A DESCRIPTION OF THE NEW MATHEMATICS PROGRAM IN LEWISBURG PRIMARY GRADES

BY

GERTHA MAXWELL CROWDER

-75

A DESCRIPTION OF THE NEW MATHEMATICS PROGRAM IN LEWISBURG PRIMARY GRADES

A Research Paper

Presented to

the Committee on Graduate Studies

Austin Peay State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts in Education

---

by

Gertha Maxwell Crowder

August 1970

To the Graduate Council:

I am submitting herewith a Research Paper written by Gertha Maxwell Crowder entitled "A Description of the New Mathematics Program in Lewisburg Primary Grades." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts in Education.

Bryan Crutcher
Major Professor

Accepted for the Council:

Wayne C. Stanger
Dean of the Graduate School

ACKNOWLEDGEMENTS

The author wishes to express sincere gratitude to Dr. Bryan Crutcher, major advisor, Mr. Whitnell O. McMahan and Dr. Ellis B. Burns, committee members, for their patience, guidance and direction in the writing of this paper; to Mr. Bill McKinney and Forest Duncan, principals of Lewisburg School, for their permission to conduct this research and to Mr. James Grimes, Supervisor of Logan County, for helpful suggestions and materials.

The primary teachers also made the writing of this paper possible by making available their files for use in this research.

TABLE OF CONTENTS

CHAPTER PAGE

Chapter 1

THE PROBLEM AND DEFINITIONS OF TERMS

Since the turn of the last decade, educators have been concerned with the quality of mathematics programs that had been taught in the schools. Charges of low quality in the content of the curriculum were raised after Russia's scientific achievements.

Much emphasis has been given to research, diagnosis, and remedial procedures. Educational practices have been slow to change because new programs involved teacher re-training, new materials, and structural innovations.

THE PROBLEM

Because of the deficiencies stated above, this paper was undertaken with the following objectives:

1. To relate briefly recommendations of authorities concerning the identification and diagnosis of a good mathematical program in content, materials, facilities, methods of instruction and evaluation procedures.

2. To describe briefly the mathematics program of the first grade at the Lewisburg Elementary School.

3. To make recommendations for the improvement of the first grade mathematics program at the Lewisburg

Elementary School.

DEFINITION OF TERMS

Many new terms were used in the literature reviewed for this paper. In order to communicate the meaning of the authors, definitions of some of the terms have been listed.

Open Sentence is a problem stated in a sentence form with a blank into which a numeral fits to solve or complete an equation. The open sentence reveals certain relationships of addition and subtraction that may not otherwise become apparent.[1]

Set is the term used to designate a collection of objects that have common characteristics.[2]

Elements of the Set are the individual objects.[3]

Subset is a division of an original set.[4]

Empty Set is a set having no elements. The empty space in a place value set is used for understanding numerals above digits. Zero is the name for the empty set when the number is written.[5]

---

[1]Rose and Ruth Weber, Teachers' Guide for the New Mathematics (Wichita, Kansas: McCormick-Mathers Publishing Company, 1963), p. 6.

[2]Joyce Benbroon, Cecile Forester, and James T. Shea, Working with Numbers (Austin, Texas: The Steck Company, 1963), p. 4.

[3]Ibid.

[4]Ibid.

[5]Ibid.

Digit is the symbol for numbers 0 through 9.[6]

Number is an abstract idea that represents quantity. A number is an idea or abstraction that we cannot see or write.[7]

Numeral is the symbol that represents a number.[8]

Names of Numbers are different numerals which may be used to represent the same number. For example, the numeral 5, the word five, the tally mark 𝍸, the Roman numeral V, 4 + 1, 3 + 2, 6 - 1, 7 - 2, 8 - 3, 9 - 4, 5 - 0 are all names for the same number.[9]

One-to-One Correspondence exists between objects that can be matched with no elements left. A one-to-one correspondence exists between two sets if it is possible to associate one and only one element of each set with one and only one element of the other.[10]

Associative Property is the characteristic that is demonstrated when several numbers are added together. You are dealing with them two at a time and the result is the

---

[6]William A. Brownell and J. Fred Weaver, Teaching Numbers We Need (Chicago, Illinois: Ginn and Company, 1963), p. 4.

[7]Rose and Ruth Weber, Teachers' Guide for the New Arithmetic (Wichita, Kansas: McCormick-Mathers Publishing Company, 1963), p. 7.

[8]Ibid.

[9]Ibid.

[10]J. Houston Banks, Elementary School Mathematics (Boston, Massachusetts: Allyn and Bacon, Inc., 1966), p. 26.

same regardless of the order in which they are added.[11]

Commutative Property is the property that two groups of numbers have that allow them to be combined in different ways with the sum always equaling the same number (amount), regardless of the order of combinations or the order of adding.[12]

Ordinal Numbers are the terms of counting as first, second, third, etc., that follow the number system.[13]

Pattern is a group of objects or numerals presenting a sequence that forms a pattern. Example: 18, 21, 20, 23, 22, ...[14]

The Ordered Set is a set whose number of elements progress as the order of natural numbers.[15]

The Number Line is a straight line along which evenly spaced points have been marked. The device is used to add, subtract, multiply or divide.[16]

Numeration System is a mathematical system based upon a certain unit. The common one is based upon units of

---

[11]Bernard H. Gundlock, Ronald Welch, and Edward Buffie, Mathematics (New York: Laidlaw Company, 1968), p. 6.

