DOCUMENT RESUME

ED 061 354 UD 012 169

AUTHOR	Rodosky, Robert
TITLE	1969-70 Basic Mathematics Improvement Component; Regular School Year and Summer School. Final Report.
INSTITUTION	Columbus Public Schools, Ohio.
PUB DATE	[70]
NOTE	39p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Compensatory Education Programs; Educational Diagnosis; Individualized Instruction; Intermediate Grades; Mathematics Curriculum; *Mathematics Instruction; Parochial Schools; *Program Evaluation; Public Schools; Remedial Mathematics; Secondary Grades; Underachievers
IDENTIFIERS	*Elementary Secondary Education Act Title I; ESEA Title I; Ohio

ABSTRACT

The Basic Mathematics Improvement Component, funded under Title I of the 1965 Elementary Secondary Education Act, has the following objectives: (1) to help the underachieving mathematics pupil make satisfactory progress toward raising his level of grade placement in mathematical computation, concepts, and applications; (2) to help the underachieving mathematics pupil become successful in his regular classwork; and (3) to help the underachieving mathematics pupil develop more positive motivations toward mathematics. Mathematics improvement classes met on a regular basis throughout the 39-week school year in each of the participating schools. Pupils met in small groups of four to eight pupils on an average of four 45-minute periods per week. Component pupils continued to participate in their regular mathematics classes. Pupils were selected by the various mathematics improvement teachers. Regular classroom teachers recommended pupils who experienced difficulty in their classrooms in mathematics and were likely to benefit from additional help. Seventeen public schools of the Columbus Public School District and three diocesan schools were served by this component. (Author/JM)

FINAL REPORT

1969-70 BASIC MATHEMATICS IMPROVEMENT COMPONENT: REGULAR SCHOOL YEAR AND SUMMER SCHOOL

Prepared by

Robert Rodosky - Evaluation Specialist

under the supervision of

Calvin M. Smith, Jr.

Supervisor, State and Federal Evaluations

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Section I - Audiences to be Served by the Evaluation

This report is written in order that Basic Mathematics Improvement Component teachers, administrative personnel in the Department of Special Program Development of the Division of Instruction, and the members of the Board of Education may become informed about the nature of the outcome of the 1969-70 Basic Mathematics Improvement Program.

Section II - Specification of the Component

A. Educational Philosophy Behind the Component

The philosophy behind the Basic Mathematics Improvement Program is stated in the 1969-70 Project Narrative Section of the Language Development and Mathematics Improvement Funding Proposal:

Low levels of both achievement and interest in the instructional program have generally been shown to be the principal reasons for students' dislike of school. Ultimately, if not corrected, these conditions contribute to school dropouts. Because of the very nature of mathematics and because of some of the promising new methods of teaching this subject, there are hopeful prospects of improving levels of achievement and interest for many disadvantaged pupils.

Training in mathematics, along with some degree of competence, gives a student a much broader choice of types of vocational training in the late secondary school or post-secondary technical-training institutions. Two-thirds of the skilled and semi-skilled job opportunities on the labor market today are not available to those who lack an understanding of the basic principles of arithmetic, elementary algebra, and geometry. Basic mathematical understandings are also essential to adult retraining programs for the unemployed.

Success or measurable achievement in mathematics has a close correlation with increased achievement in other disciplines. Other disciplines may profit from the patterns evolved as mathematics programs for the underachiever become more effective.

B. Component Subject Matter

The subject matter is essentially reduced to seven broad concepts. The concepts are as follows:

Number

Definition: A Number is an idea, and a Numeral is a name for a number idea.

Systems of Numeration

Using the idea of symbol, base, and positional notation, we often gain further insight into our decimal system by using bases other than ten. By way of background, the Hindu-Arabic system of notation is relatively simple. It is an additive system utilizing ten symbols (0, 1, 2, 3, 4, 5, 6, 7, 8, 9), and positional notation. Each numeral is a name of a cardinal number in its own right and represents a standard set. Furthermore, each numeral has another role. By its position in the name of an integer, it indicates the size of the sub-sets which it enumerates; "3" is the numeral for a set of three elements; "30" is the numeral for a set of three collections of ten each or of thirty elements.

Pupils are helped to understand that each place in a numeral has a name, and each place has a different value. For example, pupils should be led to see that in the numeral 222, the 2 on the right means two ones because it is in the ones place; the 2 in the middle means two tens because it is in the tens place; and then the two on the left means two hundreds because it is in the hundreds place. Gradually, the pupil discovers that a place in a numeral has ten times the value of the place to the right of it; they develop understanding of the decimal nature of our numeral system.

Relations

In mathematics, pupils are instructed to compare and perceive relationships between sets, numbers, and forms. Sets of numbers and sets of number pairs appear often in daily affairs. Familiar examples are: height-weight charts, temperature-time charts, cost-of-living charts, etc.

Discovery Method

The use of guided discovery is thought of as one of the modern trends in education, but it is not really new. Teachers have been using it for a long time. The discovery method, when properly used, should produce children who are alert, curious, creative, and interested. It is a technique that leads students to discover principles and make generalizations. It stimulates thought, develops the minds of those we teach, and makes them more prepared to use the knowledge they already have and apply it to new situations. It encourages students to make intelligent guesses about various situations and then to test whether or not their guesses prove to be right.

Operations

An operation in mathematics is a way of associating an ordered pair of numbers with a specified third number. When we perform the operation of addition, we associate the number, 8 for example - with the ordered pair (6,2). When we think of the same ordered pair of whole numbers, 6 and 2, and perform the operation of multiplication, the result is 12. Subtraction and division are also mathematical operations. These four operations are called the four basic operations of mathematics. Addition and multiplication are called primary operations, while subtraction and division are called secondary operations.

