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ABSTRACT

The California Mathematics Project was established in 1982 by the California State Legislature as one of several statewide responses to a widespread perception among educators and the public at large that the mathematical competence of American children has deteriorated. This report describes an attempt to evaluate the first year's work of one site of the California Mathematics Project. The Legislation provides for several levels of responsibility for the evaluation of the California Mathematics Project, one of which is the local project level. This project report consists of seven sections. Following the introduction is a profile of program participants. The second section summarizes the participants' reaction to and assessment of the 1986 Summer Institute, based on exit interview data. This is followed by an analysis of survey data gathered at the end of the Summer Institute. The fourth section of this report provides an analysis of data based on a survey of instructional practices in mathematics. This section describes and compares self-reported instructional practices of participants, a group of teachers trained by participants, and a comparison group of teachers. The survey instrument used in the collection of these data reflects instructional practices advocated in the California Mathematics Framework. The results of a year-end telephone interview with Fellows forms the basis for the next section of this report. This is followed by a discussion. (TW)

Research Group in Mathematics and Science Education

The Monterey Bay Area Mathematics Project: First Year Evaluation

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and

Nancy Brown

A report prepared for the

Monterey Bay Area Mathematics Project

Edward M. Landesman, Principal Investigator

Technical Report No. 87-1: Group for Research in Mathematics and Science Education. University of California, Santa Cruz, September 9, 1987.

The Monterey Bay Area Mathematics Project:

First Year Evaluation*

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September, 1987

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FIRST YEAR EVALUATION

Ronald W. Henderson and Nancy Brown

Introduction

The California Mathematics Project was established in 1982 by the California State Legislature (Senate Bill 424) as one of several statewide responses to a widespread perception among educators and the public at large that the mathematical competence of American children has deteriorated. This report describes an attempt to evaluate the first year's work of one site[1] of the California Mathematics Project. The Legislation provides for several levels of responsibility for the evaluation of the California Mathematics Project, one of which is the local project level. Although this is an evaluation of the Project at a single site, some knowledge of the larger context of the Project is essential to the interpretation of this local effort.[2]

The legislation that created the California Mathematics Project was generated in a milieu of immense apprehension about the ability of the products of American schools to function within a society in which technology is increasingly pervasive.

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[1]The Monterey Bay Area Mathematics Project, based on the campus of the University of California, Santa Cruz, Edward M. Landesman, Principal Investigator

[2]A more complete description of the California Mathematics Project is provided in Evaluation of the California Mathematics Project - Report 86-34. Sacramento: California Postsecondary Education Commission, 1986.

Special expressions of concern were voiced by leaders in business and industry because American students compare poorly with their peers in other technologically advanced nations (California Postsecondary Education Commission, 1986), dulling any competitive edge the United States, and California in particular, may have had. The nature of the problem has been described in numerous reports (Hill, 1981; National Commission on Excellence in Education, 1983; National Science Board Commission on Precollege Education in Mathematics, Science and Technology, 1983; Peng, et al, 1984; Tyack, Kirst & Hansot, 1980), but the spirit of the Legislature's perception is best captured in the language of the legislation itself, which attributes the decline in mathematics skills, in part, to:

> (a) Inadequate mastery by students of the mathematics techniques taught in high school, resulting in poor comprehension of college course-work and high attrition rates for those students who have these deficiencies.
>
> (b) A tendency among young women to avoid taking advanced mathematics courses in high school, which limits their choice of educational options, and screens them out of future careers in science, engineering, and other mathematically related professions.
>
> (c) Lack of mathematics instruction at the elementary school level to enable all students, including female, minority, and low-income students to develop skills and attitudes which will enable them to pursue mathematics successfully in later grades.
>
> (d) Concentration on minimum computational abilities, at all levels of schooling, with the result that opportunities for students to develop problem-solving skills necessary to advance to college mathematics or to jobs in technical fields may be available.

The Legislators recognized that improvements in the pre-service education of teachers were necessary, but of themselves would make little impact on the improvement of mathematics education. They thus realized the additional need ". . . to assist existing teachers in gaining skills necessary to increase mathematics proficiency among students."

