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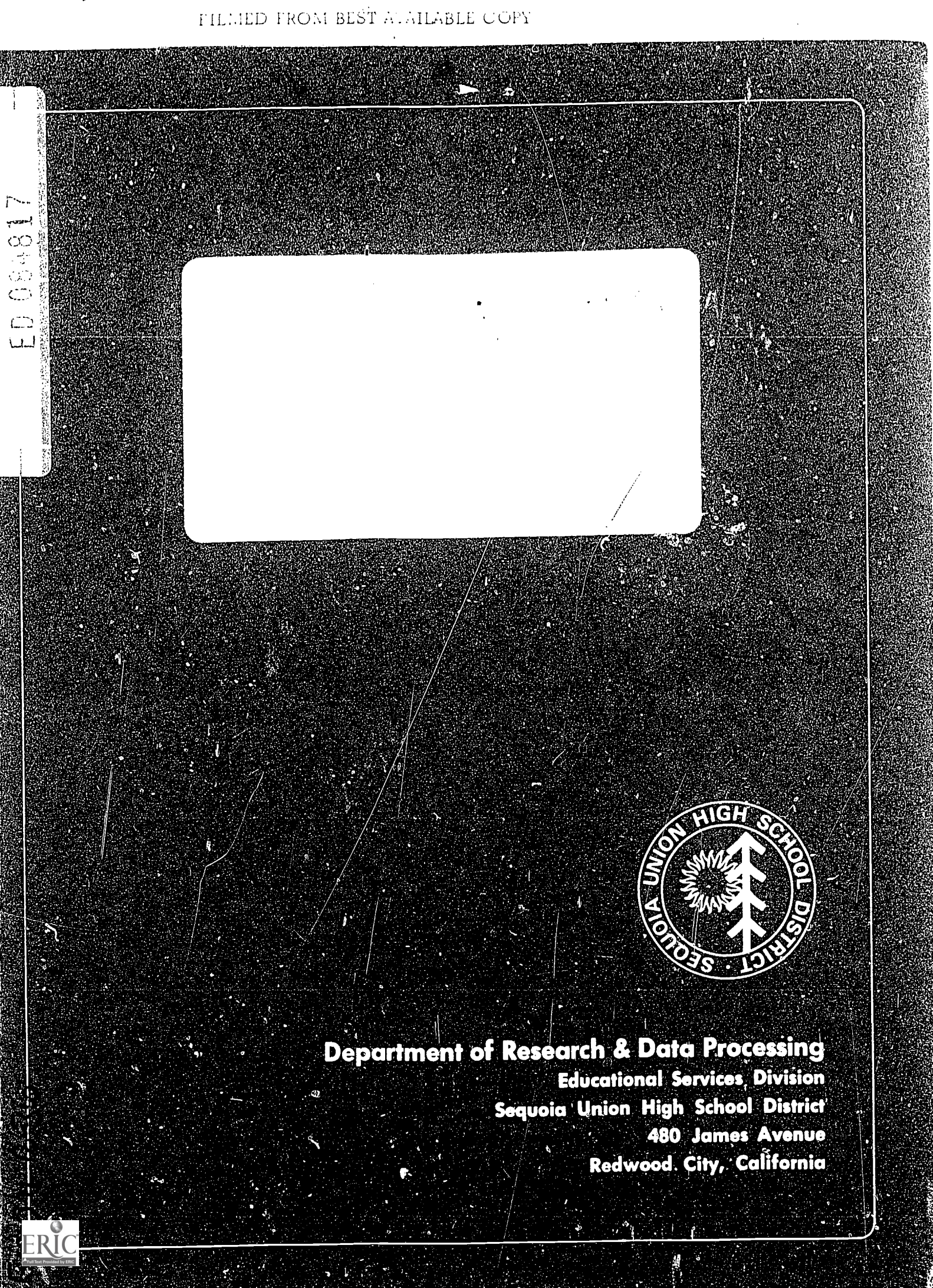
ABSTRACT

Comprehensive Achievement Monitoring (CAM) is a system designed to provide a curriculum defined in terms of performance objectives, test items to measure student performance on each objective, a set of comparable test forms to evaluate performance, testing throughout the period of the course, computerized analysis and reporting of results after test administration, interpretation of results by teachers and students leading to decisions on curriculum and study priorities, and modification of curriculum, instructional activities, and CAM. This report overviews the CAM philosophy, and then describes a practical application of CAM in beginning algebra at Carlmont High School, the CAM basic reading skills program at Menlo-Atherton High School, the application of CAM for English at Notre Dame High School, and CAM and teacher decision-making for the team Geography program at Sequoia High School. (SH)



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USING COMPREHENSIVE ACHIEVEMENT MONITORING IN THE CLASSROOM

SYMPOSIUM
CALIFORNIA EDUCATIONAL RESEARCH ASSOCIATION
SAN JOSE, CALIFORNIA
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CAM RESEARCH PHILOSOPHY

For some time it has appeared necessary to refocus the direction that educational research has taken over the years. For many years educational research has emphasized tightly controlled experiments in which only one variable at a time is manipulated in an experimental group or groups, while control groups are not manipulated and remain as static as possible.

Educators have tried to control many different variables in an attempt to isolate the single variable that might have a causative effect on student performance. Most generally this approach has been a dismal failure. One has only to examine the literature on any particular problem and note that in most instances there is no clear cut indication that certain solutions are consistently better. For many problem solutions there are as many experiments producing no effects and negative effects as there are experiments that indicate some positive effect. It's not difficult to understand the reason for this. There are too many variables to control in an educational setting. Among these variables are the students, the instructional material, the teachers, time of day, length of class time, number of students, type of testing reinforcement patterns etc. In almost any experimental situation the researcher will try to control as many variables as possible, but the dynamics of the classroom situation just preclude successful experimental control really being achieved.

Recently educational researchers have begun to explore the possibility of using multi-variable statistical analysis as a way to circumvent the problem of controlling variables. This technique shows promise but many of the procedures and applications still have to be developed before wide spread implementation of this approach will occur.

While the previous considerations concerning educational research are certainly important ones, perhaps the most important one that any educational

researcher should be cognizant of the effect his work has upon the classroom teacher in terms of disrupting classroom routine. Educational research, and that includes all evaluation that is done to determine the effect on students of particular instructional technique, teaching material, or intervention, must be recognized itself as an intervention into the classroom. The most commonly recognized and quoted research effect that is guarded against, or to which abnormally good results are sometimes credited, is the Hawthorne effect. The very introduction of the research effort with its attendant publicity and hoopla, often creates a short term benefit that is measureable and significant. There is an alternative negative effect that educational research and evaluation can impart to a classroom. It can disrupt the daily routine and operation of the classroom, upsetting both the students and the teacher. Educational researchers and evaluation people quite frequently are hit and run artists who totally disregard this aspect of their total responsibility.

Today's society is demanding that much more emphasis be placed on evaluation. This emphasis gives educational researchers and evaluators more status in their attempt to document the learning process, and possibly more effective functioning of educational systems. What they often forget, however, as they focus on finding a solution to some educational problem, is that any treatment is only as good as the person who is using it. If research and evaluation are indeed to become a panacea for improved education then teachers must become experimentalist and empirical in their decision making. Teachers must become directly involved in research to make it a living, functional part of today's educational process rather than some educational researcher's ego trip collecting dust on university library shelves.