Estimation

Often in mathematics, we are concerned with exact computation, but we neglect the equally important aspect of estimation. We may develop the methods for multiplication with understanding and yet fail to challenge pupils to think about the other relationships between numbers. We teach that 5 x 7 is 35, but we leave the child to his own devices in realizing that 5 times a number more than 7 is a product more than 35. For example: A student who would say that 5 x 7 = 35 and then say that 5 x 9 = 27 has not yet developed this relationship. Another example occurs frequently in teaching the pupil how to find the area of a rectangle. We introduce the formula, Area equals length times width, and often overlook the highly useful aspect of having students estimate the length and width of a room to get a sensible estimate of the area of its rectangular floor.

Measurement

Pupils are given many opportunities to make measurements and should be led to see the important role that measurements play in a technologically advanced society. Pupils are led to realize that standard units of measurement are arbitrarily chosen, although occasionally the units may have arisen historically. Furthermore, they recognize that units of measurement are standardized to enable them to have widespread use.

C. Component Learning Objectives

The Basic Mathematics Improvement Component has the following objectives:

Objective I. To help the underachieving mathematics pupil make satisfactory progress toward raising his level of grade placement in mathematical computation, concepts, and application.

Objective 2. To help the underachieving mathematics pupil become successful in his regular classwork.

Objective 3. To help the underachieving mathematics pupil develop more positive motivations towards mathematics.

D. Component Instructional Procedures, Tactics, Media

Mathematics improvement classes met on a regular basis throughout the thirty-nine week school year in each of the participating schools. Pupils met in small groups of four to eight pupils on an average of four 45 minute periods per week. Component pupils continued to participate in their regular mathematics classes.

The following philosophy was used for instructional tactics. The eight points are quoted from the 1968 publication of Basic Mathematics Improvement - The Columbus Public Schools:

1. The traditional readiness concept of deferment of instruction until children mature is rejected in favor of the principle that pupils can, with proper conditions, be introduced to a subject as early as desired. Two important conditions would be that it is presented properly and that the pupils have, or are provided with, an adequate background of experience.

2. Transfer of learning and future learning are enhanced when emphasis is given to basic concepts, generalizations, and processes of inquiry which have wide applicability.

3. The guided discovery of relationships by the pupil results in more efficient and permanent learning than do didactic approaches in which children learn about the conclusions reached by others.

4. Interest and motivation may be generated through the lure of discovery within the subject itself if pupils are guided to raise questions, discover relationships, interpret findings, formulate principles, and engage in other aspects of inquiry.

5. Meaningful verbal learning involves the organizing of facts into conceptual systems which can be used to generate ideas, raise questions, or make new interpretations.

6. Inductive approaches are favored because of their value in promoting discovery through inquiry and in giving experience in formulating generalizations; but deductive approaches are evident in experiences designed to develop skill in explaining new facts, formulating hypotheses, making inferences, and interpreting information.

7. The in-depth study of selected topics is more conclusive to the discovery of relationships than is a superficial coverage of masses of material.

8. Depth and breadth of learning are attained through recurring encounters wiwth concepts, processes, theories, models, and generalizations on higher cognitive levels and in new contexts.

E. Component Pupils Selection

Pupils were selected by the various mathematics improvement teachers. Regular classroom teachers recommended pupils who experienced difficulty in their classrooms in mathematics and were likely to benefit from additional help. Mathematics improvement teachers reviewed the records of pupils suggested for participation to obtain an assessment of their general intelligence and level of mathematics achievement. Pupils who had no records available were tested with the Los Angeles Diagnostic Test, a standardized instrument for diagnosing student weaknesses in mathematics. Those pupils who scored one or more years below grade level placement and whose records indicated a discrepancy between achievement and general intelligence were selected for participation in the component. A total of 35 pupils in each building were selected for participation in the component. In general, a pupil selected for the component was at least one year behind his grade level placement in mathematics and had an Intelligence Quotient of at least 80. Component teachers were not permitted to teach more than 50 pupils all year.

F. Instructional and Community Setting

Seventeen public schools of the Columbus Public School District and three diocesan schools were served by this component. Fourteen of the public schools were elementary schools. These included Beatty Park, Beck Street, Douglas, Fair Avenue, Felton, Garfield Avenue, Lincoln Park, Livingston Avenue, Main Street, Milo, Ohio Avenue, Sullivant Avenue, Weinland Park, and Windsor. The other three schools were junior high schools. These include Franklin, Linmoor, and Monroe. The three diocesan schools were Holy Rosary, Sacred Heart, and St. Aloysius.

Each public school had a full time teacher. The teacher was to meet with small groups of students (4 to 8 pupils) for approximately 45 minutes a day, 4 days a week. On the fifth day, the teacher either attended in-service meetings or met individually with students. The maximum number of pupils a teacher had at any one time during the year was 35.

All teachers in the component held at least a bachelor's degree. All teachers in the component performed the following duties:

1. assumed duties normally expected of members of the professional staff of the Columbus Public Schools,

2. selected pupils to participate in the component (maximum of 50 pupils per school),

3. developed programs which would best facilitate the realization of the objectives of the component for all pupils,

4. maintained records for both the operation and evaluation of the component,

5. cooperated with the evaluation team, and

6. assumed professional responsibility for active participation.

The component was supervised by a teacher who taught mathematics improvement classes one-fifth time and supervised the component four-fifths time. Supervisory duties consisted of the following:

1. organizing and providing for the orientation of component staff personnel,

2. providing leadership in developing professional growth programs for in-service teachers and staff personnel,

3. selecting materials and facilitating their use,

4. assisting with records and data relating to the planning, development, operation, and evaluation of the component, and

5. working directly with teachers in helping them improve their teaching performance.

