DOCUMENT RESUME

ED 054 205 TM 000 780

AUTHOR Gorth, William Phillip; Popejoy, Lee W.

TITLE A Description of Courses Monitored by Project CAM.

INSTITUTION Massachusetts Univ., Amherst. School of Education.

SPONS AGENCY Charles F. Kettering Foundation, Dayton, Ohio.
REPORT NO TM-2
PUB DATE Mar 68
NOTE 27p.

EDRS PRICE EDRS Price MF-$0.65 HC-$3.29
DESCRIPTORS *Achievement, Achievement Tests, *Behavioral Objectives, Biology, *Course Descriptions, Educational Programs, English, High School Students, History, *Individualized Programs, Mathematics, Models, *Performance Criteria, Performance Tests, Post Secondary Education, Programed Instruction, Sampling, Sciences, Testing
IDENTIFIERS *Comprehensive Achievement Monitoring

ABSTRACT

This technical memorandum describes courses which have been monitored by the Project for Comprehensive Achievement Monitoring (Project CAM, formerly known as Project CRAM). The course structures range from very structured through differentially paced programs for blocks of students to individually paced programs. Project CAM has guided the development of monitors and schedules for each of these courses and is flexible enough to accommodate other variations. The nine courses described in this memorandum are but a sample of the 40 - odd courses which have used or are using CAM. (Author)

Project Comprehensive

Achievement

Monitoring

Technical Memorandum No. TM-2 March 1968

A DESCRIPTION OF COURSES MONITORED BY PROJECT CAM

by

William Phillip Gorth and Lee W. Popejoy
School of Education, Stanford University

The research and development reported herein was performed pursuant to a grant from the Charles F. Kettering Foundation to the principal investigator, Dwight W. Allen, and under the project director, William P. Gorth, both of the School of Education, The University of Massachusetts, Amherst, Massachusetts 01002.

Additional information or permission to quote from this document or to reproduce it, wholly or in part, should be obtained from:

William P. Gorth
Director, Project CAM
School of Education
The University of Massachusetts
Amherst, Massachusetts 01002

Introduction

Technical Memorandum No. TM-2 was prepared to make available a description of courses which have been monitored by Project CRAM. The courses cover the subjects of English, history, science, and mathematics at high school and post high school level.

The course structures range from very structured through differentially paced programs for blocks of students to individually paced programs.

Project CRAM has guided the development of monitors and schedules for each of these courses and is flexible enough to accommodate other variations.

To acquire more complete information about the curricula which may interest you, please contact the teachers. Many of them have taken the opportunity to develop new curricula along with the CRAM monitors. Their addresses are listed at the end of the memorandum.

TABLE OF CONTENTS

A General Science Course Monitored by Project CRAM, 1966-1967

During the school year of 1966-67, Mr. Paul Romans at Andrew Jackson High School in Portland, Oregon, taught a General Science course to 140 ninth grade students and measured their achievement by a set of comprehensive monitors administered to randomly selected students throughout the school year.

The class was part of the Quantitative Physical Science (QPS) program being developed by Dr. S. Githens, Department of Education, Duke University. The QPS program is similar to the engineering problems approach and as such exposes the students to a large amount of laboratory work. The emphasis in the course is on the use of scientific methods and equipment. (See Githens, S, Quantitative physical science for the ninth grade. J. of Research in Science Teaching, 2, 345-348, 1964)

After a careful analysis of the QPS curriculum, the teachers of Jackson High School developed a list of objectives for the end of the year in terms of performance criteria. These objectives included the use of several different types of scientific instruments such as the micrometer, termometer, voltmeter, ammeter, balances and slide rule. The students were expected throughout the year to use and manipulate these scientific instruments and work with scientific procedures in the laboratory. A written test by itself will not measure the achievement on these instruments adequately. The monitoring system of Project CRAM helped fill a need of the course to allow a wider variety of testing instruments to be used. The CRAM model potentially reduces the heavy testing load normally expected of the teacher by going from the usual test administered to each student every other week to randomly selected samples. The test developed at Andrew Jackson High School was directly related to the laboratory work by being in fact a laboratory test.