Comprehensive Achievement Monitoring as it is conceived by the Sequoia Union High School District is a tool that enables teachers to function as researchers

and evaluators. Its concepts include a curriculum defined by performance objectives. These objectives serve as discrete items to be studied in curriculum product research or as the objects of educational process research. In fact their measurement is a partial indication of the success of the educational establishment. These performance objectives are measured by test items that are written or designed by teachers to measure student performance on each performance objective. Thus the CAM system, through its test items, truly reflects what a student is supposed to know or be able to do as determined by the teacher, and not by some externally created standardized test.

Sets of interchangeable test forms are created for each test. Sampling techniques are used to get estimates of what students know or are able to do without subjecting them to long involved testing situations that turn them off. No student has to respond to all the questions that may need to be asked in order to furnish the teacher, who is the researcher, with all the information he needs. Thus that very important factor of class disruption is kept to a minimum. Furthermore since the data is being collected relative to the regularly scheduled curriculum of the class, extra time for testing is cut to a minimum because there is no need to add extra tests to the students' schedules just to satisfy some externally located educational researcher.

Two other concepts of CAM are periodic testing, usually weekly or biweekly, as determined by the teacher, and the storage of the collected information so that a longitudinal history of performance is the result. This approach builds a data bank that continually can be tapped for information concerning individual students and groups of students, all the time being unobtrusive as far as students are concerned, and part of the regular classroom routine. The massive task of data collation and data storage is done by computer. Without the computer the approach toward research and evaluation that has been described would be a physical impossibility.

If teachers are to function empirically they must have at their disposal quick feedback of information. It is very difficult either to modify curriculum or instructional activities, or to work with students individually, without instant access to data. Computerized analysis and reporting of results on an overnight basis to the specification of the teacher is another concept of CAM.

Each of the above concepts is being developed to provide a complete evaluation cycle. The cycle is important in that we hope evaluation will become a continuous process that provides the teacher with a constant feedback of information that he can use to improve student learning. Of course there is a possible weak link in the cycle. The tool, CAM, can only be as good as the teacher who is using it. If teachers cannot successfully use the tool and interpret results then the evaluation cycle will never be completed and the tool is useless as far as teachers are concerned.

Naturally the tool is a new one. From our experience with CAM and our in-service training program we realize that there is a great amount of knowledge that teachers must have in order to implement CAM before they can use it effectively to make decisions about curriculum, instructional activites, and students.

We feel that teachers will be more prone to use data in their daily instructional decision making if there is a particular problem that they are interested in exploring. Therefore we have asked each CAM lead teacher to think about one hypothesis that he or she would like to test in their classes this coming year. We are not requiring that this hypothesis have any concern with the total problem of the effectiveness of CAM. We think that if each teacher selects a hypothesis that he or she wants to study then these teachers will begin to study the data after each test administration in an attempt to find out whether their hypothesis is true or not. More importantly we hope they ultimately will positively affect the final result by something they might do as teachers in the classroom. At

that point teachers will be taking a very important step toward using CAM data as an everyday part of their teaching operation and the evaluation cycle will be closed. Evaluation will become functional and formative.

What does this mean to educational researchers? Teachers need assistance. Most of them are well read only in their subject matter field. But they generally are creative. They need to be stimulated concerning the possibilities for what they can do within their classroom. Educational researchers can serve as tutors and guides to teachers. But they must alsways keep in mind that unless the teacher enthusiastically embraces what the educational researcher is saying, or wants to try, then the researcher will be an albatross. The teacher is probably the most important variable in today's schools. What works for one teacher may not for another, and that is the most important thing for researchers to find out. Make the classroom and that teacher the global focus of your effort rather than the idea or theory you are intellectually excited about, and you'll eventually build a mosaic that will give you answers to other questions.

II. WHAT IS CAM?

A new design for evaluating classroom achievement levels has been operational in the Sequoia Union High School District since September 1970*. Called Comprehensive Achievement Monitoring (CAM), the design's methods were developed at Stanford University and the University of Massachusetts under a grant from the Charles F. Kettering Foundation.

The CAM design includes the following components:

1. A curriculum defined in terms of performance objectives.
2. Test items designed to measure student performance on each objective for the course.
3. A set of comparable test forms which evaluate performance on all or a sample of all the objectives in the curriculum.
4. Testing throughout the period of the course at intervals determined by the teacher.
5. Computerized analysis and reporting of results within a few days after each test administration.
6. Interpretation of results by teachers and students leading to decisions on curriculum, instruction, and study priorities.
7. Modification of curriculum, instructional activities, and components of the CAM design.

Each of these components is an integral part of the evaluation cycle. Evaluation becomes a continuous process which provides the teacher with constant feedback of information which he can use to improve the learning process of the students.

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* Sequoia is pioneering the use of CAM, being the only district in California and one of three in the Western United States using CAM

Strengths of CAM

Pre-instruction measures. In a CAM design objectives can be pretested prior to instruction. If the students have acquired information and skills related to some objectives from outside sources the teacher will discover this from the pretest data and will not have to cover the material in the course. Continuous testing of objectives to be taught later in the course may indicate their relationship to objectives currently being taught. Changes in performance of specific objectives may indicate that the teacher should make alterations in the course; the sequence of instruction could be changed, the amount of time spent on certain objectives could be changed, and/or some objectives could be eliminated from the course.

Immediate post-instruction measures. The usual classroom test uses only one test item for each objective to evaluate material which has just been taught. To estimate achievement levels on just-taught objectives CAM may use more than one item for each objective. In addition, since sampling techniques are used, each objective can be tested without increasing the length of the test. Thus, with item sampling, objective sampling, and student sampling, a CAM test produces more information than the usual classroom test.

Retention measures. Particularly important for the teacher is the ability to make decisions concerning that part of the curriculum that has already been taught. Because of this, there is a continual testing for retention of material which was previously learned. Intervals between "teach" and "test" times are recorded so that analysis of retention can be made for known intervals of time. The teacher decides how many days elapse before the data represent retention. Retention

data can be used to alter the instructional process in a meaningfull manner.

The teacher makes decisions. A fundamental principle in our district's use of CAM techniques to evaluate the effectiveness of instruction is that decisions are made by the teacher. The items which are used to measure the achievement of these objectives are also determined by the teacher. Items may be either of the paper and pencil type or those that require observations by a reliable rater. Examples of types of items which may be used are:

1. True-false
2. Multiple choice
3. Completion
4. Computation
5. Essay
6. Problem solving
7. Psychomotor observations

Other decisions which teachers make in our CAM program include when and how often test monitors will be given.

Information feedback. Although the design of the testing procedures in the CAM system can become as complex as a teacher desires, the computerized information supplied to school personnel and students is easily read and understood.

For individual students it includes --

a. The total score on the current test and on each previous test.

b. The score on only those items for which instruction has occurred on the current test and on each previous test.

c. The student's response to each item on the current test reported by objectives rated as correct (+), incorrect (-), or no response (0).

d. Whether or not the student had been instructed on the item.

For any group of students in the course it includes --

1. After each test administration:

   a. The total percentage correct for each student for each test administration.

   b. The percentage correct on instructed objectives for each student for each test administration.

   c. The percentage correct for all students on each objective and any specified group of objectives, e.g., unit, for each test administration.

2. Upon demand, e.g., end of quarter or semester:

   a. An item analysis for each item as it measures achievement before instruction, immediately following instruction, and on a retention basis.

Courses in CAM. During the first semester of the 1972-73 school year seventy courses are being monitored by CAM. Many content areas are represented with courses in mathematics, biology, chemistry, physics, earth science, geography, economics, government, social psychology, anthropology, social studies, history, safety education, child development, reading, vocabulary, english, music, art, physical education, metal work, drafting, foods, Spanish, French, business law, marketing, accounting, and typing. Seventy-five teachers and approximately 6,500 students are participating in the program.