[12]Ibid.

[13]Weber, op. cit., p. 6.

[14]Patrick Suppes and Shirley Hill, "The Set Theory and the Primary Grades," New York State Mathematics Teachers' Journal, Vol. XIII (New York, 1963), pp. 46-53.

[15]Francis Flournoy, Eugene D. Nichols, and Others, Patterns and Structures (New York: Holt, Rinehart and Winston, 1968), p. 13.

[16]Ibid.

ten. Other numeration systems may be based upon units of two, five, six or other digits.[17]

THE NEED FOR THE STUDY

Although drastic revisions in teaching had long been sought by mathematicians and educators, it was not until the turn of the last decade when the national nervousness caused by Russia's Sputnik roused public support, brought a flood of federal dollars, and gave impetus to foundation funds needed to speed the revolution in Mathematics.

Americans suddenly awoke to the fact that, like it or not, progress rested largely upon science, and that science, in turn, depended largely upon mathematics. The urgent need was no longer for clerks and navigators, but for men able to describe scientific findings accurately, to explain equations, to teach the new brand of arithmetic in accord with principles of computers and automation in machines, and for men able to deal in the type of mathematics required to cope with relativity, quantum theory, and the systematic study of social interaction.[18]

College freshmen could not cope with the new mathematics; therefore, it was first included in the high

---

[17] J. Houston Banks, "Notation Systems," Chapter 4, Elementary School Mathematics (Boston, Massachusetts: Allyn and Bacon, Inc., 1966), pp. 103-115.

[18] Clarence E. Hardgrove (Chairman) and Others, "The National Longitudinal Study of Mathematical Abilities," Report of the School Mathematics Study Group (National Science Foundation, Washington, D. C., 1958), p. 16.

school curriculum, then dropped lower and lower into the grades.

Authorities were convinced that, to be effective, the program must start with the first grade and progress in difficulty from there.[19]

The author realized a responsibility to improve the opportunity for the first grade children to learn concepts in mathematics. Therefore, this study was undertaken in the first grade at Lewisburg School.

---

[19] Op. cit.

Chapter 2

REVIEW OF RELATED LITERATURE

In a review of the new mathematics programs, Adler called attention to the developmental nature of mathematics.

> Mathematics, one of the oldest sciences, is growing with the vigor and vitality of youth. It is constantly expanding into new areas of investigation. Associated with the new concepts and new ideas is a new vocabulary. Numbers and space is still very much the heart of the mathematics program. The new ideas and terms have been developed because the new programs deal with a more penetrating analysis of the properties of numbers.[1]

LIMITATION OF THE OLD SYSTEM

Many aspects of the old system of the teaching and content of mathematics dealt with rote counting and drill of the addition and subtraction facts in the early primary grades. Children simply recited by memory the numbers in sequence. Neglected were the concepts of the real functional uses of numbers. Often quantitative thinking was also inadvertently omitted. The need at that time was for clerks, bookkeepers, and accountants.

Rose and Ruth Weber had this to say:

> Arithmetic cannot depend upon rote learning. Memorized rules create irritation and dislike because

---

[1] Irving Adler, The New Mathematics (New York: The John Day Company, 1957), p. 1.

> of the constant need for repetition, and this dislike promotes forgetting, which in turn requires more repetition. Practice and review will always be required, but if understanding is established, it is not necessary to rely solely upon repetition. Without facility in computation, arithmetic becomes burdensome. Drill is essential in making an automatic response. Beyond the basic combinations, however, there is little that needs extensive drill.[2]

CHANGES DEMANDED BY NEW USES

A new approach to mathematics was indeed necessary, and for a variety of reasons. Some reasons had to do with national interests. Other causes centered on the need for mathematics for personal reasons as wage earners and citizens. These social forces were why mathematics needed to be changed.

Men had orbited the earth, satellites had rocketed into space, astronauts had landed on the moon--all as a result of the great explosion of knowledge that was taking place in the modern era. The culture was a mathematics culture.[3]

New and startling technological and scientific developments were occurring daily. An ever-increasing number of trained scientists and technicians were needed.

---

[2]Rose and Ruth Weber, Teachers' Guide for the New Arithmetic (Wichita, Kansas: McCormick-Mathers Company, 1963), p. 6.

[3]Howard Fehr (Ed.), Mathematical Education in America (Washington, D. C.: National Educational Publishing Company, 1963), p. 180.

A constant flow of trained men and women were needed to design, build, and maintain high speed electronic computers, the intricate mechanism of automation, atomic powered conveyances, and the satellites.[4]

There were uses for mathematics that were unheard of, or even thought of, a few years ago. Chemists and physicists found new uses for mathematics; biologists were applying mathematics to the study of genetics; business men were using mathematics in scheduling production and distribution; and sociologists were using complicated statistical ideas.