G. Standards, Bases for Judging Quality

The component objectives, as well as attending criteria for the judgment of overall component effectiveness, are listed below:

Objective 1. To help the underachieving mathematics pupil make satisfactory progress toward raising his level of grade placement in mathematical computations, applications, and concepts. Satisfactory progress shall be defined as the amount of change in grade placement which is greater than that which would normally be expected on a pre-post administration of the mathematics subtest of the California Test of Basic Skills. Normal expectation will be considered to be the average yearly progression of each pupil in mathematics achievement in addition to his pre-test grade placement, e.g., a fifth grader achieving at 3.5 at entrance in the fifth grade has an average achievement progression of 0.7. His normal expected grade placement at the end of the fifth grade would be 4.2 (3.5 + 0.7). The degree to which this objective is realized will be the percentage of component enrollees who surpass expected levels of grade placement in at least two of the three mathematics achievement areas previously mentioned.

Objective 2. To help the underachieving mathematics pupil become successful in his regular classwork, such that if successful, 90 percent of these enrolled in the component receive a passing grade, i.e., D or better as a final grade in mathematics. Ninety percent is based on the estimated city-wide pass-fail rate in mathematics.

Objective 3. To help the underachieving mathematics pupil develop more positive motivations towards mathematics, such that if successful, the pupil will perform classroom learning activities at an increased frequency.

Section III - Program Outcomes

A. Opportunities, Experiences Provided Pupils

The mathematics improvement teacher attempted to help each pupil on two levels:

1. concepts and skills which the pupil was encountering in his regular class;

2. concepts and skills which the pupil should have mastered in earlier grades. The portion of time spent on each of the two levels depended on the severity of the problem of each individual pupil and, therefore, varied from pupil to pupil.

B. Pupil Achievement Data

The reporting of the data is divided into two sections. Section A includes data on the evaluation of the component during regular 1969-70 school year. Section B reports on the 1970 summer school Basic Mathematics Improvement Component. In Section B a description and display of data collected in the evaluation of the summer componen[t] will be reported. Data for pupils who participated in both the regula[r] 1969-1970 school year component and the 1970 summer school component will also be presented in Section B of the analysis.

I. Section A - 1969-70 School Year

a. Objective I. To help the underachieving mathematics pupil make satisfactory progress toward raising his level of grade placement in mathematical computations, applications, and concepts.

Criterion: The extent to which the objective is achieved is the percentage of component enrollees who surpassed expected levels of grade placement in at least two of three mathematic achievement areas: computation, concepts, application.

INSTRUMENTATION

California Test of Basic Skills (mathematics subtest)

Sample: All component enrollees

Administration: Pre-post test administrations in October, 1969, and May, 1970.

Analysis: Frequency distributions by grade level and grade placement.

Results: Table I illustrates the number of pupils in each grade level whose change in grade placement was greater than that which was normally expected on a pre-post administration of the mathematics subtest of the California Test of Basic Skills (CTBS). Normal expectation was considered to be the average yearly progression of each pupil in mathematics achievement in addition to his pre-test grade placement, e.g., a fifth grader achieving at 3.5 at entrance in the fifth grade has an average achievement progression of 0.7. His normal expected grade placement at the end of the fifth grade would be 4.2 (3.5 + 0.7).

More pupils surpassed normal expectations in the computational area than in the concepts area or application area of the CTBS. This frequency pattern, shown in Table I, reflects the emphasis on computation in component classroom work. Computational procedures were stressed more than conceptual or applicative areas of mathematics during class.

Over one-half of the pupils in the program surpassed normal expectations in computation and concepts. In the elementary grade levels at least four out of ten students surpassed normal expectation in application.

TABLE I

NUMBER OF COMPONENT ENROLLEES BY GRADE LEVEL
WHO SURPASSED NORMAL EXPECTATIONS OF ACHIEVEMENT
IN THE THREE AREAS OF THE MATHEMATICS SUBTEST OF THE
CALIFORNIA TEST OF BASIC SKILLS

Grade	N	Computation	Number Concepts	Application
4	137	74	70	56
5	154	96	87	65
6	140	79	68	64
7	53	34	37	35
8	19	14	14	14
Total	503	297	276	234

N's are for matched pre- and post-test scores

The criterion for measuring objective I was the percentage of component enrollees who surpassed expected levels of grade placement in at least two of the three mathematics achievement areas previously mentioned. Table 2 organizes the data for examining the extent to which objective I was achieved. Because a total percentage of the number of component enrollees who surpassed expected levels of grade placement was needed, Table 2 is organized in such a way that all the component pupils within each grade level are divided into four mutually exclusive groups. Group I consists of pupils who surpassed expected levels of grade placement in only computation and concepts. Group II consists of pupils who surpassed expected levels of grade placement in computation and application. Group III consists of pupils who surpassed expected levels of grade placement in concepts and application, and Group IV consists of pupils who surpassed expected levels of grade placement in computation, concepts, and application. The areas of computation, concepts and application refer to the mathematics subtests of the CTBS.

A total number of pupils who surpassed expected levels of grade placement in two of three areas is computed by adding the four groups within each grade level. A total percentage of improvement within each grade level is computed by dividing the total number of pupils who surpassed expected levels of grade placement in two of three areas for the grade level by the number of pupils in the component in that grade level (N).

An examination of Table 2 reveals that within each grade level the number of pupils who surpassed normal expectations in computation, concepts and application (Group IV) is greater than the number of pupils who improved in any combination of two of the three areas (Group I or Group II or Group III).

TABLE 2

NUMBER AND PERCENTAGE OF COMPONENT ENROLLEES WHO SURPASSED EXPECTED LEVELS OF GRADE PLACEMENT AS MEASURED FROM PRE-TEST TO POST-TEST IN TWO OF THREE AREAS ON THE MATHEMATICS SUBTEST OF THE CALIFORNIA TEST OF BASIC SKILLS

		Number					
		I	II	III	IV		
Grade	N	Improvement in computation and concepts	Improvement in computation and applica- tions	Improvement in concepts and applications	Improvement in computation, concepts and application	Total	Total per- centage of improvement
4	137	27	13	9	34	83	60.6
5	154	38	16	7	42	103	66.9
6	140	27	23	12	29	91	65.0
7	53	6	4	7	24	41	77.4
8	19	2	2	2	10	16	84.2
Total	503	100	58	37	139	334	66.4

N's are for matched pre- and post-test scores

The elementary level of the program appears well balanced. The percentage range of pupils surpassing normal expectations in at least two of three areas previously mentioned is small. The percentage ranges from 60.6 percent for fourth graders to 66.9 percent for fifth graders. Between these two percentages, 65 percent of the sixth graders achieved greater than expectation in at least two of the three areas of the mathematics subtest of the California Test of Basic Skills.