III CAM COMPUTERIZED FEEDBACK

There are five basic types of computerized feedback: individual student reports, group summary reports, teacher summary reports, form analyses, and curriculum analyses.

Figure 1 is an example of an individual student report. Each student receives a copy of his own student report after each test administration. The data shown in Figure 1 is for Tim Boetticher's second test administration. The left portion of the report tells the student for each item on the test what objective the item was associated with, whether each item on the test was right (+) or wrong (-), and if instruction was completed on that objective (YES). The right portion of the student report summarizes the student's performance on the present test administration and all previous test administrations. He is given two scores, the percentage correct on the total test and the percentage correct on those objectives with instruction completed.

A teacher summary report is shown in Figure 2. This report provides the teacher with each student's performance on each test administration, the test form the student was administered on each test administration, the cumulative average for each student on all test items thus far (TOT) and the cumulative average for all items for which instruction was completed prior to the test administration (YES).

The Group Summary Report is used to present percentage correct for any specified set of objectives, e.g., unit or all objectives,

for any specified group of students. Each teacher usually gets one group summary for all students in the course, one for all his students, and one for each class of his students. The Group Summary Report shown in Figure 3 is for Mr. Castoro's class that meets during Period 7.

The Group Summary Report also shows the performance of the students on each objective. From this report Mr. Castoro will realize that he needs to do some extra work with the students on Objective 107 since the student performance (15%) was fairly low relative to the other objectives.

An example of a form analysis is shown in Figure 4. After each test administration, the teacher receives a form analysis for each form used during that test administration. The response data from all students in the course who received that form are included in the analysis. The print-out shows the objective number, the correct response alternative, the average percentage correct, and the percentage of students who chose each response for each item on the test form.

BOETTICHER TIM W 330183 PERIOD 7 CASTORO 09/27/72

MA210

TEST ADM 2 - 9/25/72

PERCENTAGE CORRECT ON ALL ITEMS IS 70 FORM 20

PERCENTAGE CORRECT ON YES ITEMS IS 82

QN	OBJ	RP	INS	QN	OBJ	RP	INS
1	101	$-	YES	26	201	$+	YES
2	101	$+	YES	27	201	$+	YES
3	102	$-	YES	28	201	$+	YES
4	102	$+	YES	29	202	$+	YES
5	103	$+	YES	30	203	$+	YES
6	103	$+	YES	31	203	$+	YES
7	104	$+	YES	32	204	$+	YES
8	104	$+	YES	33	204	$+	YES
9	105	$+	YES	34	204	$+	YES
10	105	$+	YES	35	205	$+	YES
11	106	$+	YES	36	206	$+	YES
12	106	$+	YES	37	206	$+	YES
13	107	$-	YES	38	206	$+	YES
14	107	$-	YES	39	206	$-	YES
15	108	$+	YES	40	206	$+	YES
16	108	$+	YES	41	301	$-	
17	108	$+	YES	42	301	$+	
18	110	$+	YES	43	302	$-	
19	110	$+	YES	44	402	$-	
20	110	$+	YES	45	403	$+	
21	111	$+	YES	46	501	$-	
22	111	$+	YES	47	502	$-	
23	112	$+	YES	48	504	$-	
24	112	$+	YES	49	507	$-	
25	201	$-	YES	50	509	$-	

TEST ADM	FORM	PCT COR TOTAL	PCT COR YES
1	2	34	0
2	20	70	82
CUM AVG		52	82

Figure 1. A copy of an individual student report.

COMPREHENSIVE ACHIEVEMENT MONITORING - TEACHER SUMMARY REPORT MA210

M-A MEDICAL CAREERS PERIOD 7 TNB 16 CASTORO

09/27/72

NUMBER	NAME		CUM AVG	TEST ADMINISTRATION 1	2	3	4	5	6	7	8	9	10
329581	BATTON BONITA L	TOT	56	36	76								
		YES	82	0	82								
		FORM		1	20								
329805	BENTLEY SUSAN M	TOT	44	24	64								
		YES	72	0	72								
		FORM		2	20								
330183	BOETTICHER TIM W	TOT	52	34	70								
		YES	82	0	82								
		FORM		2	20								
333310	DICARLO BARBARA	TOT	51	28	74								
		YES	80	0	80								
		FORM		3	20								
333443	DORSEY DOLORES	TOT	40	28	52								
		YES	62	0	62								
		FORM		2	20								
335604	GRUYTER FRANCES C	TOT	50	30	70								
		YES	77	0	77								
		FORM		2	20								
337477	JOHNSON CINDY M	TOT	56	32	80								
		YES	90	0	90								
		FORM		1	20								
338566	LEE LAIOPING	TOT	50	32	68								
		YES	70	0	70								
		FORM		1	20								
340323	MONTGOMERY KATHY A	TOT	67	46	88								
		YES	97	0	97								
		FORM		3	20								
666727	MORRIS DENISE	TOT	51	40	62								
		YES	72	0	72								
		FORM		3	20								
342014	PORATH DARLENE E	TOT	58	46	70								
		YES	77	0	77								
		FORM		3	20								
344440	SNYDER SANDRA	TOT	56	38	74								
		YES	80	0	80								
		FORM		1	20								
345546	TIRTOPRODJO LESTARI	TOT	41	20	62								
		YES	67	0	67								
		FORM		3	20								

Figure 2. A copy of a Teacher Summary Report

COMPREHENSIVE ACHIEVEMENT MONITORING - GROUP SUMMARY REPORT MA210

M-A MEDICAL CAREERS 09/27/72

STUDENT GROUP 1607 CASTORO PERIOD 7

CGN	CONTENT GROUP		TEST ADMINISTRATION 1	2	3	4	5	6	7	8	9	10
	NUMBER OF STUDENTS		13	13								
0	ALL OBJECTIVES	AVG	33	70								
		NUM	650	650								
1	UNIT 1	AVG	53	81								
		NUM	47	312								
2	UNIT 2	AVG	36	73								
		NUM	44	208								
3	UNIT 3	AVG	30	43								
		NUM	26	39								
4	UNIT 4	AVG	23	34								
		NUM	17	26								
5	UNIT 5	AVG	25	36								
		NUM	74	65								
101	OBJECTIVE 101	AVG	$$$	76								
		NUM	4	26								
102	OBJECTIVE 102	AVG	$$$	73								
		NUM	4	26								
103	OBJECTIVE 103	AVG	$$$	88								
		NUM	5	26								
104	OBJECTIVE 104	AVG	$$$	96								
		NUM	4	26								
105	OBJECTIVE 105	AVG	$$$	80								
		NUM	5	26								
106	OBJECTIVE 106	AVG	$$$	88								
		NUM	5	26								
107	OBJECTIVE 107	AVG	$$$	15								
		NUM	4	26								
108	OBJECTIVE 108	AVG	$$$	89								
		NUM	4	39								
110	OBJECTIVE 110	AVG	$$$	94								
		NUM	5	39								
111	OBJECTIVE 111	AVG	$$$	100								
		NUM	4	26								

Figure 3. A copy of a Group Summary Report.