Adult citizens needed mathematics to make intelligent decisions and to understand the increasingly technical culture among them.[5]

Because our nation was committed to intensive scientific and technological progress, it was essential that the children's potential for mathematics be fully developed. Their careers depended upon mathematical skills and abilities. These included trades, professions, and academic careers. It was in the elementary school that a solid foundation in modern mathematics had to be established if we were to guarantee that they would study mathematics further in high school and college.[6]

---

[4] _____, "Why We Need Modern Mathematics in the Elementary School," The Resourceful Teacher (Morriston, New Jersey: Silver Burdett Company, 1963), p. 76.

[5] Ibid., p. 76.

[6] Op. cit.

TEACHING METHODS AND CONTENTS OF THE NEW MATHEMATIC PROGRAM

Price suggested the causes in the revolution in teaching mathematics were (1) research in mathematics, (2) automation, and (3) automatic digital computing machines. A modern mathematics program maintains that ideas were acquired as a result of thinking that was done when the ideas already acquired were used as a means of discovering new ideas.[7]

The modern mathematics program was centered around the needs of the child and the structure of mathematics. It had dual aims: (1) the social aim which was intended to promote better living. Children, as they acquired ideas and skills in arithmetic, had real opportunities to put these ideas and skills into use in ways that were significant to them; and (2) the mathematical demands required that children have a high degree of command over the number facts whereby they could, by the use of these concepts, explore new properties of these same number values.[8]

---

[7]Baily Price, "Progress in Mathematics and Its Implications for Schools," The Revolution in School Mathematics (National Council of Teachers of Mathematics, Washington, D. C., 1961), p. 11.

[8]William A. Brownell and J. Fred Weaver, Teaching Numbers We Need (Chicago, Illinois: Ginn and Company, 1959), p. 1.

In teaching a modern mathematics program in the first grade, children were helped to learn to add, subtract, multiply, and divide through the study of numbers and their relationships. Such a program was more interesting and challenging. Children learned through discovery.

Elements of modern teaching focused on the structure of mathematics, the utilization of set concepts, one-to-one correspondence, emphasis on discovering and using patterns, and the consistent use of the number sentences. The inverse operations were also used.[9]

Modern programs introduced material earlier than was previously thought possible or advisable. Exploratory programs, such as those of the School of Mathematical Study Group, The Syracuse University "Madison Project," The Greater Cleveland Mathematics Program and others, reported that children learned much more at an earlier age than they did in the past and that much of the review work in traditional programs was unnecessary and unwise. The method of teaching placed strong emphasis on understanding the decimal system, the early presentation of geometry, the concepts of the point and line, and simple algebra.[10]

The modern mathematics program has grown from ordinary whole numbers we used for counting, through integers,

---

[9]Francis Flournoy and Others, Elementary Mathematics Patterns and Structures (New York: Holt, Rinehart and Winston, Inc., 1966), p. 43.

[10]Op. cit., p. v.

rational numbers, and real numbers, to complex numbers with which an electrical engineer described an alternating current. Different numeral systems were introduced. Pupils were helped to create equivalence classes of fractions and to identify properties of familiar shapes.

The Cambridge Conference on School Mathematics encouraged an intensive study and discussion among mathematicians relating to the present content structure and sequence of mathematics curricula and also the education of teachers. This conference is also of the opinion that more time is needed for the research before conclusions can be drawn.

The University of Illinois Arithmetic Projects found more research is needed before a final report is prepared.

Although the research groups working in the evaluation of the new mathematics programs have not finally reached conclusions, all agree that the new mathematics more nearly meets the needs of students in a modern education program.

In essence the programs were based upon the teaching of concepts, learning through the method of discovery with the elimination of that which was not useful and the substitution of only the new concepts that added to the total learning situation of the child.

MATERIALS, EQUIPMENT AND FACILITIES

Materials, equipment, and machines were abundant for use in teaching the concepts advocated in the new mathematics program. Manipulative objects were often used in the early grades so that a child could discover the true facts of a problem by using elements to develop a set or by moving these same elements around to better sense the meaning of relationships and the associative and commutative values of numbers.

Work-text, manipulative objects, charts, lesson pages, cards for various concepts, games, measuring devices, flannel boards, cut-outs, records, and films were a part of the vast production of mathematical aids.

Chapter 3

DESCRIPTION OF THE MATHEMATICS PROGRAM AT LEWISBURG SCHOOL

Lewisburg School was a traditionally graded school with three sections for the first grade. Class organization was a flexible, heterogeneous grouping within a self-contained classroom.

In 1967 the first grade teachers, acting upon the conviction that the current mathematics program of Lewisburg School was inadequate, planned and helped to implement a new program for the first grades. Other grades were to work out coordinating sequences in the primary unit, grades two and three.

As a first step the New Arithmetic series published by McCormick-Mathers was chosen as a guide for the changing program. This was a transition between the old and the new method of teaching mathematics. From this beginning, a new mathematics program was developed.