The charge to the California Mathematics Project was a very broad one. It translates into four goals (California Postsecondary Education Commission (p. 6, 1986). They are to:

1. Improve the quality of mathematics teaching in California.

2. Develop mathematics teachers as leaders in order to disseminate strategies, ideas, and techniques, to encourage appropriate attitudes, and to magnify the beneficial impact of the project

3. Coordinate efforts of the Project with activities (of postsecondary institutions, local schools, state agencies, and industry) directed to the improvements of mathematics teaching

4. Increase awareness of the importance of mathematics education and the current issues and efforts in mathematics education by communicating with governmental officials, lay boards at various levels, parents, and industry groups, teacher educational professionals and the general public

It would be folly to attempt to evaluate a project's success with respect to all of these goals during its initial year of operation, even if resources to do so were available. This evaluation focuses primarily on efforts and accomplishments associated with the first two of these goals, and even then the approach is selective. The legislative intent behind the California Mathematics Project initiative was to increase the mathematical competencies of students in California's public schools. Given that intent, it is clearly important, at an appropriate point in time, to assess the program's influence on student performance. The perspective followed in designing the evaluation effort reported here takes the position, however, that it would be premature to attempt to assess effects on student behavior until we are in possession of some information on the project's implementation and its influence on the attitudes and behaviors of the educators who are touched by it. Thus, this evaluation focused on the reactions of project participants to the training provided. Within the severe restrictions imposed by resource limitations, it also attempted to 1) identify changes in the participants' teaching of mathematics that might be attributed to the project, 2) determine whether or not the project produced a multiplier effect such that participants contributed to the professional development of other teachers of mathematics, and 3) undertake an exploratory examination of the effects of dissemination efforts by participants on the instructional behaviors of their colleagues.

In brief, our evaluation efforts were based on the assumption that it makes little sense to measure changes in student behavior until there is some evidence of changes in those instructional practices that reflect project goals. The California Mathematics Project is a broad-based effort to improve the status quo in mathematics education. The authors of a recent publication of the Association for Supervision and Curriculum Development (Hord, Rutherford, Huling-Austin & Hall, 1987) remind us that innovations involving curricula and instructional strategies have usually failed, and in most cases there is no way to know whether they failed because the ideas were flawed or because they were never implemented properly. Our position is congruent with that observation, and has influenced us ask if anything has changed in classroom processes and curricular content as a result of the Project. Even this modest effort is fraught with difficulties because resources were not available, and presumably never will be, to do a firsthand study of instructional process in classrooms conducted by Fellows or by teachers they have influenced. Thus, the activities reported here represent, in part, an exploration of the possibility of obtaining useful evaluative information via teacher self report.

This report consists of 7 sections. Following this introduction we provide a profile of program participants. Applicants who were accepted into the Program for 1986-87 were designated Monterey Bay Area Mathematics Fellows. In this report they are referred to either as participants or Fellows. The second section summarizes the participants' reaction to and assessment of the 1986 Summer Institute, based on exit interview data. This is followed by an analysis of survey data gathered at the end of the Summer Institute. The fourth section of this report provides an analysis of data based on a survey of instructional practices in mathematics. This section describes and compares self-reported instructional practices of Fellows, a group of teachers trained by Fellows, and a comparison group of teachers. The survey instrument used in the collection of these data reflects instructional practices advocated in the California Mathematics Framework (California State Department of Education, 1985).

The results of a year-end telephone interview with Fellows forms the basis for the next section of this report. This is followed by a discussion.

Profile of Institute Participants

A Pre-Institute survey form provided by the California Mathematics Project was sent by Monterey Bay Area Mathematics Project staff to all teachers who were chosen to participate in the 1986 summer institute. Sixteen (of the 23) participants returned completed forms. Project administrators made these forms available to the evaluator for use in preparing this report.

The Pre-Institute Form was divided into topical sections pertaining to: 1) The Teaching of Mathematics, 2) Educational Leadership in Mathematics, 3) Mathematics Autobiography, 4) Demographics and 5) Expected Project Outcomes This report draws selectively from the information provided by the Pre-Institute Form, as a means of providing a profile of the 1986 institute participants.

Demographics

Five male and 11 female participants responded to the Pre-Institute survey. Of these, the ethnic background of one was

Asian, two were Hispanic, and the remainder were non-Hispanic white. Two of the women taught in the primary grades; three women and one man taught in the intermediate grades; three men and five women were from junior high or middle schools; and one male and one female respondent reported high school teaching assignments. Years of teaching experience among the participants ranged from 1 1/2 to 28 years, with a mean of 12.69 and a standard deviation of 9.4.