COMPREHENSIVE ACHIEVEMENT MONITORING - FORM ANALYSIS REPORT

M-A MEDICAL CAREERS MA210 09/27/72

FORM 20 13 STUDENTS RESPONDED TO THE FORM DURING TEST ADMINISTRATION 2

QUESTION NUMBER	OBJECTIVE	ANSWER	AVG SCORE	RESPONSES(%) NR	1	2	3	4	5
1	101	2	69	0	30	69	0	0	0
2	101	5	84	7	0	0	0	7	84
3	102	3	61	0	30	7	61	0	0
4	102	2	84	0	15	84	0	0	0
5	103	1	84	0	84	0	0	15	0
6	103	2	92	0	7	92	0	0	0
7	104	3	92	0	0	0	92	7	0
8	104	1	100	0	100	0	0	0	0
9	105	2	76	0	0	76	23	0	0
10	105	1	84	0	84	15	0	0	0
11	106	2	84	0	15	84	0	0	0
12	106	3	92	0	7	0	92	0	0
13	107	1	23	0	23	53	7	15	0
14	107	2	7	0	53	7	7	30	0
15	108	3	92	0	0	0	92	7	0
16	108	4	92	0	7	0	0	92	0
17	108	2	84	0	7	84	7	0	0
18	110	2	92	0	7	92	0	0	0
19	110	3	92	7	0	0	92	0	0
20	110	1	100	0	100	0	0	0	0
21	111	2	100	0	0	100	0	0	0
22	111	3	100	0	0	0	100	0	0
23	112	4	84	0	15	0	0	84	0
24	112	2	69	0	0	69	23	0	7
25	201	4	23	0	23	53	0	23	0
26	201	4	92	7	0	0	0	92	0
27	201	4	69	7	15	7	0	69	0
28	201	1	92	0	92	0	7	0	0
29	202	2	61	7	0	61	23	7	0
30	203	4	100	0	0	0	0	100	0
31	203	4	23	0	53	7	15	23	0
32	204	2	61	7	23	61	0	7	0
33	204	1	100	0	100	0	0	0	0
34	204	1	84	0	84	0	0	15	0
35	205	3	76	7	7	0	76	7	0
36	206	2	84	7	0	84	0	7	0
37	206	2	92	7	0	92	0	0	0
38	206	4	61	0	0	38	0	61	0
39	206	3	61	7	23	7	61	0	0
40	206	2	84	0	15	84	0	0	0
41	301	2	7	0	0	7	61	30	0
42	301	4	69	7	15	0	7	69	0
43	302	3	53	23	7	0	53	15	0
44	402	3	53	7	0	30	53	7	0
45	403	3	15	7	46	30	15	0	0
46	501	1	38	0	38	7	30	23	0
47	502	3	15	7	15	15	15	15	30
48	504	5	38	7	15	7	30	0	38
49	507	2	38	7	30	38	7	15	0
50	509	2	53	7	0	53	7	15	15

PCT COR = 70

Figure 4. A copy of a form analysis report.

Masters for Sections II and III filed with NABT paper - October 72

Practical Application of CAM as Practiced at Carlmont High School in the Algebra I Program

Russell Reed

Now in its third year, the application of CAM in the Algebra I program at Carlmont has developed from an experimental basis to an integral part of the course. Modifications of course design and changes in the evaluation procedures have evolved to a point where those involved clearly understand what is expected of both teacher and student. This year four teachers and approximately 250 students participate in the program.

Course Design

Sixteen units (chapters) written by Albertus Niehuis Jr., head of the Carlmont Math Department, covering a years span of topics from sets to the development of the quadratic formula make up the course offering. The topics included in the first ten units and the number of objectives and items written for each unit are shown in Table 1. On the surface the course is group paced. However, because of the use of performance objectives and the feedback inherent in the CAM process, the course could be considered as a teacher centered individualized instructional program. Each unit to be taught is preceded by a set of performance objectives which identify the basic goals of the course. Examples of three objectives and their associated test items are shown in Table 2. The objectives are also stated throughout the unit, making sub-topics easily accessable to the student for study purposes.

Evaluation Design

The evaluation design used for Algebra I is referred to as a Sliding Unit CAM, so called because each test administration has components related to retention, immediate post-instruction, and pre-instruction test items. A test administration given after instruction on Unit 5 would have test items pertaining

to Units 4, 5, and 6; a test administration after instruction on Unit 6 would test materials from Units 5, 6, and 7, etc. Each test administration, given at two to three week intervals, consists of three test forms. Two of these forms are used on a predetermined testing date and differ only in terms of retention and pre-instruction test items. The third form with parallel test items is used exclusively for retake purposes. Students are requested to take the third form if they do not meet the minimum standards of performance as determined by the teachers. The objectives included on each test form for the test administration related to Unit 5 are shown in Table 3. The students are also given a final exam which contains a sampling of objectives from the entire semester; the students are told which objectives will be included on the semester final.

Results

Each student receives a copy of their individual print-out. Examples of these reports are shown in Figures 1 and 2. When necessary, the teacher and the student can examine the print-out and the student can get individual consultation on the objectives that need more study.

The teacher receives a group summary report for each test administration. An example of the group summary report is shown in Figure 3. These reports lead to the possibility of general comparisons among teachers and also give information that clearly indicates the weaknesses of the class as a whole on objectives instructed and strengths on objectives not yet instructed.

Table 1

Course Design - Algebra I CAM, Carlmont High School

Unit	Title	Number of Performance Objectives	Number of Test Items (Multiple-choice, 5 Responses)
1	Sets	7	28
2	Postulates	7	28
3	Integers & Their Subsets	7	28
4	Real Numbers & Their Subsets	7	28
5	Geometric Representation	7	28
6	Variables	7	28
7	Simple Equations	7	28
8	Simplifying Addition & Multiplication (Commutative & Associative Postulates)	10	40
9	Simplifying Addition & Multiplication (Distributive Postulate)	10	40
10	Word Problems	10	40

Table 2

Sample Objectives and Test Items

Objective 0405: The student will select the correct simplification for a complex function.

Test Item 040502:

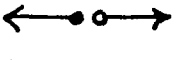
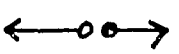
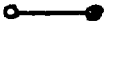
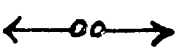
Select the correct simplification for $\frac{2 + \frac{1}{3}}{3}$

1. $\frac{1}{3}$
2. $\frac{7}{6}$
3. $\frac{5}{3}$
4. $\frac{5}{6}$
5. $\frac{13}{2}$

Objective 0502: The student will select the correct geometric description from a worded description of a set of numbers.

Test Item 050202:

Select the correct geometric description for all numbers greater than 5 or less than or equal to 1.

1. 
2. 
3. 
4. 
5. 

Objective 0605: Given an expression, and the replacements for the variables, the student will select the correct evaluation.

Test Item 060502:

For the expression $2m - n^2$, evaluate correctly when $m = -5$ and $n = 2$.

1. -14
2. -6
3. 6
4. 14
5. 4

Table 3

Evaluation Design - Algebra I

Form 51			Form 52			Form 53	
QN	Objective		QN	Objective		QN	Objective
1	0401	Retention	1-2	0501	Post	1	050102
2	0402		3-4	0502		2	050103
3	0403		5-6	0503		3	050202
4	0404		7-8	0504		4	050204
5	0405		9-10	0505		5	050303
			11-12	0506		6	050304
6-7	0501	Post	13-14	0507		7	050403
8-9	0502					8	050404
10-11	0503		15	0401	Retention	9	050503
12-13	0504		16	0402		10	050504
14-15	0505		17	0403		11	050603
16-17	0506		18	0404		12	050604
18-19	0507		19	0405		13	050703
						14	050704
20	0601	Pre	20	0601	Pre		
21	0602		21	0602			
22	0603		22	0603			
23	0604		23	0604			
24	0605		24	0605			
25	0606		25	0606			
26	0607		26	0607			

SEABAUGH LANCE 663070 SECTN 12 REED 10/19/72
CA101

TEST ADM 4 - 10/18/72
FRACTION CORRECT ON ALL ITEMS IS 23/ 26 FORM 52
FRACTION CORRECT ON UNIT ITEMS IS 14/ 14

QN	OBJ	RP	INS	QN	OBJ	RP	INS	TEST ADM	FORM	FRN COR TOTAL	FRN COR UNIT
15	401	$+	YES	9	505	$+	YES	1	12	23/30	17/18
16	402	$+	YES	10	505	$+	YES	2	32	22/28	13/14
17	403	$+	YES	11	506	$+	YES	3	42	21/29	9/10
18	404	$+	YES	12	506	$+	YES	4	52	23/26	14/14
19	405	$	YES	13	507	$+	YES				
1	501	$+	YES	14	507	$+	YES				
2	501	$+	YES	20	601	$+					
3	502	$+	YES	21	602	$+					
4	502	$+	YES	22	603	$-					
5	503	$+	YES	23	604	$+					
6	503	$+	YES	24	605	$+					
7	504	$+	YES	25	606	$+					
8	504	$+	YES	26	607	S-					
								CUM TOT		89/113	53/ 56

Figure 1. An individual student report for Lance Seabaugh.