The program had been in use for three years (1967-1969); therefore the writer chose to examine the program in reference to the method of teaching and the adequacy of the contents.

To secure the subjects for the study, an enumeration of the children who had taken part in the program was made. Of the 78 pupils who entered the program in

September 1967, only 60 remained in the Lewisburg School to complete the primary instructional period. These 60 children were designated as Group B for the convenience of the writer. Progress charts of these children were examined in grades 1-3. See Appendix A.

At the entrance to the fourth grade an achievement test score in mathematics was compiled for the 60 children who had completed the three years in the new mathematics program. These scores are listed in Appendix B, table 1.

As a further means of evaluating the program, scores of Group B were compared with intelligence scores and mathematics scores of another group labeled Group A.

Group A was also tested at the entrance to the fourth grade in 1967 after having completed the primary grades at Lewisburg School before the new mathematics program was introduced. There were 71 children in this group.

Group A was given the Otis Quick-Scoring Mental Ability Test in October, 1967. The test form used was the Beta and the form used was the FM. The results were recorded in Appendix B, table 1.

Group A was given the Standiford-Otis-Lennon Test, form CA in October, 1967. The mathematics scores from these tests were recorded in Appendix B, table 2. The numbers representing the children in table 2, Appendix B, refer to the same children listed by those numbers in table 1 of Appendix B.

Group B was given the same test in October, 1969, as Group A took in October 1967. The scores of Group B were recorded in Appendix B, tables 3 and 4. The numbers assigned to the children in table 4 refer to the same children listed as those numbers in table 3.

TEACHING METHODS AND CONTENTS

The teaching method used in the new mathematics program was largely that of the discovery method. Multi-work texts were used as guides and for follow-up experiences.[1,2,3] Teaching was done by the presentation of planned experiences which led to the self-discovery of facts. Deductive reasoning was encouraged.

The learning experiences chosen usually had a close relationship to those often experienced in the everyday life of the children. To discover certain facts suggested by the situation, a child was called upon to use specific skills of reasoning and computation. Pupils were led to

---

[1]William A. Brownell and J. Fred Weaver, Teaching Numbers We Need, Book 1 (Chicago, Illinois: Ginn and Company, 1958).

[2]Francis Flournoy and Others, Elementary Mathematics Patterns and Structures I (New York: Holt, Rinehart and Winston, Inc., 1968).

[3]Robert Morton and Others, Modern Mathematics Through Discovery, Book I (Morristown, New Jersey: Silver Burdett Company, 1968).

discover by inquiring and experimenting. The teacher's role was to prepare the children for the learning experiences, to stimulate them to make inquiries, to channel their efforts and to help them to draw conclusions from their discoveries.

Lessons were divided into these parts: (1) pupil objectives, (2) new vocabulary, (3) background material, (4) teacher preparation, (5) pre-book lesson, (6) book lesson (presentation of examples through activities), (7) maintenance of skills (pupils worked independently on work related to objectives of the day's lesson), and (8) reteaching and follow-up.

Contents

The contents of the Lewisburg mathematics program for the first grades was worked out in meetings of the first grade teachers and the supervisor of instruction for Logan County. Efforts were made also in these meetings to insure coordination and continuity of teaching.

The program that was presented for the structure of the new mathematics program is listed on the following pages:

Unit 1

Pre-Number Concepts

Sets

Members of a Set

Comparing Sets

More than, Fewer than

Equivalent Sets

Ordering Sets

Introducing the Numbers 1 to 9

The Empty Set--Zero

Writing Numerals 0 to 9

Introducing the Decimal Numeration System

Test

Unit 2

Joining Disjoint Sets

Partitioning Sets

Addition and Subtraction--inverse operations

Number Combination with Sums to 6

One as Addend, Zero as Addend

Commutative Property of Addition

Addition Table

Ordinals

Test

Unit 3

Inequalities

Reviewing Unit 1 and 2

Problem Solving

Counting by Fives, Tens, and Twos

Even and Odd Numbers

Test

Unit 4

Telling Time

Problem Solving

Addend--Addent--Sum Relationship

Addition and Subtraction with Sums 7 and 8

Commutative Property reviewed

Vertical Notation

Money

Associative Property of Addition

Test

Unit 5

Three Dimensional Objects

Geometric Figures

Geometric Regions

Comparing Lengths

Measurements

Addition and Subtraction Combinations with Sums 9 and 10

Comparing Numbers

Using Associative Property

Problem Solving

Test

Unit 6

Review--Decimal Numeration System, Inequalities, Counting by Tens and Fives, Addition and Subtraction

Problem Solving

Counting to 200

Test

Unit 7

Adding and Subtracting Tens

Comparing Numbers

Adding and Subtracting Tens and Ones

Problem Solving

Making a Calendar

Practice

Test

Unit 8

Introducing Fractional Numbers

One Half of a Set

Review--Money, Time, Associative and Commutative Properties of Addition

Discover Combinations with Sums 11 to 12

Test

Unit 9

Review: Problem Solving

Using Associative Properties to Discover Combination with Sums 13 to 18

Addition Tables

Finding Patterns on the Addition Table

Readiness for Multiplication and Division

Test

FACILITIES, EQUIPMENT AND MATERIALS

Facilities at the Lewisburg School for the first grade were that of three self-contained classrooms within

an organization of a 1 through 12 graded rural school. However, the primary grades are housed in a separate building.