One more way to examine objective I is to define levels of improvement the way the Ohio State Department of Education defines levels of improvement for the Annual Evaluation of Title I, Fiscal Year 1970:

Marked Improvement - When a child gains 15 months or more, in grade level on a standardized test in the course of 10 month program, he is said to have made "marked improvement."

Improvement - When a student gains between 11 and 14 months in grade level on a standardized test in the course of a 10 month program, he is said to have made "improvement."

Some Improvement - When a child gains between 6 and 10 months in grade level on a standardized test in the course of a 10 month program, he is said to have made "some improvement."

Little or No Improvement - If a child gains 5 months or less in grade level on a standardized test during the course of a 10 month program, he is said to have made "little or no improvement."

With these definitions, the growth of the pupils in the three sections of the mathematics subtest of the CTBS can be examined in more detail.

Computation: Table 3 illustrates the degree of improvement by the component pupil in computation. A little over one-half (254 out of 503) of the component enrollees improved their computational skills by fifteen months or better.

In every grade level of the component more pupils demonstrated marked improvement than any other degree of improvement. In fact in grades five, seven, and eight more than 50 percent of the pupils demonstrated marked improvement. Only 80 out of 503 component enrollees had little or no improvement in computation.

TABLE 3

FREQUENCY COUNT OF THE AMOUNT OF IMPROVEMENT FROM PRE-TEST OF POST-TEST OF PARTICIPANTS IN THE BASIC MATHEMATICS IMPROVEMENT PROGRAM ON THE CALIFORNIA TEST OF BASIC SKILLS, COMPUTATIONAL SECTION, MATHEMATICS SUBTEST FOR THE REGULAR SCHOOL YEAR, 1969-70

	Frequency				
Grade	Marked Improvement	Improvement	Some Improvement	Little or no Improvement	Total
4	66	22	27	22	137
5	82	28	22	22	154
6	64	28	25	23	140
7	29	6	8	10	53
8	13	2	1	3	19
Total	254	86	83	80	503

Concepts: Table 4 illustrates the amount of improvement in concepts. More pupils demonstrated marked improvement than any other type of improvement. One hundred and seventy-three pupils exhibited little or no improvement.

TABLE 4

FREQUENCY COUNT OF THE AMOUNT OF IMPROVEMENT FROM PRE-TEST TO POST-TEST OF PARTICIPANTS IN THE BASIC MATHEMATICS IMPROVEMENT PROGRAM ON THE CALIFORNIA TEST OF BASIC SKILLS, CONCEPTS SECTION, MATHEMATICS SUBTEST FOR THE REGULAR SCHOOL YEAR 1969-70

	Frequency				
Grade	Marked Improvement	Improvement	Some Improvement	Little or no Improvement	Total
4	54	13	15	55	137
5	67	19	26	42	154
6	45	14	20	61	140
7	30	7	5	11	53
8	12	2	1	4	19
Total	208	55	67	173	503

Applications: Table 5 illustrates the frequency of improvement in application. Almost as many pupils had marked improvement as pupils who had little or no improvement.

TABLE 5

FREQUENCY COUNT OF THE AMOUNT OF IMPROVEMENT FROM PRE-TEST TO POST-TEST OF PARTICIPANTS IN THE BASIC MATHEMATICS IMPROVEMENT PROGRAM ON THE CALIFORNIA TEST OF BASIC SKILLS, APPLICATIONS SECTION, MATHEMATICS SUBTEST FOR THE REGULAR SCHOOL YEAR, 1969-70

Grade	Frequency				
	Marked Improvement	Improvement	Some Improvement	Little or no Improvement	Total
4	40	13	24	60	137
5	52	13	33	56	154
6	52	19	23	46	140
7	33	3	5	12	53
8	9	6	1	3	19
Total	186	54	86	177	503

The examination of the amount of improvement of component enrollees in each area (computation, concepts, application) definitely illustrates that most of the improvement occurred in computation skills. Only 80 pupils indicated little or no improvement in computation. On the other hand, 173 pupils indicated little or no improvement in concepts, and 177 indicated little or no improvement in applications.

The data are evidence that the component achieved objective I. Two thirds of the component pupils surpassed normal expectation in at least two of the three achievement areas being evaluated: computations, concepts and applications.

b. Objective 2. To help the pupil become successful in his regular class.

INSTRUMENTATION

Collection of Pupil's End-of-Year Grades

Purpose: The purpose was to determine the distribution of final grades received by mathematics improvement pupils.

Administration: The Component director collected and recorded the final grades for pupils enrolled in the mathematics improvement classes.

Analysis: Frequency distribution by grade level, by letter grade. Final grades for 461 participants in mathematics improvement classes were collected and compiled. Grades of "F" for pupils in grades four through eight constituted 14.3% of the total number of grades received by component participants; 85.7% received grades of "D" or better. For grades four, five, and six, 89.5% of the pupils enrolled in mathematics improvement classes received grades of "D" or better. Grades of "D" or better were received by 70.4% of the seventh and eighth grade pupils enrolled in mathematics improvement classes. This data is presented in Table 6.

Although the criteria for achieving the objective was that ninety percent of the component enrollees had to receive a passing grade, it is reasonable to conclude that the elementary level attained the objective. The .05 percent difference between the results and the criteria could originate from the variability with which grades are administered. Final grades can be very subjective and can vary from teacher to teacher. One teacher may have a more rigorous grading system than his peers.

With similar reasoning, the total percentage (85.7%), of component enrollees who received a passing grade can be said to have achieved the criteria. A variance of five percent (i.e., five percent less or five percent more than the actual total percentage) would support the statement of the criteria being achieved.