STEWART TOM M 447235 SECTN 12 REED 10/19/72

CA101

TEST ADM 4 - 10/18/72

FRACTION CORRECT ON ALL ITEMS IS 23/ 26 FORM 51

FRACTION CORRECT ON UNIT ITEMS IS 12/ 14

QN	OBJ	RP	INS	QN	OBJ	RP	INS	TEST ADM	FORM	FRN COR TOTAL	FRN COR UNIT
1	401	$+	YES	14	505	$+	YES	1	11	24/30	16/18
2	402	$+	YES	15	505	$+	YES	2	31	22/28	13/14
3	403	$+	YES	16	506	$+	YES	3	41	22/29	7/10
4	404	$+	YES	17	506	$+	YES	4	51	23/26	12/14
5	405	$+	YES	18	507	$+	YES				
6	501	$+	YES	19	507	$+	YES				
7	501	$+	YES	20	601	$+					
8	502	$-	YES	21	602	$+					
9	502	$+	YES	22	603	$+					
10	503	$-	YES	23	604	$+					
11	503	$+	YES	24	605	$+					
12	504	$+	YES	25	606	$+					
13	504	$+	YES	26	607	$-					
								CUM TOT		91/113	48/ 56

Figure 2. An individual student report for Tom Stewart.

COMPREHENSIVE ACHIEVEMENT MONITORING - GROUP SUMMARY REPORT CA101

CARLMONT ALGEBRA I 10/19/72

STUDENT GROUP 7600 REED'S STUDENTS

CGN	CONTENT GROUP		TEST ADMINISTRATION 1	2	3	4	5	6	7	9	9	10
	NUMBER OF STUDENTS		76	73	74	79						
0	ALL OBJECTIVES	AVG	61	74	72	80						
		NUM	2280	2044	2088	1976						
4	UNIT 4	AVG	33	47	76	77						
		NUM	380	365	720	380						
5	UNIT 5	AVG	$$$	$$$	35	89						
		NUM	0	0	288	1064						
6	UNIT 6	AVG	$$$	$$$	$$$	64						
		NUM	0	0	0	532						
401	OBJECTIVE 401	AVG	35	46	73	73						
		NUM	76	73	144	76						
402	OBJECTIVE 402	AVG	17	54	87	92						
		NUM	76	73	144	76						
403	OBJECTIVE 403	AVG	27	39	63	63						
		NUM	76	73	144	76						
404	OBJECTIVE 404	AVG	51	64	77	77						
		NUM	76	73	144	76						
405	OBJECTIVE 405	AVG	34	34	82	81						
		NUM	76	73	144	76						
501	OBJECTIVE 501	AVG	$$$	$$$	79	88						
		NUM	0	0	34	152						
502	OBJECTIVE 502	AVG	$$$	$$$	42	88						
		NUM	0	0	38	152						
503	OBJECTIVE 503	AVG	$$$	$$$	11	80						
		NUM	0	0	34	152						
504	OBJECTIVE 504	AVG	$$$	$$$	60	89						
		NUM	0	0	38	152						
505	OBJECTIVE 505	AVG	$$$	$$$	47	96						
		NUM	0	0	34	152						
506	OBJECTIVE 506	AVG	$$$	$$$	18	91						
		NUM	0	0	38	152						
507	OBJECTIVE 507	AVG	$$$	$$$	13	88						
		NUM	0	0	72	152						

Figure 3. A Group Summary Report for Mr. Reed's students.

COMPREHENSIVE ACHIEVEMENT MONITORING - GROUP SUMMARY REPORT CA101

CARLMONT ALGEBRA I 10/19/72

STUDENT GROUP 7600 REED'S STUDENTS

CGN	CONTENT GROUP		TEST ADMINISTRATION 1	2	3	4	5	6	7	8	9	10
601	OBJECTIVE 601	AVG	$$$	$$$	$$$	93						
		NUM	0	0	0	76						
602	OBJECTIVE 602	AVG	$$$	$$$	$$$	80						
		NUM	0	0	0	76						
603	OBJECTIVE 603	AVG	$$$	$$$	$$$	11						
		NUM	0	0	0	76						
604	OBJECTIVE 604	AVG	$$$	$$$	$$$	94						
		NUM	0	0	0	76						
605	OBJECTIVE 605	AVG	$$$	$$$	$$$	55						
		NUM	0	0	0	76						
606	OBJECTIVE 606	AVG	$$$	$$$	$$$	72						
		NUM	0	0	0	76						
607	OBJECTIVE 607	AVG	$$$	$$$	$$$	42						
		NUM	0	0	0	76						
9991	POST OBJECTIVES	AVG	72	79	78	86						
		NUM	1368	1679	1800	1444						
9992	PRE OBJECTIVES	AVG	45	47	35	64						
		NUM	912	365	288	532						

Figure 3 (cont'd) A Group Summary Report for Mr. Reed's students.

CAM Basic Reading Skills - Menlo-Atherton High School

Mary Condon

In a reading program such as Menlo-Atherton has where there are 150 students involved, all reading two or more years below grade level, the first obligation of the teacher is to give these students tools. By tools I mean we need to teach word attack skills. If a student is not able to associate sounds to letters, if he cannot blend letters, if he cannot see syllables and sound them out, if he cannot see the different parts of a word like prefixes and suffixes and know their functions, he is incapacitated and almost without exception a poor reader or even a non-reader.

The teaching of skills has always been an important part of our reading program. However, in the past we used to present the material, practice it for a reasonable length of time, test on it, give grades, and then go on to the next phase of teaching.

With the advent of CAM, the format of the program has been altered. We still teach the same material but it now has been categorized and applied to CAM. The basic word attack skills program includes 48 objectives of which 19 are oral objectives and 29 are written. An example of a written objective is "Orally given a list of common two-syllable words ending in le, the student will write the separate syllables." This objective and the associated words are presented in Table 1. An oral stimulus requires a written response; conversely, a written stimulus requires an oral response. An oral objective sounds like this, "Given a list of common words ending with a silent e, the student will accurately pronounce the words." This objective and the associated words are shown in Table 2. Again, during the daily drill, the student learns that an e at the end of a word is silent and it also makes the preceding vowel sound long. During

Table 1

Example of a Written Objective

19 Orally given a list of common two-syllable words ending in le, the student will write the separate syllables.

bottle	candle
bumble	gentle
jungle	fable
ruffle	marble
sample	title
muzzle	circle
paddle	maple
cattle	dimple
tumble	needle
muscle	pebble

Table 2

Example of an Oral Objective

22 Given a list of closed syllable words, the student will add the final e and accurately pronounce the newly formed word.

mad	made	fin	fine
mod	mode	sit	site
hop	hope	pal	pale
bit	bite	mat	mate
rid	ride	cut	cute
kit	kite	can	cane
fat	fate	hid	hide
hat	hate	slim	slime
fad	fade	slid	slide
pin	pine	rat	rate

each CAM test administration, each student takes an oral CAM and a written CAM, thereby receiving two computer print-out sheets, one for each CAM taken.