Each classroom contained a small library which was supplemented by a larger library located in the high school building. A city library and a county library in connection with a bookmobile unit supplies books, records and films.

Other materials available were those listed below:

Flannel Boards

Magnetic Boards

Kits of Materials for Flannel Boards and Magnetic Boards

Number Lines

Various Models of Hundred Numeral Charts, Individual and Poster Sizes

Counting Frames

E-Z Counts for Each Pupil

Clock

Individual Desk Sets--Paste Slicks, Tongue Depressors, or 4 inch dowels for use in Lesson on Decimal Numeration System

Individual Desk Collection--10 Desks, 5 square pieces of tagboard (2 x 2); Set of cards 2 x 3 with Numerals 0 to 9 written on them and an envelope for storage

Clockface

Number Box

Number Cards

Picture Number Cards

Pattern Number Cards

Picture Cards for Number Facts

Pattern Cards for Number Facts

Number Dictionary Chart

Number Pockets

Number Strips

Peg Board

Dominoes

Perpetual Calendar

Scissors, paste, paper, crayons

Games

Ask and Draw

Climb The Ladder

Connecto

Cross The River

Fish

Fish With Bait

Follow Me

Guess Again

Hooked

Number Bingo

Numberland

Old Hat

Patterns

The Wizard

Films

Arithmetic For Beginners. Baily Films, Inc., Hollywood, California

Let's Count. Coronet Films, Chicago, Illinois

Number System, The. Encyclopedia Britannica Films, Inc., New York

Filmstrips

Using and Understanding Numbers. Society for Visual Education, Inc., Chicago, Illinois

Work and Play With Numbers. Eyegate House, Inc., New York

EVALUATION PROCEDURES

The team of first grade teachers chose the progress chart as the chief means of evaluating the progress of each child's achievement in mathematics. A skill's progress chart was constructed for each child. Evaluations scores were recorded at the end of each teaching unit. Each skill that was taught was tested and checked on the form. The date each child had satisfactorily responded to the test of each skill was recorded. A sample of this evaluation is included in Appendix A.

Work habits were also a vital part of this first year evaluation. Habits were scored by the teacher's observation of the time and manner in which a child completed an assignment of work. These habits were checked as superior, satisfactory, and unsatisfactory. Grading in the first year was done individually as each child progressed in skills.

Formal intelligence tests and standardized achievement tests were not given at this grade level except in cases which the teacher referred to the supervisor of instruction as being of unusual high or low achievement.

Achievement and intelligence tests were given at Lewisburg School at the beginning of the fourth grade level each year in October. Therefore these test scores were the only other data available for comparison of the two groups.

Chapter 4

SUMMARY AND RECOMMENDATIONS

Educators have agreed that the old mathematics did not fully serve the needs of the students. The characteristics of the newer programs included the incorporation of new subject matter, the deletion of some of the less useful content, reorganization of subject matter, acceleration, and new methods of teaching. Emphasis was upon deductive reasoning and critical thinking.

Automation and scientific discovery depended upon new and fast methods of computation that were reliable and could easily be recorded. Aided by mathematics almost every branch of science grew at a fantastic rate. Every solved problem provided a take off from which new questions could be asked and answered.

In 1967, the first grade teachers at Lewisburg studied the mathematics program of that school. The team of teachers felt that the program did not meet the criteria for an adequate elementary school mathematics program.

Test scores of 71 pupils who had finished the primary unit were secured. This group was designated as Group A. Group A finished the primary unit before the new mathematics program was initiated. A plan was devised whereby the scores of Group B would be compared with the

scores of another 60 pupils who finished the primary grades three years later. These pupils composed Group B. They had three years of instruction in the new mathematics program at Lewisburg School.

The new mathematics program at the Lewisburg School was planned and implemented in 1967. It was evaluated after three years--1967-1968, 1968-1969, 1969-1970.

Multiple work-texts were used and a table of contents was formulated. Units of work were evaluated by the use of progress charts.

The discovery method of teaching was used by the teachers in presenting units of work in lesson forms to the children. Deductive reasoning and critical thinking replaced drill and rote memorization.

Comparative test scores of Group A and B revealed that the children of Group B scored somewhat higher in concepts and application.

More research with fewer variables would be necessary before any differences could be attributed to the use of either of the programs.

Strengths of the Program

The revised program at the Lewisburg School for the first grades seemed to be effective in a number of ways:

1. Progress charts revealed that certain specific skills were learned at an earlier date in the area of concepts and the general application of these concepts.

2. Achievement test scores of those pupils who took part in the new mathematics program compared favorably with those taught by the old method.

3. Children were evaluated upon their own progress of skill development.

4. Children taking part in the new program recorded test score medians of 3.8 for concepts and 3.8 for application. Children taught by the traditional method had median scores of 3.5 in concepts and 3.4 in application.