The laboratory test had an interesting, inventive component which fit very nicely into the CRAM monitoring paradigm. The same questions were asked of the student each

time he was monitored; therefore, the tests were be definition parallel. Each student was given a specific specimen which he measured, using the different types of laboratory instruments available. Then the student was asked to calculate certain quantities familiar to people in physical science, such as mass, density and pressure. Each item on the test was designed to measure a specific objective identified in the QPS course with the intent that the student would in fact be measured on the criteria set for the course. Several teachers developed different items and described the specimens to be used for their items. A total of twelve items were then finally selected by the teachers. Each test item could be asked about each of the six different types of specimens. The specimens were rectangular-shaped solids of lucite plastic, copper, iron, brass, aluminum and brushed carbon. The six materials gave the teachers essentially six parallel forms of the test of twelve items.

Examples of the test items included such items as:

1. Obtain the most accurate mass possible of a specimen.
2. Determine the volume of a specimen.
3. Clip the specimen in the circuit board as part of the series circuit, measure the current flow in the specimen and calculate the resistance of the specimen.

The specimen was also carefully described in chemical language as a metal or non-metal, crystalline or non-crystalline solid and as magnetic or non-magnetic.

The students were given a pre-test on the first day of class using one of the specimens of material. During the school year approximately twenty-three students were tested during each two-week interval and at least five specimens were used during each test administration.

The questions were grouped into different units for the purpose of later analysis. The final test was made up of six parts, as follows:

1. Measurement of matter, 22 points.

2. Calculation from measurements, 15 points.

3. Mechanis (e.g., efficiency and velocity), 28 points.

4. Electricity, 16 points.

5. Heat, 11 points.

6. Chemistry, 20 points.

The test consisted of a total of 112 points. Measurements were made in the metric system. In all of the questions there were degrees and ranges of acceptable answers. Each range of answers was given a different number of points, corresponding to the difficulty in obtaining that measurement. Answers were not simply marked "correct" or "incorrect." Accuracy was a major concern of the QPS course. Calculations had to be made with a slide rule because of a one-hour time limit for the test monitors. Students were also offered a choice of tools to use in their measurement. For example, two types of balances having inherent differences in measurable accuracy were available to measure weight. Both a ruler and a micrometer were available to measure length. Each instrument required a different level of skill and students were rated on the level of skill they demonstrated. Each student was hand-scheduled into the testing laboratory during a segment of his weekly schedule of independent study time, which is part of the Jackson High School modular flexible schedule. The student was notified on a particular day during his "registration room" that he was to take the test that day. In this way the student was not expected to remember a test schedule and he also did not know when he would be taking a test until the day arrived. This was an attempt to obtain an accurate evaluation of the student's abilities at a particular time rather than how much he could learn in the last few days before taking a test. The students were asked the same questions on each test so the test was posted in the classroom for their information.

An Electrician's Mates, Class "A" Course Monitored by Project CRAM, 1966-1967.

During 1966-1967 a fourteen-week course for Electrician's Mates, Class "A", was taught at Great Lakes Naval Training Center at Great Lakes, Illinois. With the strong administrative coordination provided by Mr. James F. Peterman, educational advisor, Service School Command, an intensive program of monitoring analagous to Project CRAM's paradigm was made of the students enrolled in the course. The answer sheets from the test administration were forwarded to Stanford University. These data are being coded onto computer cards and will be extensively analyzed.

The following description will provide an overview of the structure of the course and the intensive CRAM monitoring carried out there. The school of the Great Lakes Naval Training Center teaching the electricians mates course consists of 34 teachers. Two sections of the week's units of the course are taught simultaneously. All fourteen weeks of the course are taught simultaneously. Students move from a one-week section with one teacher into the following weeks section taught by another teacher. The teachers teach each unit of the course for eight weeks. They begin by spending one week learning the material of the first unit of the course. The second week they develop their teaching technique for that unit. The third week they teach that unit of the course under the supervision of a senior officer. From the fourth to the eighth week they teach that particular unit of the course by themselves and the ninth week they move on to the next unit of the course and proceed through the same cycle of learning, developing teaching, teaching with a supervisor and teaching independently. The changeover in teachers consequently is quite high. They are cycled each eight week period to a new unit of the course but because of the intensive teacher orientation program for each unit, the teaching is very similar.

The students enrolled in the course are selected on the basis of their background, desire to attend further school, and qualifications as measured by arithmatic and mechanical

aptitude tests. There are 280 students enrolled in the school in this course at any one time and these students are divided among the fourteen weeks of the course in groups of 20 each. Each week the students move through the course from one teacher to the next. The usual dropout rate in the course that is, students who begin the course but do not complete it, is 13.1%. During the period monitored by Project CRAM, the dropout rate applied to less than 6.5%. All of the students taking the course are working towards the same professional goal they proceed through very similar materials, lectures, readings, and assignments. The exception would be if students begin to lag behind in material of a particular course, programmed materials and textbooks are available as sources of remedial instruction. These are assigned to the student during his study hours in the evening.