When the results are returned to the student, they are interpreted by the student and the teacher on a one to one basis. The student now has tangible results of his work. An example of an individual student report is shown in Figure 1. The student can actually see what he has done and what he further needs to do. These results also give the teacher specific information that she needs to work further with the student.

The 48 objectives that make up our program cover a basic phonics or decoding course. Each day the students work in small homogeneous groups of six or seven for about 20 minutes drilling on the objectives that will be included in the next CAM. Multi-modal teaching techniques provide obvious advantages for educationally handicapped students. Use of visual, auditory, kinesthetic, and speech tactile learning modes enable the students to have successful learning experiences. The remainder of the period is spend on vocabulary development and comprehension skills. The master schedule indicates that there is a test administration every two weeks. On each CAM there are some newly instructed items, some review items, and some uninstructed items. Last year after the third test administration, we noticed that the overall scores indicated that the students had not done as well as they had done on the first two test administration. After careful analysis of the results, it was concluded that the students had not mastered the objectives, probably because the material had become more difficult and there was now considerably more material to retain. Consequently, the decision was made to reteach the material and readminister the 300 series. This could be done without the students retaking the same test since each CAM has two test forms, and each student could take the alternate form which contained the same objectives but different items. Again because of the increasing difficulty of the material and

STEWART TOM M 459214 SECTN 1 CONDON 11/25/71

MA401

TEST ADM 5 - 11/24/71

PERCENTAGE CORRECT ON ALL ITEMS IS 85 FORM 311

PERCENTAGE CORRECT ON YES ITEMS IS 90

QN	OBJ	RP	INS	QN	OBJ	RP	INS	TEST ADM	FORM	PCT COR TOTAL	PCT COR YES
1	9	$+	YES	19	14	$+	YES	1	111	45	0
2	9	$+	YES	20	14	$+	YES	2	211	100	100
3	9	$+	YES	21	16	$+	YES	3	311	60	83
4	9	$+	YES	22	16	$+	YES	4	411	62	100
5	10	$+	YES	23	16	$-	YES	5	311	85	90
6	10	$+	YES	24	16	$+	YES				
7	10	$+	YES	25	17	$+					
8	10	$+	YES	26	17	$+					
9	11	$+	YES	27	17	$+					
10	11	$+	YES	28	17	$-					
11	11	$+	YES	29	18	$+					
12	11	$+	YES	30	18	$+					
13	12	$+	YES	31	18	$-					
14	12	$+	YES	32	18	$-					
15	12	$-	YES	33	19	$+	YES				
16	12	$-	YES	34	19	$+	YES				
17	14	$+	YES	35	19	$+	YES				
18	14	$+	YES	36	19	$+	YES				
								CUM AVG		70	92

Figure 1. An example of an individual student report.

the growing multitude of retention items, it was necessary to give two test administrations for the last two CAMS. The immediate feedback of test results and their evaluation along with the prerogative of modifying the master schedule and the teaching strategy are in my opinion the reasons for the success of the program.

As indicated in the final test results shown in Figure 2, a great deal of improvement can be made with such an instructional program. The forte of the program is that the student is never released from his obligation of mastering specific material because there is a constant overlapping of the material. CAM with its computer print-outs has activated an interest in achievement; it has created a motivation for accomplishment. The grade level distribution of students in September, January, April, and June is shown in Figure 3. The 150 students began the year with a vocabulary median grade level of 5.1; in May it had risen to 6.3. The comprehension median grade level was 4.7 in September and in May it rose to 6.9. These gains are remarkable indicating the overall effectiveness of the program.

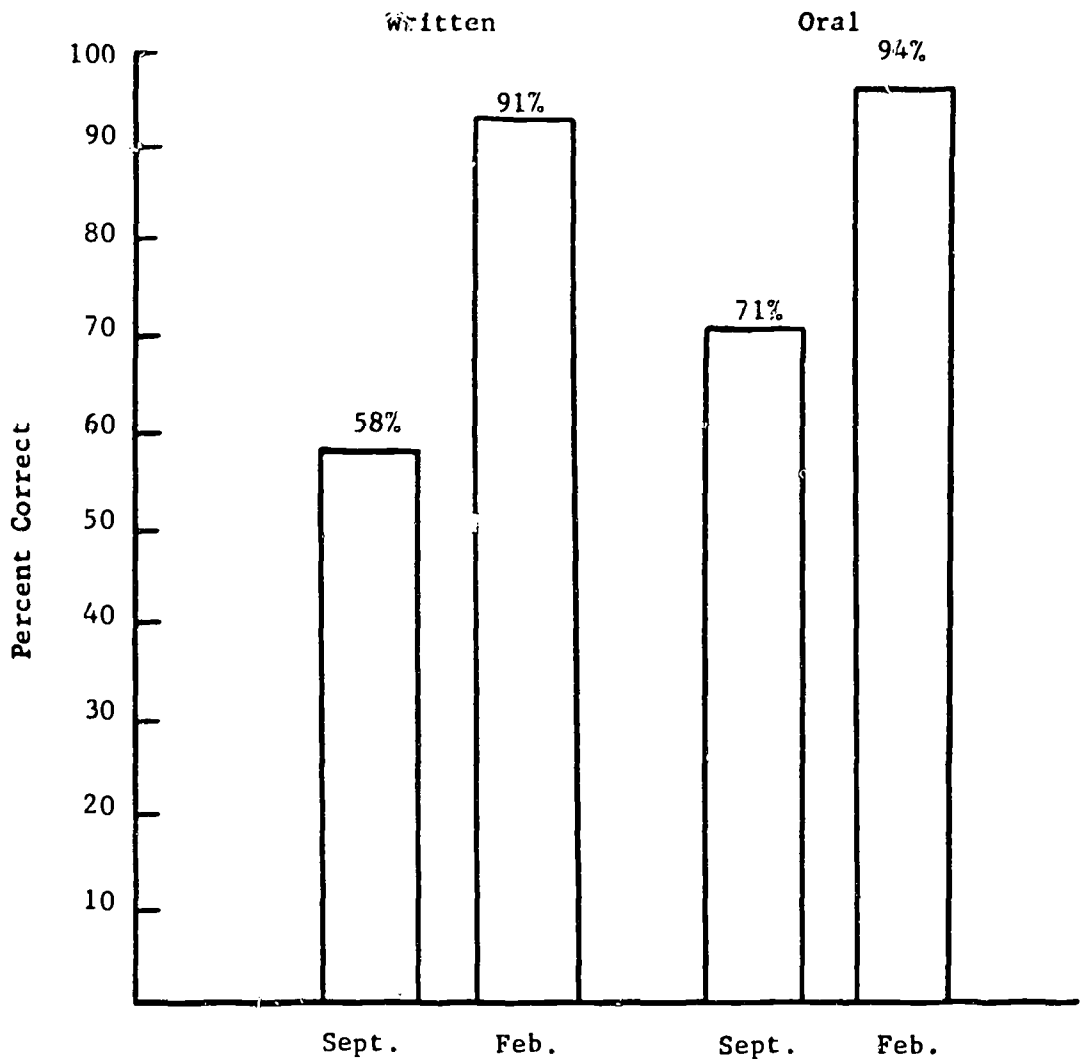


Figure 3. Percent correct on CAM tests in September and February for students in the Menlo-Atherton High School Reading Program.