The junior high level failed to meet the criteria for objective 2.

TABLE 6

FINAL GRADES RECEIVED BY PARTICIPANTS IN BASIC MATHEMATICS IMPROVEMENT COMPONENT BY LETTER GRADE AND GRADE LEVEL

	Letter Grade					
Grade Level	A	B	C	D	E	Total
4	7	22	38	36	10	113
5	11	22	54	34	13	134
6	8	16	49	34	16	123
7	3	7	14	23	17	64
8	1	3	7	6	10	27
Total	30	70	162	133	66	461

Total Failures: 66 or 14.3% (N=461)

Failures at Elementary Level: 39 or 10.5% (N=370)

Failures at Junior High Level: 27 or 29.6% (N=91)

C. Objective 3. To help the underachieving mathematics pupil develop more positive motivations toward mathematics

Criterion: The pupil will perform classroom learning activities at an increased frequency.

INSTRUMENTATION

Teacher Rating Scale of Mathematics Behavior

Purpose: The purpose was to determine if the component changed pupil motivation toward mathematics as reflected by pupil behavior in mathematics class.

Administration: Pre-post administrations in October, 1969 and May, 1970.

Analysis: Item analysis of score difference between administrations.

A locally constructed teacher rating scale of pupil behavior in mathematics class was completed by the regular classroom teachers of all elementary pupils in the component at the beginning and the close of the school year. In addition, a 10 percent sample of pupils not in the component was selected by the evaluator. Regular classroom teachers were asked to rate students in the sample at the same time as they rated component pupils.

The instrument included nineteen items. The teacher recorded the frequency of student behavior mentioned in each item. The rating scale of each item ranged from one to five. A one indicated that the pupil performed the behavior referred to in the item one out of every five opportunities. A two indicated that the pupil performed the behavior referred to in the item two out of every five opportunities. A three indicated that the pupil performed the behavior three out of every five opportunities. A four indicated that the pupil performed the behavior four out of five opportunities. A five indicated that the pupil performed the behavior five out of five opportunities.

For analysis purposes, the items were defined as being positive or negative. A positive item was defined as a behavior in which a high frequency of occurrence is preferred. A negative item was defined as a behavior in which a low frequency of occurrence is preferred. High number responses are preferred for positive items. Low number responses are preferred for negative items.

For reporting purposes, the ratings on each item were averaged. Table 7, 8, 9, and 10 present a summary of the data collected by the

Teacher Rating Scale of Pupil Behavior in Mathematics. Table 7 summarizes data for the pre-test in October, 1969, and Table 8 summarizes data for the post-test in May, 1970. Both of these tables can be used for comparing behavior ratings of component pupils and non-component pupils. Table 9 can be used in comparing the change from pre-test to post-test of behavior ratings of component enrollees. Table 10 can be used for comparing differences from pre-test to post-test of teachers' ratings of component pupils and non-component pupils.

An analysis of the data indicates that the behavior of the component pupils was slightly less desirable than non-component pupils during the pre-testing period. On only three behaviors did component pupils demonstrate a more preferable behavior than non-component pupils. Basic Mathematics Improvement Component pupils did not disturb the class as much, attended math class more, and did not question the relevancy of mathematics as much as non-component pupils.

On the post-tests, after one year of mathematics, component pupils were rated as having attended math class more than non-component pupils.

The only improved behaviors of component pupils from pre-test to post-test are as follows:

1. The component pupils demonstrated increased ability in applying mathematical concepts of their grade level (e.g., whole numbers, rational numbers, etc.).

2. The component pupils increased their volunteering in helping the teacher with mathematics lessons.

TABLE 7

AVERAGE TEACHER RATING OF MATHEMATICS BEHAVIOR OF COMPONENT AND NON-COMPONENT PUPILS: PRE-TEST, OCTOBER, 1969

Item	Type of Item	Average Rating of the Item	
		Component Pupils	Non-Component Pupils
The pupil has to be reminded about mathematics assignments.	-	2.4	2.2
The pupil participates in classroom mathematics discussions.	+	2.4	2.8
During mathematics class, the pupil is attentive.	+	3.0	3.2
During mathematics class, the pupil initiates discussion.	+	2.0	2.4
The pupil is able to perform mathematical operations at his grade level (e.g., addition, subtraction, multiplication, division).	+	2.5	3.1
The pupil completes mathematics assignments without assistance.	+	2.6	2.9
The pupil completes mathematics assignments in the allotted time.	+	2.6	3.0
The pupil persists in solving a difficult mathematics assignment.	+	2.1	2.6
During mathematics class, the pupil disturbs the class.	-	1.7	1.8
The pupil demonstrates ability to apply mathematical concepts of his grade level (e.g., whole numbers, rational numbers, etc.).	+	2.2	2.8

TABLE 7 cont'd.

Item	Type of item	Average Rating of the Item: Component Pupils	Non-Component Pupils
The pupil needs assistance in mathematics.	-	2.9	2.7
The pupil attends mathematics class.	+	4.5	4.4
The pupil is concerned for his progress in mathematics.	+	3.0	3.1
The student volunteers to help the teacher with mathematics lessons.	+	1.9	2.4
The pupil acts as if he resents mathematics class.	-	1.5	1.5
The pupil voluntarily corrects mistakes on mathematics homework assignments.	+	2.1	2.7
The pupil questions the relevancy of mathematics.	-	1.7	1.8
The pupil is interested in mathematics	+	3.4	3.3
The pupil demonstrates more than normal frustration in mathematics	-	2.5	2.4

1=1 out of every 5 behavior opportunities
2=2 out of every 5 behavior opportunities
3=3 out of every 5 behavior opportunities
4=4 out of every 5 behavior opportunities
5=5 out of every 5 behavior opportunities