5. Contents of the program were enlarged to include new mathematical concepts.

Weaknesses of the Program

Although the new mathematics program at the Lewisburg School seemed to be an improvement over the old method, many handicaps existed:

1. Materials were not housed in a conveniently located place. Heavy equipment was kept in another building; therefore, it was not used as often as desired.

2. A duplication of manipulative objects kept in each classroom could have been eliminated if there had been a materials center.

3. Teaching machines were not available.

4. Formal testing devices, such as standardized achievement tests and individual intelligence tests, were not administered in the first grades.

5. Coordination of the program was often less than

adequate.

RECOMMENDATIONS FOR IMPROVEMENTS

These recommendations for the improvement of the Lewisburg mathematics program were advised:

1. A materials center was needed.
2. Teaching machines should be provided.
3. Standardized achievement tests and individual intelligence tests should be administered to the first grades.
4. Heavy equipment should be available within the building.
5. A planning and evaluating committee composed of teachers from all grades, supervisor of instruction, guidance personnel, and administration representatives, should be set up to insure adequacy of content, coordination and continuity of the program.

BIBLIOGRAPHY

BIBLIOGRAPHY

Adler, Irving. The New Mathematics. The John Day Company, New York, 1955.

Banks, J. Houston. Elementary School Mathematics. Allyn and Bacon, Inc., Boston, Massachusetts, 1966.

Benbroon, Joyce, and Cecile Forester. The Teachers' Edition of the New Working With Numbers. The Steck Company, Austin, Texas, 1963.

Bergamini, David, and Editors of Life. Mathematics: Numbers Along The Way from One to Zero. Time, Inc., New York, 1968.

Brownell, William A., and Fred Weaver. Numbers We Need, Book Two. Ginn and Company, Chicago, Illinois, 1958.

Fehr, Howard, (Ed.). Mathematical Education in America. National Educational Publishing Company, Washington, D. C., 1963.

Flournoy, Francis, Eugene D. Nickols, Robert Kaline and Leonard Simon. Elementary Mathematics, Patterns and Structures (Revised Teachers' Edition). Holt, Rinehart and Winston, New York, 1963.

Gundlach, Bernard H., Ronald Welch and Edwin Buffie. Mathematics. The Laidlaw Company, New York, 1968.

Hargroves, Charles E. (Chairman and Others). "The National Longitudinal Study of Mathematical Abilities," (Report of the School Mathematics Study Group). National Science Foundation, Washington, D. C., 1958.

Price, Bailey, "Progress in Mathematics and Its Implications for Schools." The Revolution In School Mathematics. The National Council of Teachers of Mathematics, Washington, D. C., 1961.

Suppes, P. and Shirley A. Hill. "Set Theory in the Primary Grades." New York State Mathematics Teachers' Journal, 1963.

Weber, Rose and Ruth Weber. The Teacher's Guide for the New Arithmetic. McCormick-Mathers Publishing Company, Wichita, Kansas, 1963.

Weber, Rose and Ruth Weber. The Teacher's Guide for the New Mathematics. McCormick-Mathers Publishing Company, Wichita, Kansas, 1963.

Author not listed. "Why We Need Mathematics In the Elementary School," The Resourceful Teacher. Silver Burdett Company, Morristown, New Jersey, 1963.

APPENDIX A

Progress Chart

INDIVIDUAL PROGRESS CHART FOR FIRST GRADE

	Check Category and Date			
	to 10	to 50	to 100	to 100
	Date	Date	Date	Date
Counting				
Reading Numbers				
Writing Numbers				
Adding sums				
Subtracting				
Correspondence				
Fractions				
1/2				
1/3				
1/4				
Measures				
Calendar				
Liquids				
Pints				
Quarts				
Time to 1/2 hour				
Money (to dollar)				
Multiplication readiness				
Number lines				
Open sentences				
Order of numbers				
Place value of numbers				
Size				
Zeros				
Shapes				

APPENDIX B

Intelligence and Achievement Scores for Groups A and B

Table 1 -- Group A

Otis Quick Scoring Mental Ability Test Results
Given October 26, 1967 for Group A

Subject (Child)	C A Yrs.	C A Mos.	Score	IQ	M A Yrs.	M A Mos.
1	8	11	39	126	12	8
2	8	2	29	120	11	1
3	9	3	36	120	12	2
4	8	11	33	120	11	8
5	9	2	34	119	11	0
6	9	2	34	119	11	0
7	9	5	33	116	11	8
8	8	11	29	116	11	1
9	8	11	28	115	11	0
10	9	2	30	115	11	2
11	8	5	24	114	10	5
12	8	11	26	113	10	8
13	9	4	30	113	11	2
14	9	9	20	110	11	2
15	8	10	26	110	10	8
16	9	0	27	110	10	10
17	8	10	22	109	10	1
18	9	4	29	109	11	1
19	9	4	29	109	11	7
20	9	7	26	108	10	8
21	9	0	20	106	9	10
22	9	8	28	106	11	0
23	9	7	21	103	10	3
24	9	4	20	103	9	10
25	9	9	23	103	10	3
26	8	11	16	103	9	3
27	10	11	30	102	11	2
28	9	1	17	102	9	5
29	9	3	20	101	9	0
30	8	10	18	101	9	0
31	10	8	26	100	10	8
32	9	7	18	100	9	7
33	8	11	12	99	8	9
34	9	10	21	98	9	9
35	9	2	16	98	9	1
36	9	6	19	98	9	4
37	9	5	15	98	9	2
38	9	7	16	98	9	3
39	9	7	16	98	9	3
40	10	0	21	97	9	7
41	10	3	23	97	9	10
42	10	6	21	96	10	0

