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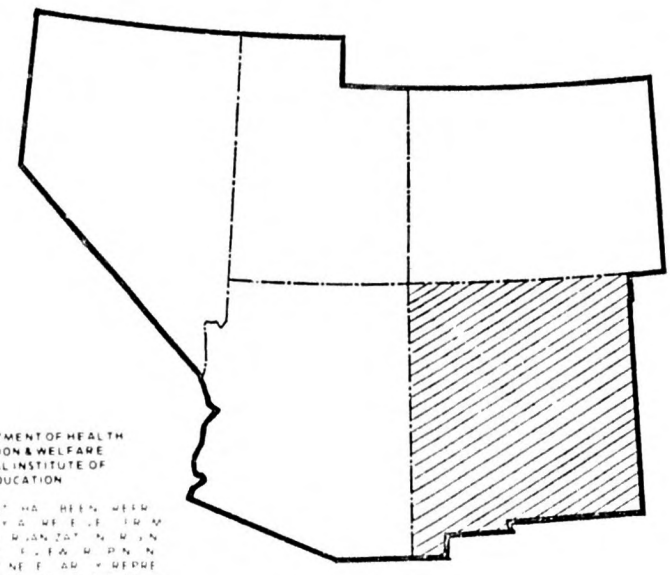
ABSTRACT

In an effort to resolve the small school problems of limited math offerings, small classes, scheduling, and teacher overload, a secondary teacher from Quemado, New Mexico (a rural area) initiated use of five different programmed mathematics courses in one class period. Objectives were to: increase math offerings; decrease scheduling problems; increase motivation; provide for individual differences; meet requirements re: modern math and examining bodies; limit heavy grading duties; promote student development in formula solving, graph reading and construction, math nomenclature, etc.; and increase teacher time for individualized and/or group instruction. Employing a teacher's aide, a grading system built upon point accumulation, and student carrels, programmed courses in basic math, beginning and advanced algebra, plane geometry, and trigonometry were offered twice daily in two 45 minute periods. Results indicated: high student interest at the beginning of the year with a gradual slow down, particularly among the slower students; difficulty in getting all students to work at a rate commensurate with their ability; most teacher attention directed at slow students; increased teaching demands; and increased course completion by graduating seniors (the appendices presents a 1959-65 breakdown of course completion, the grading system, and a student's evaluation of programmed instruction). (JC)

NEW MEXICO
Western States Small Schools Project

PROGRAMMED MATHEMATICS

QUEMADO HIGH SCHOOL



STATE DEPARTMENT OF EDUCATION

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Foreword

The purpose of this publication is to assist administrators and teachers contemplating the use of programmed mathematics in their schools. We hope to assist by reporting the classroom experience of Mr. Darril Goodman, high school mathematics teacher in the Quemado Public Schools, Quemado, New Mexico, with programmed mathematics.

This study was conducted under the auspices of the New Mexico Western States Small Schools Project, a project directed by the New Mexico State Department of Education and financed by the Ford Foundation.

The consultant for the study was Miss Lura Bennett, Specialist in Mathematics, New Mexico State Department of Education, who worked consistently with the teacher and the students.

In this study, five mathematics courses were offered in the same period of time. This, of course, increased the number of mathematics offerings, and it also made the construction of the high school class schedule easier.

The classroom aide mentioned in this report was a study in itself. For more details of the classroom aide position, write to the Project Director, Small Schools Project, State Department of Education, Santa Fe, New Mexico, 87501.

DAN D. CHAVEZ
Project Director

Problems and Objectives

This section lists the problems. The objectives are also listed.

PROBLEMS

1. Limited offerings in mathematics
2. Difficult scheduling of mathematics courses
3. Small classes—lack of competition encourages lax habits
4. Too much teacher time devoted to grading homework

OBJECTIVES

By the use of programmed mathematics, our objectives are:

1. To increase the number of mathematics offerings
2. To partially resolve the difficulty of class scheduling by the use of multiple class situations; that is, offering more than one mathematics course in the same period of instruction
3. To create in the pupil a desire to learn mathematics
4. To provide for individual differences
5. To meet requirements of (1) modern mathematics courses of study, and (2) examining bodies
6. To eliminate the time devoted to grading homework; thus, devoting more time to teacher planning
7. To develop the ability of students to solve formulas
8. To develop the ability of students to read and construct graphs
9. To introduce the students to and make them reasonably familiar with the vocabulary and nomenclature of mathematics
10. To develop mastery of the fundamental skills, principles, and processes used in mathematics

By the employment of a classroom aide, we hope to:

11. Relieve the teacher of time-consuming, record-keeping tasks related to programmed instruction
12. Have the teacher devote the entire class period to providing individualized or small group instruction

Programmed Mathematics: Organization and Administration

By Darril Goodman

This part is dvoted to sections regarding materials used, organization and administration, role of the classroom aide, grading and reporting to parents, student carrels, comments on programmed instruction, and observations.