The structure of the course requires each student spend thirty clock hours per week in class about six hours per day. Of this total time, approximately 20 hours are taken up with lecturing to small groups of students. During the final weeks of the course which extendsthrough fourteen weeks, lecture time is somewhat reduced and approximately 30% of the students time is spent in laboratories. Demonstrations, motion pictures, and working with electrician's materials are used during the regular course. They are specific assignments made to all student are the same and require about one hour of homework each night. This homework is usually scored and corrected and the students usually take a ten-question quiz each morning before the class begins. The textbook and workbooks, problem assignments, labs, and homework have all been developed at the Great Lakes Naval Training Center and are called the EMAS School Curriculum.

The monitors consisted of fourteen sets of three weekly final tests and one set

of three final tests for the entire fourteen week course. These tests were developed by a team of test developers at the Great Lakes Training Center. Each item on each test was generally tied to some segment of the curriculum developed for the course. These items were critiqued and analyzed by the specialists at the center. After the tests were taken they were corrected by Mr. Peterman's staff and averages for the class were given to the teachers. Individual test grades on the tests were not given back to the students.

The monitoring schedule was quite complex because three parallel forms of the weekly tests as well as the parallel forms on the final criterion tests were available and because the students covered such a large amount of material each week. The monitoring was done at two distinct levels. Each week was considered a sub course of the total fourteen week course. The three monitors measuring the weeks material were administered on a pre-established schedule either at the beginning of the first day of the week, at the end of each of the subsequent days of the week. Each class was tested on a different pattern of three days out of the six possible testing periods for each week. Each week's test results can therefore be analyzed as if they are tested at different times during the progress of the course. In addition to the weekly testing the three parallel forms of the criterion tests were administered to different groups at different points during the fourteen weeks. These patterns of final criterion testing were varied over the different sets of student proceeding through the course and a comparison can be made among the different testing patterns as well as a composite of the different testing patterns to develop achievement profiles.

All of the data from the testing was forwarded immediately to Dr. Kenneth Knight, Assistant Professor in the School of Business at Stanford University. Dr. Knight coordinated

the initial coding of the total test scores for all of the students for all of the different courses at Great Lakes. This entailed coding more than 12,000 observations. These observations were collated on IBM computer cards and analyses have begun. Dr. Knight and the staff of Project CRAM will coordinate their efforts in fully analyzing the total pool of data available from Great Lakes. The projected types of analyses include a general analysis of each weeks weekly tests and the criterion tests for the fourteen week course by the method of regression. Achievement profiles can be plotted from the coefficients obtained from the regression analysis. Multiple test administration for each week and for the overall fourteen week course will be compared. Individual abilities of the students enrolled in the course will be scored and similarities or differences among the achievement profiles of these groups will be considered. Students enrolled in units of the course beyond the first, when monitoring began, will be compared with students who were enrolled in the course and exposed to the complete fourteen week set of tests. Some weeks during the course included a smaller number of class meetings because of vacations due to public holidays. The shorter weeks will be compared with the full-length five day weeks for differences in achievement profiles.

A Tenth Grade Program in English, History, Biology, and Mathematics: Part of a Title I Project, Monitored by Project CRAM, 1967-1968.

In 1967-68 at Duluth Central High School in Duluth, Minnesota, a major effort to develop an individualized instruction program in an inner-city Title I, funded by Title monies, was made. The objectives stated by the principal of Central High School, Dr. James Duffy, were the following:

(1) to provide an educational program which would meet the needs of low-achieving students who entered Central High School;

(2) to attempt to discover the effect which an individualized instruction program could have upon the senior high school age student and particularly to discover the effect that the individualized instruction program would have upon the low-achieving student; and

(3) to increase the achievement level of the educationally-deprived high school students in basic academic areas of language arts, mathematics, science and social studies.