The formal mathematics education of participants ranged from high school geometry (n = 1) to a MAT degree in mathematics (n = 1). No one held an MA degree in mathematics. Two participants, in addition to the MAT degree holder, had majored in mathematics in college and seven had minored in the subject. Seven participants had taken no mathematics course work beyond trigonometry or some other fourth year high school course. Institute participants came from schools that were either predominantly Hispanic or non-Hispanic white in student composition. Asians represented about 12% of the population in one school, but in all other schools Asians constituted 5% or less of the student body. Five teachers were from schools in which half or more of the students were Hispanic, and in two of these cases the proportions were 90% or more. The schools represented by five participants had student populations that were 70% or more non-Hispanic white. The schools represented by Institute participants served very few Black students. In one school, 15% of the students were Black, in another 5% were Black, and in all others 2% or less of the students were reported as Black.

Self-Described Teaching Practices

Part'. ..nts were asked to respond to a rating scale devised to describe their own teaching. The response format was a 5-point Likert-type scale, with response alternatives ranging from "Not at all descriptive" (1 point) to "Very descriptive" (5 pints). The specific questions were as follows:

In teaching mathematics, I

a) feel enthusiastic about the subject.

b) make special efforts to minimize math fear or anxiety.

c) give personal help to students who have difficulty.

d) stress problem-solving process, rather than solutions.

e) encourage students to guess or to make estimates.

f) have students apply concepts to demonstrate understanding.

g) test for conceptual understanding.

h) have students discover concepts using manipulatives.

i) set aside time for exploring mathematical ideas.

j) use "real world" examples of problems whenever possible.

k) present information on women mathematicians/scientists.

l) know when students are bored or confused.

m) invite students to share knowledge or observations.

n) have students work in small groups.

o) engage students in math contests, puzzles, problems of the day, etc.

Descriptive statistics for the responses to these items are presented in Table 1. In general, participants reported the statements to be highly descriptive of their own teaching behavior, with most means falling above 4, on a 5 point scale. The lowest means and greatest variability were found for items "h" (i.e.., having students discover concepts using manipulatives), "i" (i.e.., setting aside time for the exploration of mathematical ideas), and "k" (i.e., presenting information on women mathematicians/scientists).

Table 1
Descriptive Statistics for Self-Reported Descriptions of Teaching Behavior

Item	N	Min.	Max.	Mean	SD
a	16	4.0	5.0	4.69	.48
b	16	3.0	5.0	4.38	.62
c	16	3.0	5.0	4.19	.85
d	16	2.0	5.0	4.06	1.00
e	16	1 0	5.0	4.13	.96
f	16	2.0	5.0	4.00	.72
g	16	3.0	5.0	4.06	.85
h	16	1.0	5.0	3.25	1.29
i	16	1.0	5.0	3.13	1.36
j	16	3.0	5.0	4.38	.72
k	16	1.0	5.0	2.31	1.25
l	16	3.0	5.0	4.19	.75
m	16	2.0	5.0	4.13	.96
n	16	2.0	5.0	3.44	.89
o	16	3.0	5.0	4.19	.83

Pearson correlations were computed as an initial means of exploring whether variations in the responses self-descriptions of teaching practices might be related to background variables. Table 2 reports correlations for only those items that were found to correlate significantly with one or more of the background variables of gender, highest level of mathematics completed, years of teaching experience, or grade level of teaching assignment.

Table 2
Self-Descriptive Statements of Teaching Correlated with Background Variables

Background Variable	Item a	Item h	Item i	Item n
Gender	-.16	.46	.37	.34
Math Completed	.50*	-.65**	-.44	-.40
Teaching Experience	-.14	-.05	.12	-.33
Grade Level	.33	-.73**	-.62**	-.71**

Coding for the background variables was: gender (male = 1, female = 2), math completed (a ten point scale, ranging from 1 for Algebra I to 10 for M.A. in mathematics), teaching experience (1 point for each year) and grade level (primary grades = 1, intermediate grades = 2, junior high or middle school = 3, and high school = 4).

It is interesting to note that neither teachers' gender nor teaching experience were significantly correlated with any of the self-descriptive statements. Enthusiasm for the subject was associated with participants' level of mathematics training, while both mathematics background and grade level taught were negatively associated with the use of manipulatives to help students discover concepts (item "h"). The greater the amount of formal mathematics training, and the higher the grade level taught, the less teachers tended to use manipulatives.

Given that level of teaching assignment and level of mathematics training attained by teachers covary (r = .66 in this sample), a multiple regression analysis was employed to explore the question of which of these variables accounted for the greatest portion of the variance in self-reported use of manipulables for mathematics concept discovery. Ratings for the item were regressed on mathematics background and grade level of the teaching assignment. The multiple R was .762, R^2 = .581, $p < .004$ (df 2,13). Only the standardized coefficient (-.533) for grade level was significant ($p < .045$), suggesting that differences in the use of manipulables is attributable primarily to grade level, and is not a product of the level of the teacher's formal mathematical education.