Programmed Materials Used

The programmed mathematics courses used were five in number:

Name of Course	*Name of Program*	*Company*
Basic Mathematics	Basic Mathematics	TEMAC
Algebra I	Modern Mathematics, Course I	SRA
Algebra II	Algebra II	TEMAC
Plane Geometry	Modern Mathematics, Course 2	SRA
Trigonometry	Trigonometry	TEMAC

Organization and Administration

Two class periods are devoted to mathematics in the Queemado High School class schedule. Five programmed courses are offered in each of the two periods. Thus, a student can enroll in any one of five programmed courses. This arrangement makes the construction of the high school class schedule much easier.

The two classes meet five times a week; each period is 45 minutes in length. The period was shortened from 60 minutes to 45 minutes because 60 minutes was too long for students to concentrate on the program without becoming bored.

The first part of the period is devoted to students who need extra help on a particular subject. The last part of the period is spent with students who need little help. Nevertheless, any student may come to the teacher any time during the period for assistance. Most of the time is spent going through tests the students have taken the day before. It is the student's responsibility to take the tests over the different chapters as they feel ready for them. It is the responsibility of the teacher to find out where and why the student is failing, and then to assist the student by means of individual conferences.

Role of the Classroom Aide

An aide has been employed to assist the teacher. The aide relieves the teacher of many tasks; this, of course, gives the teacher more time to devote to individual conferences with students.

The aide takes roll, administers chapter tests as students complete the chapters, supervises and grades the objective-type chapter tests, and grades the chapter tests. The aide keeps records of tests administered and homework and classwork completed. The aide also prepares instructional material the teacher plans.

Grading and Reporting to Parents

Six-week (and semester) grades in programmed mathematics are based on a point system. The grade system is based on a minimum and maximum number of points. The minimum grade is determined by taking the minimum number of chapters a student should complete successfully by the end of the semester to receive credit, then multiplying this number by the minimum passing grade. The maximum grade is determined by taking the maximum number of chapters that may be completed, then multiplying this number by the maximum grade (100). The grades in between are scaled evenly between the minimum number of points and the maximum number of points. The report also indicates the number of points the grade was based on. The semester grade was also based on the point system.

Student Carrels (Study Booths)

In the first year of the project (1962-63), regular student desks were used. This arrangement was found to be unsatisfactory in the use of programmed instruction: students were easily distracted by the actions of other students—primarily walking and talking.

As a result, carrels were built. These carrels were constructed along the perimeter of the room. With these arrangements, students were less distracted. These arrangements also made it easier for the teacher to supervise and assist the students.

Comments on Programmed Instruction

Programmed instruction is excellent for providing for individual differences among students. The use of programmed instruction also provides the opportunity for the teacher to spend more time on individualized instruction. The nature of programmed instruction does not necessitate the use of teacher time to grade homework. The exclusive use of programmed instruction will result in monotony and boredom.

Observations

1. Student interest was high at the beginning of the year. At the end of the first six-week period. some of the students—especially the slow students and those students not interested in mathematics—started slowing down.
2. When other teachers gave big assignments, ments, students slowed down in their programmed instruction work.
3. If classes become larger than usual, there is not enough teacher time to provide individualized instruction.
4. There is difficulty in gettting all students to work at a rate commensurate with their ability.
5. The use of programmed instruction does not make teaching easier; in fact, it makes teaching more difficult.
6. The slow students received most of the teacher's time.
7. The number of courses completed by graduating seniors increased. (See Appendix A)

Appendix A. Number of Mathematics Courses Completed by Graduating Classes

This table shows a comparison of the number of mathematics classes taken by graduating classes from 1959 to 1965. The table also shows the number of mathematics courses completed by next year's sophomores, juniors, and seniors.