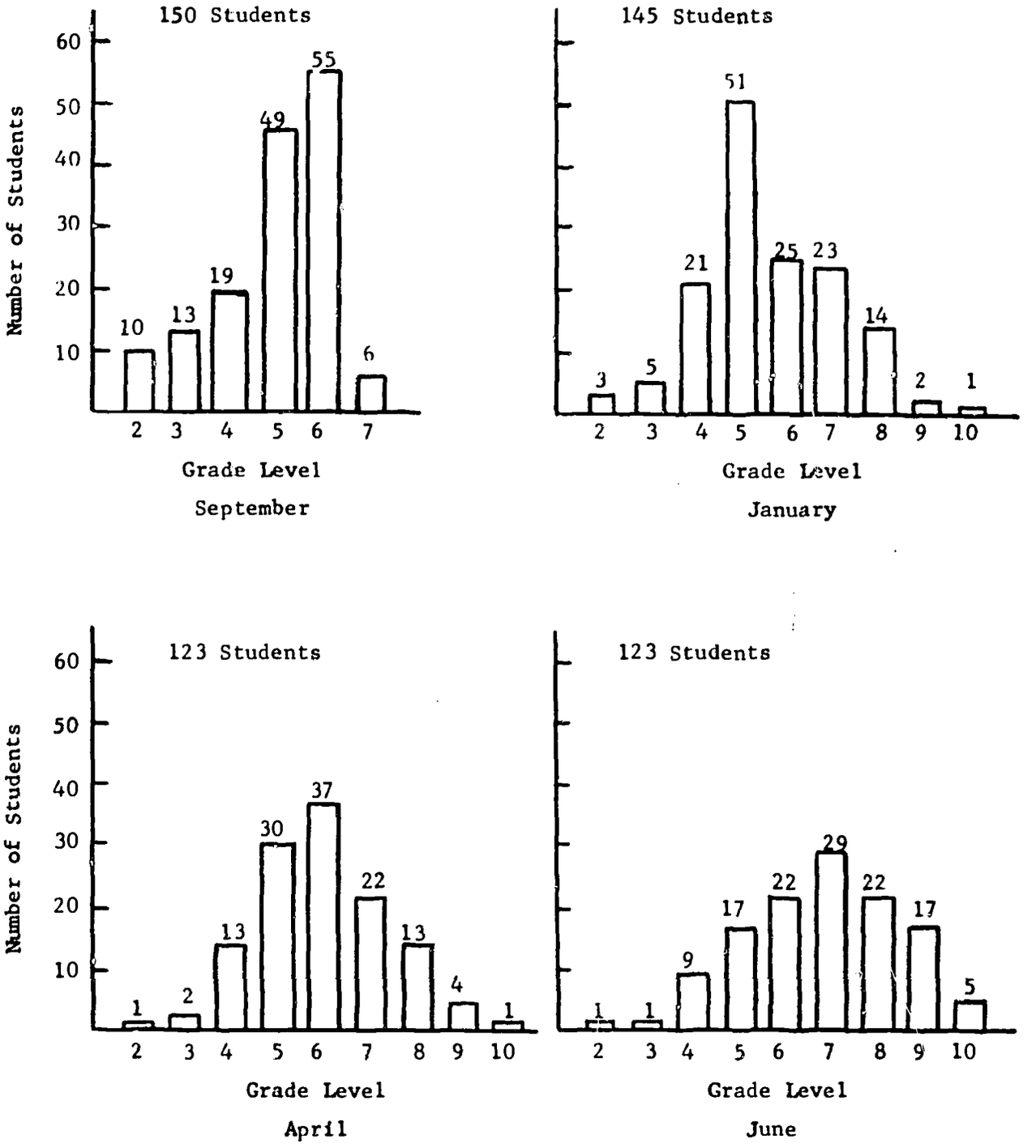


Figure 4. Grade level distribution of students in the Menlo-Atherton High School Reading Program.

The Application of CAM for English - Notre Dame High School
Marianne Rackham

In order to understand the way in which we are using CAM in the English Department at Notre Dame High School, it is necessary to first understand the situation in which we teach. Ours is a one track, college-prep high school which is operating on a flexible-modular schedule for the fifth year. Both these facts are factors in our CAM use. When we were originally approached by Mr. Easter, we had just completed a year of work on a WASC evaluation. The WASC committee used Form B, which is the tool for curriculum evaluation, and so we were not unfamiliar with the writing of performance objectives, even in a field as esoteric as that of English.

In the course of writing our objectives for the evaluation, I became more and more convinced that in a one track school like ours, we actually teach the same material over and over with an increasing degree of sophistication. We expect our ninth grader to learn--or relearn in many cases--grammar; we expect our sophomore to apply this knowledge to the writing of simple composition; and we expect our juniors and seniors to expand on the basic concepts even further. In every instance, we either presume a body of knowledge or we presume a lack of knowledge, but whatever the basic presumption, we teach and reteach the same students the same material year after year. To a certain extent, this same generalization can also be made about our teaching of literature.

With this hypothesis as the basis of my CAM, I proceeded to design a course which would be operable on all levels and which would, hopefully, save us from teaching concepts which were in fact already a part of the students body of knowledge, and at the same time, prevent our assuming a body of knowledge which did not exist. I started by writing a number of objectives which began with a concept as basic as identification of parts of speech and which progressed

through more basics like functions of parts of speech, capitalization, punctuation, recognition of sentence types, and culminated with a very sophisticated unit on language, connotation and denotation, paragraph construction, and finally the multi-paragraph composition. We initiated the program in the second semester of academic year 71-72 with our ninth graders, and the student response to the program was quite favorable. There were five teachers on the team--flexible-modular scheduling almost always involves team teaching--and 180 students in the course. One teacher elected not to participate. Because of the late start and beause our projection for the year had not originally included the CAM material, we covered only a small percentage of the objectives in the original course. We did, however, cover enough material for me to recognize certain problems which existed in my original evaluation design and over the summer, I re-wrote and re-vised. In September of this year, we initiated the course on three levels. At the outset, a Standard Cam--that is a test designed to sample all of the objectives in the course--was given to all the students. Using the material generated by the computer, every teacher was then free to determine the starting place for her class or classes. Teachers of junior and senior composition have been amazed to discover that basics like punctuation and sentence construction are areas which require work, while at the same time, teachers of certain freshmen sections have discovered these students are ready for composition assignments usually not presented in the ninth grade.

When the student is presented with her printout, she is in a position to diagnose her own problems. She can tell, for example, if she has mastered a given objective by looking at the number correct out of the number attempted, and if she is not achieveing 80% or better, she comes for individualized instruction. Her teacher can tell from the data generated by the computer what kinds of exercises she should receive. In a class of mixed ability levels, it

is my practice to place a student who is achieving 80-100% on items we have taught in charge of a student who is achieving below the acceptable level. Both are stimulated to achieve in this kind of a situation.

This year, in addition to CAMming grammar and composition across three levels, we are also CAMming the literature portion of the Sophomore English course. This is a course which is team taught by four individuals, three of whom were involved in our original CAM projects. Our philosophy in this is very similar to our philosophy in our Grammar course. In the teaching of literature, we are basically always looking to teach certain basic objectives. It is only the degree of sophistication which differs. For example, characterization in the freshman short story unit is the same concept we teach in the senior novel course. Only our approach varies. With this in mind, the teachers involved wrote objectives and test items for each unit taught in English II. One teacher designed a poetry course, one a novel course, one a drama course, and the fourth unit was given over to grammar. At this time, our objectives are largely concerned with basics, but it is our hope that with time and experience we can expand these units so that they too can be used across levels. The particular work of literature used would vary from class to class, but the framework into which it is placed would remain constant. All poetry courses are involved with meter and rime, language, allusion, diction, etc. All fiction courses are concerned with plot, character, setting, theme, and style. All drama courses are concerned with the content of poetry and fiction plus characteristics unique to the genre. Our goal for this year is to create a CAM framework into which we can fit most of the material taught in the English classes of our school.