TABLE 8

AVERAGE TEACHER RATING OF MATHEMATICS BEHAVIOR
OF COMPONENT AND NON-COMPONENT PUPILS:
POST-TEST, MAY, 1970

Item	Type of Item	Average Rating of the Item: Component Pupils	Average Rating of the Item: Non-Component Pupils
The pupil has to be reminded about mathematics assignments.	-	2.8	2.4
The pupil participates in classroom mathematics discussions.	+	2.4	3.0
During mathematics class, the pupil is attentive.	+	3.0	3.3
During mathematics class, the pupil initiates discussion.	+	1.8	2.3
The pupil is able to perform mathematical operations at his grade level (e.g., addition, subtraction, multiplication, division).	+	2.5	3.2
The pupil completes mathematics assignments without assistance.	+	2.5	3.2
The pupil completes mathematics assignments in the allotted time.	+	2.5	3.1
The pupil persists in solving a difficult mathematics assignment.	+	2.0	2.4
During mathematics class, the pupil disturbs the class.	-	1.9	1.6
The pupil demonstrates the ability to apply mathematical concepts of his grade level (e.g., whole numbers, rational numbers, etc.).	+	2.4	3.0
The pupil needs assistance in mathematics.	-	3.1	2.7

TABLE 8 Cont'd.

Item	Type of Item	Average Rating of the Item: Component Pupils	Average Rating of the Item: Non-Component Pupils
The pupil attends mathematics class.	+	4.5	4.4
The pupil is concerned for his progress in mathematics.	+	2.9	3.5
The student volunteers to help the teacher with mathematics lessons.	+	2.1	2.4
The pupil acts as if he resents attending mathematics class.	-	1.6	1.5
The pupil voluntarily corrects mistakes on mathematics homework assignments	+	1.9	2.2
The pupil questions the relevance of mathematics.	-	1.9	1.8
The pupil is interested in mathematics.	+	3.1	3.6
The pupil demonstrates more than normal frustration in mathematics.	-	2.6	2.3

1=1 out of every 5 behavior opportunities
2=2 out of every 5 behavior opportunities
3=3 out of every 5 behavior opportunities
4=4 out of every 5 behavior opportunities
5=5 out of every 5 behavior opportunities

TABLE 9

COMPARISON OF AVERAGE PRE-TEST, POST-TEST TEACHER RATINGS OF MATHEMATICS BEHAVIOR OF ELEMENTARY COMPONENT ENROLLEES
1969-70

Item	Type of Item	Average Rating of the Item Pre-Test	Post-Test
The pupil has to be reminded about mathematics assignments.	-	2.4	2.8
The pupil participates in classsroom mathematics discussions.	+	2.4	2.4
During mathematics class, the pupil is attentive.	+	3.0	3.0
During mathematics class, the pupil initiates discussion.	+	2.0	1.8
The pupil is able to perform mathematical operations, at his grade level (e.g., addition, subtraction, multiplication, division).	+	2.5	2.5
The pupil completes mathematics assignments without assistance.	+	2.6	2.5
The pupil completes mathematics assignments in the allotted time.	+	2.6	2.5
The pupil persists in solving a difficult mathematics assignment.	+	2.1	2.0
During mathematics class, the pupil disturbs the class.	-	1.7	1.9
The pupil demonstrates ability to apply mathematical concepts of his grade level (e.g., whole numbers, rational numbers, etc.).	+	2.2	2.4
The pupil needs assistance in mathematics	-	2.9	3.1

TABLE 9 Cont'd.

Item	Type of Item	Average Rating of the Item Pre-Test	Post-Test
The pupil attends mathematics class	+	4.5	4.5
The pupil is concerned for his progress in mathematics.	+	3.0	2.9
The pupil volunteers to help the teacher with mathematics lessons.	+	1.9	2.1
The pupil acts as if he resents attending mathematics class.	-	1.5	1.6
The pupil voluntarily corrects mistakes on mathematics homework assignments.	+	2.1	1.9
The pupil questions the relevancy of mathematics.	-	1.7	1.9
The pupil is interested in mathematics.	+	3.4	3.1
The pupil demonstrates more than normal frustration in mathematics.	-	2.5	2.6

1=1 out of every 5 behavior opportunities
2=2 out of every 5 behavior opportunities
3=3 out of every 5 behavior opportunities
4=4 out of every 5 behavior opportunities
5=5 out of every 5 behavior opportunities

Table 10 contains the differences in the teachers' ratings of pupil behavior from pre-test to post-test of component pupils and non-component pupils. For each item the pre-test teacher rating is subtracted from the post-test teacher rating for both component pupils and non-component pupils. A positive sign in front of the difference indicates a behavior improvement. A negative sign in front of the difference indicates a behavior regression.

As stated above, the behavior ratings indicated that component pupils improved in two behaviors. Of these two behaviors, non-component pupils improved equally in demonstrating the ability to apply mathematical concepts of their grade level. While the component pupils improved their behavior of volunteering to help the teacher with mathematics lessons, non-component pupils demonstrated no gain in this area.

From pre-test rating to post-testing rating component pupils improved their rating on two items, remained the same on four items, and regressed on thirteen items. During the same period, non-component pupils improved their rating on ten items, remained the same on five items and regressed on four items.

The component improved in only two of nineteen identified classroom behaviors. The component did not achieve objective 3.

TABLE 10

DIFFERENCES OF TEACHER RATING FROM PRE-TEST TO POST-TEST OF MATHEMATICS BEHAVIOR OF COMPONENT PUPILS AND NON-COMPONENT PUPILS, 1969-1970

Item	Difference of Rating From Pre-Test to Post-Test: Component Pupils	Non-Component Pupils
The pupil has to be reminded about mathematics assignments.	-.4	-.2
The pupil participates in classroom mathematics discussions.	0	+.2
During mathematics class, the pupil is attentive.	0	+.1
During mathematics class, the pupil initiates discussion.	-.2	-.1
The pupil is able to perform mathematical operations at his grade level (e.g., addition, subtraction, multiplication, division).	0	+.1
The pupil completes mathematics assignments without assistance.	-.1	+.3
The pupil completes mathematics assignments in the allotted time.	-.1	+.1
The pupil persists in solving a difficult mathematics assignment.	-.1	-.2
During mathematics class, the pupil disturbs the class.	-.2	+.2
The pupil demonstrates ability to apply mathematical concepts of his grade level (e.g., whole numbers, rational numbers, etc.).	+.2	+.2
The pupil needs assistance in mathematics.	-.2	0

TABLE 10 Cont'd.