Table 1 (continued)

Subject (Child)	C A Yrs.	C A Mos.	Score	IQ	M A Yrs.	M A Mos.
43	10	4	20	96	9	10
44	9	9	19	96	10	3
45	10	10	23	96	10	3
46	8	11	12	95	8	9
47	10	3	17	94	9	5
48	9	11	14	93	9	0
49	9	4	13	93	8	10
50	10	7	21	93	9	0
51	8	7	14	93	9	0
52	9	11	14	93	9	0
53	9	7	14	93	9	0
54	10	1	17	92	9	0
55	9	8	13	91	9	0
56	10	1	17	92	9	0
57	9	8	13	91	8	10
58	12	3	30	90	10	10
59	9	7	11	90	8	7
60	9	10	9	89	8	9
61	9	10	9	89	8	9
62	10	3	12	89	8	9
63	10	4	16	89	9	3
64	9	9	12	89	8	9
65	9	6	8	88	8	2
66	10	5	12	88	8	6
67	10	0	10	85	8	5
68	11	2	19	82	9	8
69	11	2	19	82	9	8
70	13	1	18	77	9	7
71	14	0	13	67	8	10
Group A Median Scores	9	6	19	98	9	4

Table 2

Achievement Test Scores in Mathematics for Group A
Given in October, 1967

Subject	Mathematics Scores (Gr. level)		
	Computation	Concepts	Application
1	4.6	3.7	3.2
2	3.7	3.6	3.2
3	4.8	3.1	3.4
4	3.9	3.5	3.3
5	4.8	4.0	3.9
6	3.7	4.0	4.0
7	3.9	3.3	3.5
8	3.2	3.3	3.3
9	4.9	3.8	4.4
10	4.7	4.0	5.2
11	5.5	5.0	5.6
12	4.7	3.3	4.0
13	3.7	3.0	3.5
14	3.9	3.2	2.7
15	5.0	4.3	4.2
16	4.7	4.0	3.9
17	4.9	3.3	3.3
18	5.1	3.3	3.7
19	4.7	4.3	3.9
20	4.7	6.2	5.1
21	5.1	3.8	3.4
22	3.8	2.9	3.3
23	5.6	7.5	5.2
24	4.7	4.0	3.0
25	5.5	3.6	4.7
26	4.6	3.2	4.3
27	3.9	3.9	3.7
28	4.2	3.2	3.6
29	3.5	3.0	3.0
30	3.7	3.3	3.4
31	4.9	3.8	4.2
32	5.1	5.0	4.7
33	4.0	3.3	3.8
34	3.2	3.0	3.4
35	4.8	2.9	3.5
36	4.9	3.8	4.3
37	4.7	3.9	3.5
38	4.7	4.0	4.2
39	5.0	4.3	4.2
40	3.9	3.5	3.6
41	3.9	3.2	2.9
42	4.0	3.9	3.9

Table 2 (continued)

Subject	Mathematics Scores (Gr. level)		
	Computation	Concepts	Application
43	4.3	3.5	3.0
44	4.1	3.7	3.4
45	4.3	3.0	3.0
46	2.9	2.0	2.6
47	4.1	3.4	4.0
48	4.0	3.5	4.0
49	5.0	3.0	3.3
50	3.8	3.2	3.9
51	4.0	5.6	5.7
52	3.6	2.7	3.2
53	3.8	3.0	2.9
54	3.6	3.7	3.2
55	4.2	4.3	4.3
56	3.7	3.0	3.7
57	3.3	3.0	3.1
58	4.8	4.0	4.2
59	4.1	4.1	4.4
60	3.1	2.1	2.3
61	3.4	2.9	1.6
62	3.0	3.0	3.1
63	2.9	2.8	3.0
64	3.1	2.7	2.1
65	3.0	3.1	2.9
66	3.8	3.5	3.9
67	3.9	3.9	3.8
68	3.2	3.0	3.2
69	3.4	3.0	2.9
70	3.3	3.0	3.0
71	2.7	2.8	2.0
Group A Median Scores	4.1	3.5	3.4