The program developed was to schedule a group of approximately 200 tenth graders of low and middle ability into two large sections. Each section met for a four-hour block of time which was shared by the team of 4 teachers, one in each of the major subject matter areas. The students were allowed to participate in activities arranged by the teachers during this four-hour block of time. The curriculum developed for each of the subject matter areas was of a performance criteria type, where instructional objectives were defined very carefully in behavioral terms. Each subject had a sequence of objectives which each student was expected to master. Students were able to proceed toward the mastery of these objectives at their own individual pace. The curriculum was organized into contracts in which the students were asked to complete activities and hand in assignments to meet the

instructional objectives contained in each contract. The individualized instruction came from the ability of students to complete contracts at their own individual pace.

All of the students involved in the Project, called Project CENTRAL, had requested either B or C level courses which are defined in the school. Each of the students in the Project had requested to be in B or C level courses which are generally the low and middle-ability level of students. Central High School is an inner-city high school which qualifies for Title I monies. The staff at the high school numbers 65 teachers. The students enrolled in Central High School are approximately 1,500. There are 100 students enrolled in the courses monitored by Project CRAM. All of the courses are primarily for the 10th grade level. The English course is required of 10th graders, but the Biology, Mathematics and Social Studies are not required courses. The student proceeds through the same materials in each course at his own individual pace. The monitor items for each course were developed by the teachers during the summer preceding the course. They were written by each teacher individually. Mr. John Carlsted, administrative assistant, provided coordination for Project CENTRAL during the school year. Although all of the courses have generally the same overall structure, there are slight variations for each subject matter area, therefore each subject will be described separately.

Mr. Jack Baldwin teaches the World History course. His course requires the students to attend approximately 4 hours of large group sessions per week. There is no required homework outside of class, and approximately 10 motion pictures and a dozen film strips will be used during the year. Mr. Baldwin has chosen the Pageant of World History, History of Our World, and Story of Nations, as the major texts to support his course.

A Tenth Grade Program in English, History, Biology, and Mathematics at a Title I Project, Monitored by Project CRAM, 1967-1968 (Cont'd)

He notifies the students approximately one day ahead of time that they are scheduled for the CRAM monitoring. Each student takes approximately a half hour to complete his monitor. Approximately two hours of teacher time, and one hour of non-teacher time are used each week for the monitoring. Either Mr. Baldwin or a student teacher distribute, proctor, collect and mail the answer sheets. The feedback is put into a folder which the student may look at any time to plot his progress towards the goals of the course. Mr. Baldwin initially developed a set of objectives for his course which were incremental, that is, the student proceeded through increased performance in the course. Objectives would be like that of map-reading and being able to identify important areas on a world map, or identifying certain items on a time-line. These objectives were not expected to be completed by the student at the end of a particular week, but to be gradually completed during the school year. Another way of defining the objectives would be chronologically, parallel to the contracts which the students were to complete. This will be also developed during the school year.

The course in Biology was taught by Mr. Al Gagne. Mr. Gagne chose to use the B.S.C.S. Yellow Version biology series, supplemented with materials from the B.S.C.S. Special Materials Booklet. He developed the monitor items to parallel the B.S.C.S. Yellow Version biology course. The items were developed with the cooperation of another teacher. The monitors are administered during the regular class period and the students are notified when they appear in class. Each student takes approximately one-half hour to complete the monitor. Mr. Gagne spends approximately 2 hours per week and uses non-teaching help of one hour per week to distribute, proctor, collect and process the monitor answer sheets and monitors. The feedback to students is collated in individual student folders in biology which the students may examine at any time. Mr. Gagne indicates that the students do not

A Tenth Grade Program in English, History, Biology, and Mathematics at a Title I Project, Monitored by Project CRAM, 1967-1968. (Cont'd)

seem to mind taking the monitors and are interested when the results become available.

Mr. Warren Park teaches the Introductory Mathematics course. He has approximately 5 hours of student's time each week, and expects 2 hours of work to be completed by students outside of the classroom. Approximately 50 film strips have been made available to the students. The major text for the course is Preliminary Mathematics, by Dressler, with supplementary texts of Essential Mathematics by Lankford, et. al., and Business Mathematics, by Rosenberg and Lewis. Mr. Park developed the monitor items during a teacher's workshop immediately preceding the course in conjunction with another teacher. The monitors are administered during regular class time every Monday. The students are notified when they arrive in class that they are to be monitored. The students average about 30 minutes per administration of a monitor. Because Mr. Park chose to have completion type questions rather than multiple choice questions, he codes the correct and incorrect responses after correcting the tests, onto IBM answer sheets for processing at Stanford University. He distributes the materials and proctors the tests during the regular class period. The feedback from the Stanford analysis is filed in individual student folders for their use.

