July 1969.

Materials which teach reading, writing, arithmetic and social experiences concurrently, prepared specifically for retarded children, were as effective as a conventional text program. Boys achieved significantly better than girls. (ages 7-10; 60 pupils)

Pinegar, Rex Dee. A Comparison of a Conventional Teaching Technique With a Programed Instruction Technique as Applied to Teaching Basic Arithmetic Addition and Subtraction Combinations to Normal and Educable Mentally Retarded Boys. (University of Southern California, 1967.) Dis. Abst. 28A: 3571; Mar. 1968.

Both retarded and normal pupils, using either programmed materials or conventional instruction, made significantly fewer errors on immediate posttests than control pupils; retarded pupils also made fewer errors on retention tests. There were no significant differences between retarded and normal pupils due to mode of presentation. (MA 6-8; 72 pupils)

Pritchett, Edward Milo. An Instrument of Measurement to Appraise the Arithmetic Abilities of Educable Mentally Retarded Children Ages Six Through Nine. (Research Study No. 1.) (Colorado State College, 1965.) Dis. Abst. 26: 7120; June 1966.

An individual test of arithmetic achievement requiring no reading or writing was found to have high reliability (.99) and correlated .88 with the Arithmetic Concepts and Skills Section of the Metropolitan Achievement Tests. (ages 6-9; 314 pupils)

Quick, Alton David. Number and Related Concepts for Arithmetic for the Educable Mentally Retarded. (University of Alabama, 1966.) Dis. Abst. 27A: 2953-2954; Mar./Apr. 1967.

Piaget's stages of global comparisons, intuitive and concrete operations occurred in order in the mentally retarded, but there was a lag of the stages in MA. (MA 4-6; 80 pupils)

Rainey, Dan S. and Kelley, Francis J. An Evaluation of a Programed Textbook with Educable Mentally Retarded Children. J. Excep. Child. 34: 125-126; Oct. 1967.

Programmed instruction in mathematics was more effective than either rote or understanding procedures when pupils were reading above the 2.3 grade level. (82 pupils)

Reitz, Ronald Tennyson. A Comparison of Methods for Teaching Conservation of Number to Retardates. (The Pennsylvania State University, 1970.) Dis. Abst. 31A: 2796; Dec. 1970.

Of four combinations tested, the most effective technique consisted of training on conservation of number problems with yes/no feedback plus verbal mediation. (ages 6-13; 40 pupils)

Schwarz, Robert H. and Shores, Richard E. The Academic Achievement of EMR Students and Social Class. Am. J. Ment. Def. 74: 338-340; Nov. 1969.

Middle-class children achieved at a clearly higher level on a standardized arithmetic test than lower-class children at ages 9-10, but the difference decreased by ages 14-15. (ages 9, 10, 14, 15)

Thompson, Jack M. and Finley, Carmen J. A Further Comparison of the Intellectual Patterns of Gifted and Mentally Retarded Children. Excep. Child. 28: 379-381; Mar. 1962.

On the WISC (IQ) test, retarded pupils scored lowest (tenth) on the arithmetic subtest, while arithmetic was ranked seventh for gifted pupils. (age 10; 709 pupils)

Werner, Heinz. Perception of Spatial Relationship in Mentally Deficient Children. J. Genet. Psychol. 57: 93-100; 1940.

Groups of mentally deficient children responded to tests of spatial relationship (involving tapping cubes in a specified pattern) with a decrease of errors as MA increased. Achievement on an arithmetic test was found to be highest by those who responded better to the stimuli being presented by flashes rather than by taps. (MA 6-12; 180 pupils)

Werner, Heinz and Carrison, Doris. Measurement and Development of the Finger Schema in Mentally Retarded Children; Relation of Arithmetic Achievement to Performance on the Finger Schema Test. J. Ed. Psychol. 33: 252-264; Apr. 1942.

The Finger Schema Test for mentally retarded children was found to be correlated with arithmetic achievement for those having extremely high and low scores. (MA 6-10; 80 pupils)

Whyte, Lillian Agnes. The Development of Classification Ability in Children of Below Average Intelligence. (Columbia University, 1969.) Dis. Abst. 30A: 4700-4701; May 1970.

Results indicate confirmation of Piaget's and Inhelder's hypotheses that the development of classification occurs in the pre-operational and concrete-operational periods, while ordering classes develops during the formal-operational period. The intellectually subaverage seem to follow the normal pattern and sequence of development, fixating at lower stages in the hierarchy. (IQ 30-89; 120 pupils)