Graduating Class	Average Number of Mathematics Courses Completed	Remarks
1959	1.3	
1960	2.2	
1961	1.3	
1962	2.0	
1963	2.2	First year of project
1964	3.3	
1965	3.0	
1966	2.7	One more year of high school
1967	1.9	Two more years of high school
1968	.88	3 more years of high school

Appendix B. Memorandum to Parents on Grading

TO: Parents and students

FROM: Darril H. Goodman

SUBJ: Report to Parents on Grading of Programmed Mathematics

This year we are reporting the six weeks progress on the report card. A point system is being used. Students will be graded on the number of points earned each six weeks. The points are based on the scores the student receives on the chapter tests. The final grade will be determined by the total number of points the student earns in the course. The six weeks average does not determine the final grade; the total number of points earned during the year will determine the final grade. Each six weeks grade gives you and the student a better idea of how the student is doing. A student could do poorly one six weeks, but in the following six weeks, this could be corrected with extra effort. The following page is a report on this six weeks work and the point scale upon which the grades will be based. If there are any questions, please come in and see me.

Appendix C. Report Card for Programmed Mathematics

QUEMADO HIGH SCHOOL

Name ..... Subject: Algebra I

Date .....

The following is a report of the student's performance during the ..... six weeks period and a report of the progress made during the semester to the present time. The student obtains points on the basis of the test grades. Your child has obtained ..... total points for the year. Your child has obtained ..... points this six weeks for a grade of .....

Semester Grade: .....

Semester Grading Scale		Points for Six Weeks	
A+	3000-2841	A+	1000-947
A	2840-2633	A	946-895
A—	2632-2526	A—	894-843
B+	2525-2366	B+	842-790
B	2365-2206	B	789-738
B—	2207-2052	B—	737-686
C+	2051-1891	C+	685-633
C	1890-1733	C	632-581
C—	1732-1572	C—	580-529
D+	1571-1416	D+	528-473
D	1415-1258	D	472-421
D—	1257-1100	D—	420-375
F	Below 1100	F	Below 375

Appendix D. Student Paper on Programmed Materials

The following is a paper prepared by a student in May, 1963. The student prepared this paper as a requirement for a scholarship application.

PROGRAMMED MATERIAL

Today you hear very much about new teaching devices. One of these devices, that is fast becoming popular, is programmed materials. I became acquainted with programmed materials when they were introduced into my school at the beginning of the school year. I have taken three programmed courses this year, all with great success. I am thoroughly convinced that programmed materials are workable and will find a great future in the teaching industry.

Programmed materials are similar to workbooks which have the answers. Instead of containing just questions, like workbooks, programmed materials have frames that give information and ask questions. The materials to be taught are broken down into small steps and placed in logical order. In each frame, there is a question that is easily answered from information given in that frame or in previous frames. Each frame proceeds in such small steps that each question is easy to answer if the previous frames have been worked with care. As soon as the student answers the question, he is able to check his answer. The immediate knowledge that the answer is correct gives strong reinforcement to the answer. If the student happens to make an incorrect response, he will refrain from associating this response with the question again. A test is given over each topic in the course or after a certain number of frames have been completed. If the student faiis the test, the unit must be worked over. When the person has passed the test he is able to move on to the next unit. No homework is handed in by the student. Only the chapter tests are graded.

While I have been working with programmed materials, I have had a very good chance to observe myself and other students work with the course. I have noticed several advantages to programmed courses.

The student proceeds at his own rate. No one is pushing or holding the student, and there is no reason to work at the same rate as the others in the class. Slow students seem to progress more rapidly when no one is pushing them. I know from experience that when I can work at my own rate, I retain interest more readily.

To receive a passing grade on a unit of work, the student must be retaining a large amount of the knowledge in the unit. With conventional textbooks, some students try to get by, by copying homework and then flunking or making a low grade on the test. With programmed materials, there is no reason to copy. There is no grade given on homework, and besides, the answers are already there. The student knows that if he copies, he will not be able to pass the exam.

Programmed materials demand concentration. With conventional textbooks, the student is not required to make active response. Many times a student may read assigned material but not be concentrating on what he is reading. With programmed materials, you must concentrate to be able to answer the question.

Programmed materials require less group discussion time. This leaves more time for the advanced students to progress. More time is left for the teacher to give assistance to the slower students.

I see a great future for programmed materials. I believe that someday almost all courses will be programmed. However, programmed materials will never replace the teacher. Only the teacher can give the instruction and guidance that the student needs.