Item	Difference of Rating From Pre-Test to Post-Test: Component Pupils	Non-Component Pupils
The pupil attends mathematics class.	0	0
The pupil is concerned for his progress in mathematics.	-.1	+.4
The student volunteers to help the teacher with mathematics lessons.	+.2	0
The pupil acts as if he resents mathematics class.	-.1	0
The pupil voluntarily corrects mistakes on mathematics homework assignments	-.2	-.5
The pupil questions the relevancy of mathematics.	-.2	0
The pupil is interested in mathematics.	-.3	+.3
The pupil demonstrates more than normal frustration in mathematics.	-.1	-.1

2. Section B - 1970 Summer School

a. Description: The Basic Mathematics Improvement Component conducted summer school classes in the fourteen public elementary schools previously mentioned. In nine of these schools, the regular school year component teacher conducted classes. The other five schools had teachers new to the program.

The duties of the teachers and the supervisor were similar to those during the regular school year component. The summer school component differed from the regular year component mainly in its emphasis. Mathematical concepts and applications were stressed more than computational methods. The pupils made crafts and went on field trips. The component teacher guided the pupils in discovering and using mathematical ideas.

Component classes were conducted in the morning. Teachers were recommended to have three one-hour classes of approximately five to ten students. The teachers varied the schedule in proportion to the amount of response by the pupils.

b. Findings

Objective I. To help the underachieving mathematics pupil make satisfactory progress toward raising his level of grade placement in mathematical computations, applications, and concepts.

INSTRUMENTATION

California Test of Basic Skills (mathematics subtest)

Sample: All summer school component enrollees

Administration: The tests were administered in October, 1969, May, 1970, and July, 1970

Analysis: Frequency distribution by grade level and grade placement.

Results: Table II summarizes the frequency of component enrollees who participated during summer school, by grade level, and who surpassed normal expectations of achievement in computations, concepts, and applications. These pupils attended both the regular school year component and the summer school component. The administration of the pre-test of these pupils occurred in October, 1969, and the post-test administration occurred in July, 1970.

The frequency of improvement in conceptual skills was nearly equal to the frequency of improvement of computational skills. Fourth and fifth graders surpassed normal expectations in each area with equal frequencies. Summer school could contribute to the near equal frequency of pupils surpassing normal expectations in computations and concepts. During the regular school year more pupils surpassed normal expectations in computations than in concepts or applications. After summer school, a nearly equal number of pupils surpassed in concepts as in computation. Fewer pupils surpassed normal expectation in application than in computation and concepts.

TABLE II

FREQUENCY OF COMPONENT ENROLLEES (WHO PARTICIPATED DURING SUMMER SCHOOL) BY GRADE LEVEL WHO SURPASSED NORMAL EXPECTATIONS OF ACHIEVEMENT IN THE THREE AREAS OF THE MATHEMATICS SUBTEST OF THE CALIFORNIA TEST OF BASIC SKILLS (October, 1969 - July, 1970)

		Frequency		
Grade	N	Computation	Concepts	Application
4	29	18	18	9
5	34	20	21	18
6	22	16	10	10
Total	85	54	49	37

N's are for matched pre- and post-test scores

Another way to examine the gains of summer school is to modify the four definitions of improvement which appear on page 16.

Marked Improvement - When a child gains 3 months or more in grade level on a standardized test in the course of 1.5 month program he is said to have made "marked improvement."

Improvement - When a student gains 2 months in grade level on a standardized test in the course of 1.5 month program, he is said to have made "improvement."

Some Improvement - When a child gains between 1 month in grade level and standardized test in the course of 1.5 month program, he is said to have made "some improvement."

Little or No Improvement - If a child demonstrates no gains in grade level on a standardized test during the course of 1.5 month program he is said to have made "little or no improvement."

With these definitions of improvement, summer school data was grouped into frequency distributions - Tables 12, 13, 14.

Marked improvement occurred more in concepts and application than in computation. Thirty-five pupils had marked improvement in concepts and twenty-two pupils had marked improvement in applications while only eleven pupils had marked improvement in computation.

TABLE 12

FREQUENCY COUNT OF THE AMOUNT OF IMPROVEMENT FROM PRE-TEST TO POST-TEST OF PARTICIPANTS IN THE BASIC MATHEMATICS IMPROVEMENT PROGRAM ON THE CALIFORNIA TEST OF BASIC SKILLS, COMPUTATION SECTION, MATHEMATICS SUBTEST
May, 1970 - July, 1970

(Summer)

Grade	Frequency				Total
	Marked Improvement	Improvement	Some Improvement	Little or No Improvement	
4	2	2	6	19	29
5	5	5	2	22	34
6	4	1	1	16	22
Total	11	8	8	57	85

TABLE 13

FREQUENCY COUNT OF THE AMOUNT OF IMPROVEMENT FROM PRE-TEST TO POST-TEST OF PARTICIPANTS IN THE BASIC MATHEMATICS IMPROVEMENT PROGRAM ON THE CALIFORNIA TEST OF BASIC SKILLS, CONCEPTS SECTION, MATHEMATICS SUBTEST

(Summer)

	Frequency				
Grade	Marked Improvement	Improvement	Some Improvement	Little or No Improvement	Total
4	11	2	0	16	29
5	14	2	0	18	34
6	10	1	0	11	22
Total	35	5	0	45	85

TABLE 14

FREQUENCY COUNT OF THE AMOUNT OF IMPROVEMENT FROM PRE-TEST TO POST-TEST OF PARTICIPANTS IN THE BASIC MATHEMATICS IMPROVEMENT PROGRAM ON THE CALIFORNIA TEST OF BASIC SKILLS, APPLICATIONS SECTION, MATHEMATICS SUBTEST

	Frequency				
Grade	Marked Improvement	Improvement	Some Improvement	Little or no Improvement	Total
4	8	2	0	19	29
5	8	0	0	26	34
6	6	1	0	15	22
Total	22	3	0	60	85

Section IV - Relationships and Indicators

A. Congruence with Objectives

The major question an evaluation of outcomes should answer is "How well did the program meet its objectives?"

