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ABSTRACT

This newsletter describes various programs developed by SMSG with particular emphasis on mathematics instruction for disadvantaged children. In particular, "Mathematics for the Elementary School - Special Editions" and "Secondary School Mathematics - Special Editions," are described including their inception, writing, testing, and content. Ordering information and an order blank are included. (JG)

SCHOOL MATHEMATICS STUDY GROUP

Newsletter No. 33

September 1970

MATHEMATICS FOR DISADVANTAGED AND LOW ACHIEVING STUDENTS

Early in its history, SMSG demonstrated that it was not concerned solely with above average college-bound students. The first junior and senior high school SMSG texts were designed for college-capable students, but even before these were finished work had been started on a revision of the texts for grades 7, 8, and 9, which would be more useful for average and below average students than the original versions. These texts, INTRODUCTION TO SECONDARY SCHOOL MATHEMATICS, Volumes 1 and 2, and INTRODUCTION TO ALGEBRA, were finished in 1962.

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During 1963, arrangements were made for a study to be carried out during the following two academic years in which these texts were used by students between the 25th and the 50th percentile in general ability. This study demonstrated that such students could learn about as much mathematics as above average students provided they were given more time. Further information on this study is contained in SMSG Report No. 5.

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In 1964, in order to obtain comments and suggestions from the mathematical community, SMSG convened a conference to discuss all aspects of mathematics education for below average achievers. A report of this conference was published.

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As a result of this conference, SMSG took on two new activities. One was concerned with primary school mathematics for disadvantaged children and led to a revision of the SMSG materials for kindergarten and grade one.

Two assumptions were made in revising the original SMSG books to make them more useful for children with backgrounds that differ significantly from what is usually thought of as "middle and/or upper class."

1. These children are entitled to a mathematics curriculum which is mathematically sound and properly sequenced from both a mathematical and pedagogical point-of-view.
2. They can learn from such a curriculum if

the material is presented in a way which takes into account the presence or absence of the special skills, attitudes, and behavior which the school seems to demand as a prerequisite for academic success.

Since the existing books had been revised in light of teacher reports during a year try-out, on-site observations and the recommendations of consultants, the revised editions met the requirement of the first assumption.

To find out if the material was appropriate for disadvantaged children and if not, how it might be modified for maximum benefit, SMSG set up centers in Boston, Chicago, Detroit, Miami, Oakland (California) and Washington, D. C. Seven kindergarten and eight first grade teachers and their classes were involved. The designation of a particular school in the disadvantaged area of each city, as well as the selection of teachers and their classes were made by the local school system.

The fifteen teachers were provided with all the available educational and play materials suitable for their classes as well as the revised SMSG texts. Each teacher had available the services of a mathematics consultant and a psychologist at regular intervals.

The teachers made weekly reports describing and evaluating their daily mathematics lessons and following the progress of individual students. They prepared reports on each chapter of the SMSG books as they completed the material. The teachers also met, as a group, with committee members of SMSG four times during the school year to discuss progress, report difficulties and to recommend modifications of the existing SMSG text materials. All classes were visited at least once by a member of the SMSG staff at Stanford University.

As a result of the teachers' reports, the group meetings, and the on-site observations and recommendations of mathematics consultants and psychologists, the existing SMSG kindergarten and first grade texts were rewritten. They are now published under the same title followed by "Special Edition."

The Special Edition of the kindergarten book reflects teacher concern that many different activities and types of material be readily at hand to introduce and reinforce the concepts which are considered preparatory to first grade work. Teachers are encouraged to look upon this period as one which is exploratory and developmental. Mastery of concepts by every child is NOT implied.

The Special Edition of grade one begins with a review of the concepts presented in kindergarten but provides a complete teaching procedure so that the child without kindergarten experience is not penalized. Many more student pages are available where teachers have indicated a need for a slower pace in the development of a particular concept. In some cases the order of presentation was altered. For example, teachers found it easier to teach the numbers 11–19 after ten and the multiples of ten less than one hundred had been developed rather than stress the numbers 20–99 and then return to the teens. Those pages which are to be used in the teaching of a lesson are so marked. In the teacher edition many activities which stress the use of manipulative materials are suggested before a given page in the book is to be considered. If the concept is a difficult one, such as the idea of "fewer than," for ALL children, the teacher is alerted to this fact in order to avoid frustration at the lack of immediate results. With these children the pace will be slower and the range of achievement is apt to be greater than in a middle class heterogeneous group. Consequently, teachers are made aware of situations which will require a great deal of development and the necessity of making additional worksheets to fit the individual differences in the class. Unhappily for teachers, there is NO book of any kind or description which has enough pages of varying difficulty to fit the range of needs in any one given class.

For the benefit of teachers of primary school disadvantaged children, a new volume, No. 13, was added to the *Studies in Mathematics* series. This book was written at the request of teachers and consultants who indicated a need for a book devoted to the mathematics and pedagogy of a contemporary instructional program that emphasizes conceptual learning. The beginning chapter discusses the factors which contribute to being disadvantaged, a description of such children and the implications for teaching. The following seventeen chapters introduce and provide a progressive development of significant ideas in the K-3 program. In each chapter the exposition of a concept and the related development of appropriate skills is followed by a section called "Applications for Teaching." This unusual feature is an important one since the mathematics dictates the pedagogy. The reader is told what ideas, language, etc. may prove difficult for disadvantaged children and provides suggestions which other

teachers have found helpful. Before the usual listing of new vocabulary and exercises for each chapter is a small section entitled "Question." The question or questions considered here are the ones most frequently raised by teachers of disadvantaged children when working with the mathematics consultant. They highlight the points which seem to cause teachers the greatest amount of misunderstanding and erroneous interpretation.