Items "i" (setting aside time for the exploration of mathematical ideas) and "n" (having students work in small groups) were both negatively correlated with the grade level of the participants' teaching assignments, indicating a greater use of these approaches in the lower grades.

Expected Project Outcomes

A series of rating scale items asked participants to rate the extent to which they **expected** the California Mathematics Project to increase or expand their:

a) knowledge or understanding of mathematics.

b) empathy for students learning mathematics.

c) repertoire of problem-solving strategies.

d) enjoyment of mathematics teaching.

e) awareness of resources for teaching mathematics.

f) self confidence in teaching mathematics.

g) understanding of math curricula across grade levels.

h) belief in the need for changes in math curricula.

i) repertoire of techniques for teaching mathematics.

j) use of concrete materials and manipulatives.

k) standards of evaluating student performance in math.

l) network of contacts with other math teachers.

m) discussions about math teaching within your school.

n) commitment to increasing minority and female participation in mathematics.

o) pride in teaching as a profession.

p) familiarity with uses of microcomputers in math teaching.

q) ability to develop inservice presentations.

r) appreciation of process in learning.

The descriptive statistics presented in Table 3 reveal a pattern of greater variability in outcome expectations for the California Mathematics Project than was true for the self-descriptions of teaching behaviors.

Simple correlations are presented in Table 4 for all expectation items that were significantly associated with any one experience, mathematics background, or grade level.

The significant correlations in Table 4 identify a number of interesting relationships between expectations of project

Table 3
Descriptive Statistics on Participant Expectations for Mathematics Project Outcomes

Item	N	Min.	Max.	Mean	SD
a	16	1.0	5.0	3.88	1.03
b	16	2.0	5.0	3.75	.93
c	16	4.0	5.0	4.75	.45
d	16	1.0	5.0	4.19	1.05
e	16	3.0	5.0	4.50	.82
f	16	1.0	5.0	3.69	1.14
g	16	2.0	5.0	4.06	1.00
h	16	1.0	5.0	3.81	1.38
i	16	2.0	5.0	4.50	.89
j	16	1.0	5.0	3.81	1.38
k	16	2.0	5.0	3.88	1.09
l	16	2.0	5.0	4.00	.97
m	16	3.0	5.0	4.13	.81
n	16	2.0	5.0	3.63	1.15
o	16	1.0	5.0	3.88	1.09
p	16	3.0	5.0	3.94	.68
q	16	1.0	5.0	4.18	1.05
r	16	2.0	5.0	4.06	1.00

Table 4
Project Expectations Correlated with Background Variables

Background Variable	Item a	b	d	f	h	i	j	n	o	q
Gender	-.22	.41	.39	.42	.61*	.55*	.56*	.26	.43	.52*
Math Background	-.48*	-.48*	-.59*	-.75**	-.35	-.61**	-.56*	-.34	-.54*	-.34
Teaching Experience	.29	-.15	-.52*	-.37	-.43	-.57	-.56*	-.30	-.39	-.49
Grade Level	-.20	-.53*	-.35	-.59*	-.39	-.59*	-.53*	-.61**	-.40	-.35

outcomes and background variables. Lower grade teachers expressed a higher expectation for increased or expanded knowledge of mathematics (item "a") than did teachers at higher grade levels. Teachers who had less formal background in mathematics than their fellow participants, and who taught at the lower grade levels, tended to express the expectation that the project would help them to feel greater empathy for students learning mathematics (item "b"). Math background and years of teaching experience were both negatively associated with the expectation that the project would help them to experience increased enjoyment in teaching mathematics (item "d"). Math background and grade level were negatively related to the expectation of increased self confidence in teaching mathematics (item "f"). Item "h", which expressed the expectation that the project would lead participants to an increased belief in the need for curricular changes in mathematics was positively associated with gender, indicating that women held this expectation more strongly than men.

Item "i" was significantly related to all four background variables. A program outcome involving an expanded repertoire of techniques for teaching mathematics was anticipated more strongly by women than men, more by teachers with relatively lower levels of formal preparation in mathematics, more by the less experienced teachers, and more by teachers in lower than in upper grades. The same pattern held for expectations involving increased use of concrete materials and manipulatives.