The English course in the CENTRAL Project is taught by Mrs. Carol Beatty. It is called Cinematics in English and is an extremely innovative type of program for students of low and middle ability. Her emphasis in on a cinematic or visual presentation of images. The students are scheduled into large group sessions about 4 hours a week and small group sessions about 1 hour a week. Approximately 2 hours of time are expected outside of class by students each week. The course emphasizes the viewing and interpreting of motion pictures. Therefore, approximately 100 motion pictures are available to the students during the school year. Each week the students are scheduled to view a full-length feature movie. Other

A Tenth Grade Program in English, History, Biology, and Mathematics at a Title I Project, Monitored by Project CRAM, 1967-1968. (Cont'd)

written language resources are short stories and the Language Systems Series by Posterman and Damon. The objectives for Mrs. Beatty's course were developed by her during a summer workshop. She developed the monitor items herself. The monitors are presented during regular class time and the students' names are called off when they appear in class. The students average 15 minutes to complete the 20-item monitor. The teacher spends approximately 2 hours each week in administering the CRAM monitors. The monitor items are of interest because of their similarity to the objectives of the course. The course is a visually oriented course of interpreting motion pictures. The monitor includes a color photo to be interpreted for each question. Students are expected to gain facility in interpreting visually presented items. The students seem enthusiastic about the unusual form of the tests and the uniqueness of them. The interest could be maintained by a judicious scheduling of student's monitoring.

The students at Central High School Project are being monitored by Project CRAM in four different courses. The same 100 students are enrolled in the four courses and take CRAM monitors in each of these courses. This is a situation very comparable with the actual operation of student-enrolled in the high school and being monitored in each of the courses he is taking.

In addition to the achievement monitoring, several interest, attitude and biographical inventories are being administered in a pre- and post-test course monitoring. These materials are being considered for more frequent and regular monitoring during the school year in Duluth, and for other schools.

A Trigonometry and Advanced Algebra Course
Monitored by Project CRAM, 1967 - 1968

Kailua High School is a public school on the island of Oahu in Hawaii. It has a faculty of 111, a student body of over 2800 and is in its first year of operating on a flexible schedule. The staff of the school is highly motivated and innovative in its considered approach to a top quality program for the students.

Under the chairmanship of Mrs. June Yamashita, the teachers in the mathematics department have developed teacher-written presentation packages for a trigonometry (first semester) and advanced algebra (second semester) course. The primary sources for the packages were the teachers' summary sheets of lectures and worksheets combined with the College Entrance Examination Board's course criteria and various State curriculum guides. Modern Trigonometry by Welchon (Ginn and Co.) and Vance's Modern College Algebra (Addison-Wesley) are supplemented references.

The 108 eleventh and twelfth grade students enrolled, many of whom are not math majors, spend three hours weekly in formal classes. These class presentations are given in large and small group modes, Individual attention is provided at the mathematics resource center by the teachers, teachers' aide, and advanced students. All twelve teachers in the department work alternately in the resource center. In addition to attending formal instruction, the students are expected to spend from three to five hours weekly on study and exercises although the correction of this work is left up to the students.

Monitoring items were prepared by the department chairman and processed by the Project CRAM staff. The monitors for the trigonometry phase were all multiple choice response. For the algebra phase the staff decided to check the work itself and transfer a right-wrong tally on the CRAM answer sheets.

Students are notified at the beginning of the week in their large group meeting who will be taking monitors. The students then have the responsibility of taking the monitor during their independent study periods in the resource center. All answer sheets and monitors are placed in advance in alphabetically-arranged manila folders. One of the mathematics teachers on duty administers the monitor. In most cases the monitors are scored as the student hands in his work. At this time the teacher shows the student how to do the problems missed that should have been performed correctly. For students missing this instant feedback, the teacher meets with the student at the earliest available time to go over the work. The department chairman then mails the answer sheets for analysis by the Project.

A Trigonometry and Advanced Algebra Course
Monitored by Project CRAM, 1967 - 1968 (Cont'd)

In addition to the above feedback each student has a profile sheet on which scores are graphed. A performance criterion (PC) sheet is also provided to indicate which PCs were covered on a monitor and how the student scored on each.

As is required of most successful programs, the principal of Kailua High School, Mr. Milton deMello, has been enthusiastic about the program. The department chairman, Mrs. Yamashita, has spoken before numerous groups on the Project and describes the usual reaction of other professionals as "completely positive." When the Project was discussed at an open house after the beginning of the school year, there was a favorable reaction of the part of parents.