The appendices deal with (1) the scope and organization of the K-3 program, (2) the usefulness and difficulties of the language of mathematics and (3) a report of the study of disadvantaged children which supplied the information needed to write the Special Editions and this volume.

SMSG Reports 2 and 4 provide further information on these activities.

A by-product of these activities was a booklet meant for nursery school teachers who are working with disadvantaged children. A number of mathematical ideas which are normally explored in kindergarten or the first grade are described. For each of these, a number of nursery school activities are suggested which should facilitate the student's later development of these topics in kindergarten or first grade. All the activities suggested were tried out with disadvantaged nursery school children and found to be feasible.

* * *

A second SMSG activity undertaken as a result of the 1964 conference is now culminating in the publication of a junior high school mathematics program SECONDARY SCHOOL MATHEMATICS – SPECIAL EDITION designed for students whose mathematics achievement in elementary school was very low. The first nine chapters, more than enough for one school year, were made available in September 1970 and another year's worth of material will be made available the following September.

The mathematical content of this junior high school program is derived from the new SMSG Secondary School Mathematics Program, described originally in SMSG Newsletter No. 24 and again more briefly in Newsletter No. 30. However, the format of this special edition is a decided departure from that of the usual classroom textbook.

This change of format comes as a result of a small experiment, conducted over a three-year period, with junior high school very low achievers

in mathematics. Details of this experiment will be found in SMSG Reports 6 and 7. The heart of this experiment was the development of materials that would relieve the student from the burdens of computation, as much as possible, and concentrate on mathematical concepts and relationships. Tables were provided to enable the student to compute whenever the content of the material so dictated. A second departure from the norm was that students were not provided with textbooks but were issued daily worksheets on which the lesson for the day was printed and which contained ample space to do any of the required work. Worksheets were placed in a binder which, in most cases, was kept in the classroom. There were two factors that prompted this approach. First, because of these students' apparent immaturity and lack of organization, a textbook became a handicap to them. Simply keeping track of its physical location appeared to be beyond the capabilities of most of the students. Secondly, this approach seemed to produce the more positive effect of having the students consider what they had accomplished, rather than projecting what they had yet to do. These two aspects of the experiment proved to be extremely successful both from the point of view of the student and the teacher. The students included in this experiment learned about as much mathematics as similar students in control classes; however, there were marked attitude changes among the experimental students which did not appear among the control students and these changes were deemed to be desirable ones. In addition, discipline problems were markedly lower in the experimental classes than in the control classes. SMSG has retained these features in the development of this new material.

A group of writers prepared experimental versions of nine chapters during the summer of 1969. During the 1969–1970 school year, sixteen seventh grade classes, taught by fourteen teachers in eleven different schools, tried out the experimental chapters. All the students were low achievers in mathematics. Several classes consisted of Black students and two of Mexican-American students. Most of the classes finished eight chapters. The reactions of the students, the parents, and the teachers were extremely favorable. Teacher evaluations for each chapter were systematically collected and these evaluations served as a basis for the revision of the nine chapters during the summer of 1970.

Throughout the trial period participating teachers attended biweekly seminars in which the materials and teaching problems were discussed. Problems which arose were carefully noted and ways and means of counteracting them have been incorporated in a short teachers commentary. Suggestions for handling the material have also been included in the commentary.

The following are chapter headings of the material available:

Revised Version

1. Flow Charts
2. Structuring Space
3. Functions
4. Number Theory
5. The Integers
6. Rational Numbers
7. Probability
8. Equations
9. Congruence

It should be noted that although this material is presented to the student in the form of worksheets, it is not, in the ordinary sense, a workbook. Topics in each chapter are sequentially developed lesson by lesson. Teacher-led class discussion exercises are carefully programmed to lead the student to successful experiences in the exercise sets. Every effort has been made to construct lessons that prevent failure. The quantity of reading and the reading level have been reduced to a minimum. At the end of each chapter there are included: (1) a cumulative "self-test," which enables the student, on his own, to determine how he is progressing; (2) a practice test, which in essence, tells the student what he is expected to know; and (3) a chapter test which is administered by the teacher.

As the cost of producing individual worksheets commercially proved to be prohibitive, this material will come to the teacher in bound volumes. Each chapter will consist of a number of lessons of one or more pages. Each page will be perforated for easy removal. These pages can then be reproduced in quantities sufficient for the class by means of spirit master units. Although this reproduction process may appear to place an extra burden upon the teacher, in practice the extra time required to reproduce the material is more than compensated for by the positive results, both mathematically and behaviorally, that appear in

the classroom.

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Finally, early in 1970, SMSG convened another conference to discuss mathematics programs in inner-city schools. During this conference, most of the more promising inner-city school mathematics programs were reviewed and discussed, and a number of suggestions were presented for ways of improving these programs. A report of this conference is available.

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Obviously, SMSG has merely scratched the surface of the problem of providing suitable mathematics programs for disadvantaged and low achieving students. We hope, however, that the activities will point the way to more numerous and more powerful efforts in the future.

REPORTS

This series consists of reports, too long to be included in SMSG Newsletters, on various SMSG projects. Single copies may be obtained by a postcard request to SMSG, Cedar Hall, Stanford University, Stanford, California 94305.

2. *The Special Curriculum Project*
4. *The Special Curriculum Project: 1965–66*
5. *The Slow Learner Project: The Secondary School "Slow Learner" in Mathematics*
6. *Preliminary Report on an Experiment with Junior High School Very Low Achievers in Mathematics*
7. *Final Report on an Experiment with Junior High School Very Low Achievers in Mathematics*

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