Item "n", indicating an expectation for an increased commitment to enhanced participation in mathematics by women and minorities was strongly associated with grade level. Lower grade teachers expressed stronger expectations for this outcome than did teachers in the higher grades. Teachers with relatively little formal mathematics training expressed stronger expectations that the project would enhance their pride in teaching as a profession than did teachers with more formal education in mathematics. Finally, female participants and those with fewer years of teaching experience were stronger than males and more experienced teachers in expressing the expectation that the project would enhance their ability to develop inservice presentations.

Educational Leadership in Mathematics

The educational leadership section of the survey requested information on the frequency with which teachers had engaged in certain activities, such as demonstrating techniques for other teachers, or preparing a grant proposal. Approximately 88 percent of the participants had been asked by another teacher how they teach a particular math concept. Thirty-one percent had been asked to visit another teacher's classroom to observe and give feedback, and the same proportion of participants reported that they had been asked by a peer to teach a certain concept or demonstrate a technique for teaching mathematics. Only 25% had been asked to develop a special math-related event at their school, although half had organized informal discussions around the teaching of mathematics with other teachers in their schools or districts. Approximately 38% reported having written at least one computer program or having used computer software to teach mathematics, and 31% had written a grant proposal to improve mathematics teaching. Twenty-five percent, on at least one occasion, had conducted an inservice workshop or presentation for other teachers on some aspect of mathematics education.

Participants also responded to a series of items pertaining to their use of new approaches, attendance at professional meetings, administrative support for their ideas about teaching, feelings about making presentations, self-perceptions of leadership qualities, and perceptions of the impact teachers can have on change in mathematics education. Descriptors for the Likert scale categories for these items ranged from "Strongly Agree" (4 points) to "Strongly Disagree" (1 point). Descriptive statistics on responses to these items are presented in Table 5.

From these responses it appears that the majority of this group of participants felt rather strongly that they employ new methods and materials in their mathematics teaching. Similarly, most, but not all, reported frequent attendance at meetings for the propose of improving their effectiveness as teachers, and the majority thought their ideas about teaching were respected by administrators at their school. Some of the participants appear to feel somewhat uncomfortable leading discussions or making presentations to peers, administrators, or parents, but most did not feel great discomfort in carrying out such tasks.

There was a fairly strong self-perception of leadership qualities among members of this group. Furthermore, there was a strong sense of optimism that teachers can play an important role in bringing about change in mathematics education.

Mathematics Experience and Participation

Table 5
Self-Descriptions of Math Education Leadership Characteristics

Item	Mean	SD	Min	Max
a. I often use new approaches and materials in teaching mathematics.	3.25	.58	2	4
b. I frequently attend workshops, conferences or institutes hoping to improve my effectiveness as a teacher.	3.56	.81	1	4
c. Administrators at my school are generally supportive of my ideas about teaching.	3.50	.63	2	4
d. I am uncomfortable leading discussions or making presentations before other teachers, administrators, or parents.	2.80	.68	2	4
e. I consider myself to have leadership qualities.	3.38	.50	3	4
f. Teachers can play an important role in influencing change in mathematics education.	3.75	.45	3	4

Information on the participants' teaching experience and educational background in mathematics was presented earlier. In addition to these characteristics, information relating to their own experiences as mathematics students in high school was obtained. Specific information on membership and participation in major mathematics education organizations was solicited using a five point Likert-type scale with response alternatives ranging from "Not at all descriptive" (1 point) to "Very descriptive" (5 points).

Table 6
Self-Descriptions of High School Math Experiences

Item	Mean	SD	Min	Max
When I was a high school student:				
a. mathematics was one of my favorite subjects.	4.25	1.00	2	5
b. teachers encouraged me to continue my math education.	3.56	1.46	1	5
c. I avoided mathematics whenever possible.	1.19	.54	1	4
d. most of my math teachers were very good.	3.81	1.11	1	5
e. mathematics was generally easy for me.	4.06	1.12	2	5

In general, participants reported having enjoyed mathematics in high school, but encouragement to continue their mathematics education was less than universal. As a group, they had not avoided mathematics courses, but neither did they consider the statement that most of their math teachers had been very good as highly descriptive of their experience. For the majority, mathematics had seemed relatively easy.