Student reaction has also been positive. The teachers estimate that more than 80% of the students are very positive about seeing their names on the weekly monitor list. The students also completed an evaluation sheet which indicated an overwhelming enthusiasm for what was going on. The use of a flexible schedule and team teaching no doubt influenced this reaction. There was, however, some insecurity evidenced in comments relating to a felt need by the students to be told to do the work, that some had trouble motivating themselves and were in need of grades to measure achievement and success. These reactions are tied in with the other happenings in the school, as well as the Project, and may be an indication of the students' problems in developing more responsibility for their education and some of the intrinsic motivation and rewards that can be generated through such a program.

Another indication of the enthusiasm of the staff and students is the opening of the resource center during vacation periods and holidays. The teachers have made themselves available and have reported that "a goodly number come during these times, and, what is more, this includes students who need individual help and should be coming!"

A Senior Level Social Studies Course Monitored by Project CRAM, 1967-1968.

Paul Pigue, a member of the social studies team at Kailua High School, has encouraged the development of behavioral objectives for the required twelfth grade social studies course. Prior to the beginning of his first teaching assignment, he obtained the course description and text, outlined behavioral objectives and developed items to measure the achievement of these objectives. From these items Project CRAM generated monitors which he has been administering to the 170 students in his section of 800 seniors enrolled in the course.

The students attend one large-group meeting and two small-group meetings each week. They have been enthusiastic about the concept of the monitoring of their achievement. The teacher reports a growing interest in the faculty concerning the concept. Mr. Pigue has continued to implement and evolve the program with the other five teachers in this course.

The thirty teachers in the department and one hundred eleven teachers in Kailua High School have been developing an outstanding educational program for their 2800 students. There is dynamic leadership by the principal, Mr. Milton deMello, and members of his staff. The future of the course will undoubtedly reflect this impetus.

A Comprehensive Introductory High School Mathematics Course Monitored by Project CRAM, 1967-1968

During the 1967-68 school year a particularly exciting innovation in introductory high school mathematics was implemented at Andrew Jackson High School in Portland, Oregon. The project was coordinated by Mrs. Jeanne Stromquist, working with Mrs. Jean Steed, Mr. James Norton, and Mr. Robert Christiansen and with the administrative sponsorship of Dr. Roy Carlson, principal. The program consisted of a mathematics course for the entire freshman class. The major innovations included in the course were the use of a team of seven mathematics teachers who individually taught two-week units of material to various classes of students. The students were scheduled into the blocks every two weeks during the school year.

The importance of the re-scheduling at frequent and regular intervals is that a variety of levels of difficulty of mathematics material could be taught simultaneously, but the students could be scheduled into the block which suited their rate of progress and understanding of the material. If a student in an advanced two-week section began to falter, he would be scheduled for the next two weeks into a slightly less difficult block, or the alternative situation would be if a student began very slowly at the first of the school year with remedial work, he could easily finish several of the less difficult units very thoroughly and then be in a position to move into the more difficult sequence of two-week blocks. The frequent re-scheduling of students on the basis of diagnostic post-tests taken at the end of each two week interval provides a powerful means of adjusting the instruction to the individual student. At the same time, students are still maintained in an educational program which teaches groups of students rather than isolating a student in a completely independent and individualized program. The teacher's resources and knowledge can then be applied to the homogeneously grouped set of students in a manner of maximum efficiency and effectiveness.

A Comprehensive Introductory High School Mathematics Course Monitored by Project CRAM, 1967-1968 (Cont'd)

Andrew Jackson High School is a suburb school, newly-constructed, with a faculty of 60 teachers. Seven of these teachers are involved in the Introductory Mathematics Program and teach the course as a team effort. Of the 1,100 students enrolled in the school, approximately 28% of the students, or 313, are enrolled in the Introductory Mathematics Course and are monitored by Project CRAM. Each teacher has advisory responsibility for approximately 44 students during a school year.