The data provided by the program enables us to assess our curriculum, our teaching methods, and our individual student performance. Once the assessment has been made, we can only improve.

CAM and Teacher Decision-Making

Sequoia High School Geography Team

Bruce Edmonds

Introduction

Comprehensive Achievement Monitoring has added a new dimension to the team Geography program at Sequoia High School. For the first time, we are able to make important instructional decisions based on actual data rather than on intuition. As the Geography Team has become more expert in the use of this tool, we have beocme more empirical in our approach to the problems of the classroom, more selective in our choices of activites and materials, and most important, more effective as teachers, as evidenced by marked increases in student progress.

Background

Course Design

The Geography Team is composed of four teachers and two teacher aides. There are six sections of team geography. Each period there is one large group class (55-70 students) which is heterogeneous in composition and is directed by two teachers and two aides. There is also one advanced standing class (10-15 students) each period with one teacher. Instruction is group-paced.

The course content includes the following units of study:

Unit 1 - Geography of Cities
Unit 2 - Manufacturing and Agriculture
Unit 3 - Cultural Geography
Unit 4 - Political Geography
Unit 5 - Habitat and Resources

The text we use in the High School Geography Project: Geography in an Urban Age.

Evaluation Design

The Sequoia Geography Team uses a "sliding CAM" upon which is superimposed a semester "standard CAM." That is, for each of the twelve test administrations, students receive some pre-test items, some post-test items, and some retention items. Every objective (and there are nearly 200 for the year) is tested three times with three different test items. Standard CAM's are given as comprehensive semester examinations. The evaluation design for Geography is shown in Table 1.

Teacher Decision-Making

Immediate Decision-Making

CAM allows us to make daily strategy decisions on the basis of hard data evaluation. Pre-instruction testing has provided data for short-term decisions regarding instruction and classroom management.

1. Instructional emphasis placed on objectives is determined by an evaluation of CAM pre-test summary data.
2. "Exceptional" students are identified so that we may individualize our instruction.

Post-instruction data allow us to:

1. provide remedial prescription on an individual basis.
2. make decisions on material for which review is necessary.
3. grade students on the objective basis of achievement.

Long-Term Decision-Making

While the use of CAM data for daily instructional decisions is at the heart of the CAM project, we are learning how to use the tool in a broader sense as well. The Sequoia Geography Team has sough answers to a number of questions. In each case, we defined a research hypothesis and CAM provided the vehicle for its measurement. Consider the following examples:

Question 1: Are the High School Geography Project materials more effective than

Table 1

Sequoia Geography - CAM Evaluation Design

Test Adm.	Pre-Instruction	Post-Instruction	Retention
1	Unit 1, Part 1		
2	Unit 1, Part 2	Unit 1, Part 1	
3	Unit 2, Part 1	Unit 1, Part 2	Unit 1, Part 1
4	Unit 2, Part 2	Unit 2, Part 1	Unit 1, Part 2
5		Semester 1	
6	Unit 3	Unit 2, Part 2	Unit 2, Part 1
7	Unit 4	Unit 3	Unit 2, Part 2
8	Unit 5, Part 1	Unit 4	Unit 3
9	Unit 5, Part 2	Unit 5, Part 1	Unit 4
10	Unit 6	Unit 5, Part 2	Unit 5, Part 1
11		Unit 6	Unit 5, Part 2
12		Semester 2	

the traditional geography textbook?

CAM developed and tested a model which compared the effectiveness of HSGP materials to the traditional text using student performance as the measurement criteria. The following pattern appeared:

	Pre-Test	Post-Test	Retention Test
Traditional Text.	30	70	60
HSGP.	30	70	80

The HSGP materials are designed to be concept reinforcing, thus, the important difference in retention test scores.

Question 2: Does the increased effectiveness of HSGP justify the extra cost of the materials?

CAM designed a model which compared HSGP to traditional materials in terms of expenditures and student performance. Cost per unit of student performance gain favored the new materials. In addition, since the study was broken down by each seperate objective, we were able to determine those objectives which were prohibitively expensive in terms of student performance gain.

Question 3: Of the many different activites and teaching techniques which we employ in the classroom, which ones seem to be most effective?

By documenting the teaching method used during the instruction of each objective we were able to compare the method against student progress data for each objective.

Product Development - A Case in Point

At the end of each year CAM participants are encouraged to carefully analyze their courses, rewrite and reorganized objectives, and to revise and reconstruct tests and evaluation designs. To do so, CAM produces test form analysis material

and a variety of other summary data by which decisions on product development take place.

As we reviewed our CAM data last spring, a problem became apparent. The data revealed that the student performance distribution curve was no longer bell-shaped, but bimodal.

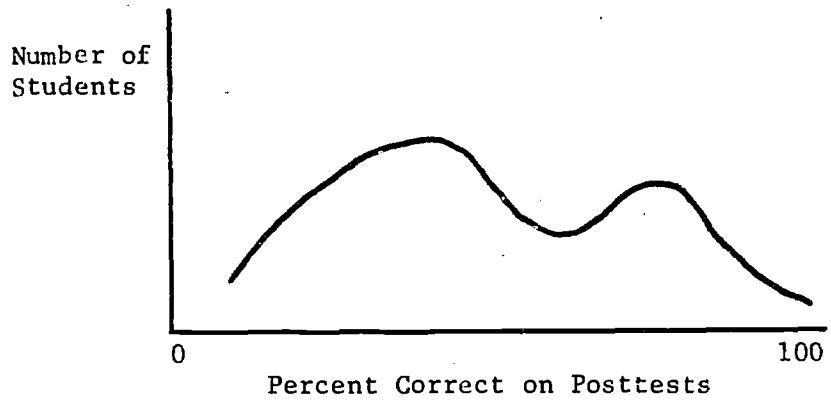


Figure 1. Distribution of students on the posttests.

Increases in minority students due to the district's desegregation effort, and a steady growth of our Mexican-American population contributed to the curve distortion.

Since our instruction is group paced, we had focused our instructional level at a middle point, providing individualized help for students at either end. The error in this approach is at once apparent. There were very few students at the instructional level. The questions, then, were 1) toward which mode do we adjust the level, and 2) how do we provide for the remainder? For many reasons, we decided to move the level downward thus providing for our ever-increasing number of educationally handicapped students and to establish advanced standing geography classes.

Additionally, with the realization that special attention must be paid to the large group of low achievers, the team added a black teacher, an additional

teacher aide, and an earphone reading lab. We also rewrote much of the reading material to a lower vocabulary/comprehension level.

The effects of these changes are being studied this year as we raise such questions as:

1. What are the effects of withdrawing the advanced standing students from the team class a) on the large group and b) on the advanced standing group itself?

2. Is there both progress improvement and attitudinal improvement, or neither?

3. Will the instructional intensification at the lower level result in significant student progress improvement?

Without the data that Comprehensive Achievement Monitoring is about to provide, the kinds of instructional modification that we have made in the Sequoia geography program would not have been possible. The need for the changes would not have been as apparent, the specific problems to which we addressed ourselves could not have been isolated, and the results of the changes could not have been as effectively measured.