Table 3

Otis Quick Scoring Mental Ability Test
Given in October, 1969
For Group B

Subject (Child)	C A		Mental Ability Test Scores			
	Yrs.	Mos.	Score	IQ	M A Yrs.	Mos.
1	9	0	39	125	12	7
2	10	10	46	122	13	6
3	8	2	29	120	11	1
4	9	3	36	120	12	2
5	9	2	34	119	11	10
6	9	6	39	118	12	4
7	9	9	38	115	12	2
8	8	5	24	114	10	5
9	8	11	26	113	10	8
10	9	2	27	112	10	10
11	9	2	26	111	10	8
12	8	11	24	111	10	5
13	9	9	30	110	11	2
14	9	2	25	110	10	7
15	8	6	29	108	10	8
16	9	7	28	108	10	8
17	9	0	39	108	12	4
18	8	11	20	107	9	10
19	9	10	29	106	10	8
20	9	11	26	105	10	8
21	10	10	29	105	10	8
22	10	2	30	104	10	10
23	9	9	23	103	10	8
24	8	11	16	103	9	3
25	9	7	21	103	10	0
26	9	11	27	103	10	5
27	10	0	26	102	10	3
28	10	11	30	102	11	2
29	8	10	14	101	9	0
30	10	1	24	99	10	1
31	10	3	25	99	10	1
32	10	3	25	99	10	1
33	10	1	24	99	10	0
34	10	3	25	99	10	1
35	9	6	19	98	9	5
36	9	5	15	98	9	2
37	9	5	15	98	9	2
38	9	7	16	98	9	3
39	9	6	19	98	9	5
40	10	3	23	97	9	10
41	10	0	21	97	9	7
42	9	6	18	97	9	2

Table 3 (continued)

Subject (Child)	C A		Mental Ability Test Scores		M A	
	Yrs.	Mos.	Score	IQ	Yrs.	Mos.
43	10	3	23	97	9	10
44	10	4	20	96	9	4
45	10	10	23	96	10	3
46	10	3	22	96	9	8
47	10	4	20	93	9	5
48	9	11	14	93	9	0
49	10	1	17	92	9	0
50	12	3	30	90	10	10
51	10	6	17	89	9	0
52	10	10	19	89	9	3
53	9	10	9	89	8	9
54	10	0	10	89	8	5
55	10	5	12	88	8	9
56	9	6	8	88	8	2
57	10	7	15	87	8	9
58	10	6	11	83	8	2
59	11	2	19	82	9	8
60	13	1	18	77	9	7
Mental Ability Test Median Scores	10	1		99	10	1

Table 4

Achievement Test Scores in Mathematics for Group B
Given in October, 1969

Subject (Child)	Mathematics Scores (Grade level) Computation	Concepts	Application
1	5.2	5.0	5.0
2	5.0	5.1	5.0
3	5.1	5.0	4.9
4	5.2	4.9	5.3
5	4.1	4.5	4.3
6	3.7	3.7	3.8
7	4.8	4.7	4.9
8	4.5	4.4	4.4
9	4.4	4.1	4.0
10	4.0	4.1	4.1
11	4.1	4.1	4.1
12	4.3	4.2	4.2
13	4.6	4.5	4.4
14	3.9	4.1	3.9
15	4.0	4.4	5.1
16	4.2	3.8	3.9
17	4.0	3.7	3.9
18	3.8	4.2	3.9
19	3.9	3.8	3.8
20	5.2	3.7	3.6
21	3.2	3.3	3.0
22	3.7	4.0	4.1
23	4.3	4.0	3.9
24	3.8	3.8	3.6
25	4.4	4.0	4.1
26	3.9	2.9	3.1
27	4.0	3.8	3.6
28	5.1	4.2	4.6
29	3.6	3.5	4.1
30	3.9	3.7	3.8
31	4.2	4.2	4.1
32	3.9	3.7	3.9
33	4.0	4.0	3.2
34	3.7	3.9	3.6
35	3.2	3.4	3.6
36	3.7	3.7	3.1
37	3.1	3.2	3.2
38	3.5	3.1	3.4
39	4.0	3.8	3.0
40	3.9	3.5	3.5
41	3.6	3.7	3.2
42	4.0	3.9	3.7

Table 4 (continued)

Subject (Child)	Mathematics Scores (Grade level) Computation	Concepts	Application
43	4.2	4.1	4.0
44	5.0	4.5	4.8
45	4.1	4.0	4.0
46	3.6	4.0	3.9
47	3.9	3.8	3.4
48	3.9	3.1	3.0
49	3.1	3.0	2.9
50	3.9	4.0	3.8
51	3.5	3.6	3.8
52	3.9	3.0	3.4
53	3.6	3.5	3.6
54	3.1	3.7	3.6
55	4.0	3.7	3.5
56	3.6	3.0	3.1
57	3.7	3.2	3.7
58	3.8	3.5	3.4
59	3.4	3.2	3.3
60	2.5	2.7	2.3
Achievement Test Median Scores	4.0	3.8	3.8

*Corresponding numbers in table 3 and 4 refer to the same child.

APPENDIX C

Work Habit Checklist

Work Habits

Directions:
Check each child's habits at the end of each unit of work.

	Superior	Satisfactory	Unsatisfactory
Finishes assignments on time		x	
Works independently	x		
Asks for additional work	x		
Does work neatly			x
Participates in group discussion		x	
Participates in group activities	x		
Leadership		x	
Follows as well as leads			x
Cooperates		x	
Shares materials		x	
Uses time wisely		x	