The course is mainly for 9th grade students although some 10th grade students are also enrolled. It is not required of all students but is one of the alternative courses in a minimum mathematics requirement for graduation. The students who are enrolled in the course are not primarily students majoring in mathematics. The students did not proceed through exactly the same material at exactly the same rate. The strength of the program is that students may proceed through different sequences of material at their own individual pace while still maintaining some kind of group identification because groups of students are taught the material. The students spend approximately 40 minutes every other week in a large group lecture session. The students are scheduled for approximately 3 hours of classroom work and 1 hour of subject laboratories each week. The homework assignments are usually corrected, scored, and graded. The students are expected to work about 4 hours per week in the subject outside of scheduled school time. The students use teacher-written packages of activities as they proceed through their materials. In addition audio-visual aids are provided in the form of 6 motion pictures and several film strips. Because the materials were organized and developed by the teachers teaching the course, there has been an integration of content from several different textbooks. The major textbooks used for the course are: Algebra, A Logical Approach, Book I, by Pearson and Allen, and Introduction to Algebra, Part I, and Introduction

A Comprehensive Introductory High School Mathematics Course Monitored by Project CRAM, 1967-1968. (Con t'd)

to Secondary School Mathematics, Volume I, Part I and II, by S.M.S.G.

The monitors used in the course were developed in a teacher's workshop during the summer preceding the first teaching of the course. The workshop involved 4 of the 7 teachers. The items were written by the teachers in the course after they had identified a list of 1,000 very specific objectives that they would like their students to master for the introductory course. One item was written to monitor each objective. The monitor items were then catalogued in several different ways. The entire pool of 1,000 items was first catalogued according to the field of mathematics, such as logic, or arithmatic; then the entire pool of items was classified by the complexity of the items; the pool was classified by the number system used, and finally again by the certain mathematical skills involved in the problems. The multiple classification of each item was carried out to enable feedback and consideration of a variety of different characteristics which each item would possess. These different characteristics will eventually be used to diagnose student difficulties in one of the different dimensions.

The students are monitored during mathematics laboratories and are notified that they will be monitored when they appear at the laboratory on the day that they are regularly scheduled to appear. The laboratory assistant, or the laboratory instructor is in charge of notifying the student that he is to take a monitor; the students average about 45 minutes to take each monitor. Each teacher spends about 2 and 1/2 hours each week administering CRAM monitors and non-teaching assistants spend approximately 4 hours. The monitors are distributed by the laboratory assistants and proctored by the teachers and laboratory assistants. They are collected by the advising teacher and checked and mailed by Mrs. Steed. The feedback from Stanford University is handed to the students who are encouraged to compare their correct and incorrect answers with the list of objectives which is available to them in the classroom.

A Comprehensive Introductory High School Mathematics Course Monitored by Project CRAM, 1967-1968 (Cont'd)

Each resource center has a master list of all of the objectives posted, thus the students are able to identify which specific objectives they were able to master and which they have not.

A General Science Course Monitored by Project CRAM, 1967-1968.

During 1967-1968, Mr. Paul Romans of Andrew Jackson High School in Portland, Oregon, taught for a second year a general science course monitored by laboratory performance tests along the Project CRAM paradigm. The course was part of the Quantitative Physical Science (QPS) program being developed by S. Githens (See Quantitative Physical Science for the Ninth Grade, S. Githens, J. Res. in Science Teaching, 2: 345-348, 1964) at Duke University.

The monitor items required the student to manipulate materials in the laboratory and were corrected by hand, but the results of each item were coded onto optically scored answer sheets for scoring and feedback from Stanford University.

A FIRST YEAR ALGEBRA COURSE

MONITORED BY PROJECT CRAM

During the 1966-1967 school year, Mr. Max Lane and Mr. Ray O'Dell taught a first year Algebra course at John Marshall High School in Portland, Oregon which they had developed during the preceding summer. Its development was encouraged by Dr. Gaynor Petrequin, Principal. It consisted of a curriculum defined in performance objectives and taught to the students through the use of student packages. The packages contained the objectives for each portion of the course, the activities that the student was to complete, and the criterion performance expected of the students. The packages were self-contained and covered approximately one week's work. The students were allowed to proceed through the materials at their own pace. The students found the self-pacing quite an exciting innovation. They could learn and absorb the material at the rate at which they felt was the most comfortable. Students who wanted to proceed very quickly through the material were given the opportunity. Other students who needed the time to learn the material thoroughly were allowed to work more than an average number of days on one package.

The materials developed were specifically designed for a first year Algebra course in a school which had an enrollment of 2100 students. Approximately 189 students were enrolled in the first year Algebra course. Mr. Lane and Mr. O'Dell each were directly responsible for approximately 90 students. The majority of students were in the ninth grade, but some from the 10th and 11th grades were also enrolled. This course is not a requirement for all students and alternative courses are available. The students enrolled in the course are not generally majors in science and mathematics but leave the course to engage in many other subject matter majors.