In answering this question, each objective and the criterion for each objective will be stated for both the 1969-70 regular school year component and the 1970 summer school component. A summary of the data relating to the criterion of the objective will follow.

1. 1969-70 Regular School Year Component

Objective 1.0 To help the underachieving mathematics pupil make satisfactory progress toward raising his level of grade placement in mathematical computations, applications and concepts.

Criterion: The degree to which this objective is realized is the percentage of component enrollees who surpass expected levels of grade placement in at least two of the three mathematics areas: computation, concepts, application.

The frequency of pupils surpassing normal expectations decreased from computation to concepts to applications. The data reflect the emphasis of the component during the school year centered around computational methods. The criterion for objective I was met by the component. Two-thirds of the component enrollees achieved above expectation in two of the three areas (computation, concepts, application):

Objective 2.0 To help the underachieving mathematics pupil become successful in his regular class work.

Criterion: Ninety percent of those enrolled in the component receive a passing grade.

Of the elementary mathematics improvement participants, 89.5% received passing final grades. Of the junior high participants, 70.4% received final passing grades. The component did not achieve objective 2 at the junior high level.

Objective 3.0 To help the underachieving mathematics pupil develop more positive motivations toward mathematics.

Criterion: The pupil will perform classroom learning activities at an increased frequency.

Only two of 19 learning activities indicated change among the component pupils. The pupils indicated increased ability in applying mathematical concepts at their grade level, and the pupils volunteered to help the teacher with the mathematics lesson more frequently. The component did not achieve objective 3.

2. 1970 Summer School

Objective 1.0 To help the underachieving mathematics pupil make satisfactory progress toward raising his level of grade placement in mathematical computations, applications and concepts.

Criterion: No criterion was previously stated.

Data from the regular school year indicated more students surpassed normal expectations in computation than in concepts and application. However, summer school data indicated almost equal numbers of pupils surpassing normal expectations in the three areas previously mentioned.

The summer school data reflects that summer school helped pupils in concepts and applications more than in computation.

Section V - Judgment of Worth

A. Value of Outcomes

The data indicate that a high percentage of component enrollees improved in the achievement areas of computation, concepts, and application. Since measureable achievement in mathematics has a high positive correlation with increased achievement in other disciplines, it is reasonable to assume that a high percentage of component enrollees have attained a higher level of achievement in other subject areas.

Despite the apparent gains made by many of the component participants, the post-test level of achievement indicates that some of the pupils are still in need of additional instruction. That is, despite the fact that notable gains were made on the California test, in some instances the level of achievement is still markedly behind the norms for each grade level. In addition, deficiencies tend to be greater at the upper grade levels.

It is interesting to note that although the seventh grade gains were marked, 26.6 percent of seventh grade pupils received failing grades at the end of the year. Clearly then, the improvement made in the mathematics improvement classes does not indicate that pupils were prepared to return to their regular mathematics classes, except in the rare instances where pupils not only surpassed their expected levels of achievement, but have also met optimal levels of achievement.

B. Recommendations

The examination of the amount of improvement of component enrollees in each area (computation, concepts, application) definitely illustrates that most of the improvement occurred in computational skills. Of the 503 component pupils who were pre-tested and post-tested, 340 of the pupils demonstrated eleven months or more improvement in grade placement on the CTBS in computational skill. Of the same pupils, 263 demonstrated eleven months or more improvement in grade placement on the CTBS in concepts, and 240 demonstrated eleven months or more improvement in grade placement on the CTBS in applications.

Another way to discover if most of the improvement occurred in computation is to examine the number of pupils who demonstrated little or no improvement in grade placement on the CTBS in the three areas. Eighty pupils indicated little or no improvement in grade placement on the CTBS in computation. On the other hand, 173 pupils indicated little or no improvement in grade placement in the CTBS in concepts, and 177 indicated little or no improvement in grade placement on the CTBS in applications.

It is reasonable to postulate that classroom activities in BMIC emphasized computation skills more than conceptual or applicative skills.

Recommendation: Classroom activities should be designed to include more conceptual and applicative areas of mathematics to complement the computational emphasis now in the classroom.

The data of the summer component indicates that the classroom activities of the summer component complement the regular school year component. The post-test of the summer component indicated that equal numbers of pupils surpassed normal expectations in the three areas of computation, concepts and application. However, of the fourteen classrooms in summer school, only 85 pupils were served. This averages to approximately 6 pupils per classroom. Facilities and the time allowed for the summer component indicates that more pupils could be served.

Recommendation: Summer school basic mathematics improvement should be continued. The next summer school component should try to serve more students within each school.

The analysis of final grades for mathematics improvement participants would appear to indicate that elementary pupils were considerably more successful in their regular mathematics classes. 29.6 percent of the seventh graders received failing marks in mathematics. At least two possibilities may be entertained. Elementary pupils did achieve to a much higher degree; their failures constituted only 10.5 percent of the total number of grades reported for mathematics improvement enrollees (N = 461). It could also be suggested that a more rigorous grading policy is followed at the junior high level than at the elementary level.

Recommendation: Final grades should not be viewed as a major indication of the success of the Mathematics Improvement Component.

Final grades could be accompanied by comments from the pupils' regular teachers. These comments should express the regular teachers' assessment of the pupils' capacities to perform as compared to other members of the students' regular class.