The students are allowed to proceed through the material at their own rate. There is one sequence of presentation for the packages and the students proceed through basically the same material in the same order. The students spend approximately 4 hours each week in groups of 16 or more students for either lecture or study periods. One hour a week is spent in a subject matter resource center. There are specific homework assignments but these are not usually corrected, scored or graded. The students are expected to spend from 2 to 3 hours per week in addition to the time they spent in class. Approximately 10 motion pictures and 20 film strips are available for the students' use during different points during the course. The basic text book for the course is called, "Modern Algebra - Structure and Method" by Dolciani.

The CRAM monitors themselves have been developed from the basic structure of the text book with materials, resources and the knowledge of the teacher's familiarity with the subject matter used to supplement the basic text material. The items for the CRAM monitors were written by Mr. Lane and Mr. O'Dell during the summer preceding the course at the same time that they developed the performance criteria and packages for their course.

A First Year Algebra Course Monitored by Project CRAM (cont'd) 2

Students are usually monitoring the regular class time or an independent study period and may take the monitor either in their regular class room or in a special test room. The students are notified that they are to appear for a CRAM monitored during class time and may be notified from two to four days before their monitoring. Each test requires approximately 40 minutes of student time. Each week the teachers are involved in from two to three hours of time in administering the CRAM tests. Other staff members, non-teachers and students will assist the teachers with one or two hours of work each week. The answer sheets and monitors are distributed to the students and collected by the teachers. After each monitoring period, the students who have been monitored receive computer output which indicates the objectives he was able to answer questions about. The students being monitored by Project CRAM seem willing to take the test during the year. The administrators of the school were interested in the progress of the CRAM monitoring. The turn out of parents for an Open House was quite large and very enthusiastic about the new types of educational tools being used in a first year Algebra course.

1968

A Tenth Grade Biology Course Monitored by Project CRAM, 1967-1968.

The science teachers at the innovative and flexibly scheduled Nova High School in Fort Lauderdale, Florida, have developed a linear sequence of Learning Activity Packages for the required tenth grade biology course, each of which has alternative activities. The packages were developed primarily from the B.S.C.S. yellow version, using the blue and green versions and the Modern Biology text as supplements.

Of the 2923 students enrolled in the school, 317 began taking the course in January, 1968, with Mr. Paul Woodall and a Project CRAM model of testing. They spend two hours a week in large groups, two hours in small groups and from zero to four hours in the lab, moving through the packages at their own individual rates. No homework assignments are made.

Items for unit test and CRAM monitors were prepared by the science teachers. The students know that they will be taking a unit test, or CRAM monitor when they complete a learning package. Students take these monitors in a school-wide testing room under the supervision of a teacher-aide. The answer sheets are then mailed to Project CRAM for processing.

ADDRESSES OF TEACHERS IN PROJECT CRAM

Duluth Central High School
N. Lake Avenue & 2nd Street
Duluth, Minnesota 55802

English - Mrs. Carol Beatty, History - Mr. Jack Baldwin
Biology - Mr. Al Gagne, Mathematics - Mr. Warren Park

Hopkins High School
1001 Highway Seven
Hopkins, Minnesota 55343

Chemistry - Mr. Chuck Thiele, Mathematics - Mr. James Whitney

Kailua High School
451 Ulumanu Drive
Kailua, Hawaii 96734

Social Studies - Mr. Paul Pigue, Mathematics - Mrs. June Yamashita

Andrew Jackson High School
10625 - S. W. 35th Avenue
Portland, Oregon

General Science - Mr. Paul Romans
Mathematics - Mrs. Jean Stromquist (Chairman)
Mrs. Ray Steed, Mr. Dick Clark
Mr. James Norton, Mr. David Larsell
Mr. Robert Christiansen, Mr. Donald Romaine

John Marshall High School
3905 S. E. 91st Avenue
Portland, Oregon 97266

Mathematics - Mr. L. Max Lane, Mr. Ray S. O'Dell

Nova High School
3600 S. E. 70th Avenue
Fort Lauderdale, Florida 33314

Science - Mr. Paul Woodall

Service School Command, Naval Training Center (Bldg. 300)
Great Lakes, Illinois 60088

Educational Advisor - Mr. James F. Peterman