Table 7 shows the frequency of membership and participation in conferences and meetings of professional mathematics education associations. Membership in the California Mathematics

Association was more common than membership in any other

Table 7
Participation in Professional Associations

Type Activity	NCTM			CMC			L/RMA		
Member	Yes	No		Yes	No		Yes	No	
	4	12		7	9		2	14	
Attend Mtg's or Conf's	Nvr	Occ	Ofn	Nvr	Occ	Ofn	Nvr	Occ	Ofn
	13	2	1	10	4	2	14	2	0

mathematics education association, with 7 of the 16 respondents claiming affiliation. Frequency of membership in national or local and regional associations was very low. The rate of participation in the conferences and meetings of these associations was even more sparse, with a substantial majority indicating that they never attended.

Summary

In general, the teachers who participated in the Monterey Bay Area Mathematics Project during this initial year appear to be reasonably representative of teachers in the region served by the project. They display considerable variation in their own formal preparation in mathematics, as would be expected considering that they represented the entire K-12 grade range in their teaching assignments. It is interesting, and probably not atypical, that seven of the 16 teachers who provided data had no formal mathematics coursework beyond what, under present circumstances, would generally be considered to be high school level math. Contrary to what some school critics might expect, the majority of the participants reported generally positive experiences in their own mathematical education and the overall tendency toward "math avoidance" was very low. On the other hand, relatively few had received encouragement to continue their mathematics education.

The nature of the student populations served by the schools represented by these teachers was also fairly representative of the area. Some schools were predominantly hispanic, others predominantly non-hispanic white, and others a mix of these populations. The schools represented served relatively few Asians or Blacks. If teachers of Black students are to be included in greater numbers it will probably be necessary for the Project to draw more participants from Monterey County than from Santa Cruz County.

Daily Assessments of Summer Institute Activities

A questionnaire completed by participants at the end of each day during the Summer Institute provided the staff with formative evaluation information. The staff used this daily feedback on Institute activities and content to make adjustments in the program.

Each questionnaire employed a likert-type format and had two distinct sections. Items in the first section asked participants to rate each activity or topic for interest level, clarity of presentation, and perceived usefulness. Participants responded to the item for each activity by circling a number from 1 to 5, 5 representing the descriptors "very interesting," "very clear," or "very useful," as appropriate. The second section included questions intended to elicit participants' perceptions of the applicability of the activities and topics to their own teaching situation. The questions asked whether each activity was 1) applicable to the individual's teaching situation, 2) an activity they planned to implement, 3) a practice already familiar to other teachers at their school, and 4) already included in the instructional practices being used by teachers in their school who were familiar with the ideas inherent to the activity. Again, participants were asked to circle a letter representing their opinion, from strongly agree to strongly disagree, with an option for no opinion. A sample copy of the questionnaire for one day of the Institute is displayed in Appendix A. Participants also wrote suggestion cards at the end of each day, to be considered along with the structured data from the questionnaire in making adjustments in structure, activities, and presentations.

In general, the daily feedback on institute activities and content were very favorable. In some cases, activities and content were perceived as better suited to application at one level of instruction than another. It was interesting to note that participants tended to rate activities and topics as interesting and clearly presented even when they perceived its direct applicability to their own situation as moderate or less.

During the planning of the institute their was some difference of opinion regarding the use of activities involving stations. Some staff members thought that secondary teachers might respond less favorably than lower grade teachers to the procedure of rotating through stations. The data indicated that stations were consistently among the most favorably rated activities.

Overall, the sessions on logic were among the most highly rated, with little variance in the responses. Somewhat unexpectedly, participants who taught in the lower grades were especially positive in their ratings of the logic sessions, and most of them indicated an intent to implement age-appropriate instruction in logic in their classes.

Data representing participants' estimates of the degree to which their colleagues were already familiar with the content and activities presented in the Institute, and whether or not these practices were already in use, suggested that the Institute was exposing participants to new material. In many cases participants were unable to estimate their colleagues familiarity with or use of specific practices. Nonetheless, to the degree that they were able to make a judgment, instructional practices based on Institute content appeared not to be widely known or practiced by colleagues of this group of participants.

Correlations were computed daily to determine if judgments of on topics were associated with gender or level of teaching assignment. In most cases the favorable responses to the topics cut across these characteristics. However, women and teachers in the lower grades tended to respond more favorably to topics that dealt with issues of ethnic and gender equity in mathematics than did men and secondary teachers.

It is not clear whether gender or teaching level was the more important operative variable in this case, since there was a moderate degree of colinearity between the two variables (r = -.36). It may be warranted to make special efforts to make gender and ethnic equity issues salient to groups that may be inclined to be less responsive to these topics.

Summer Institute Exit Interview

Exit interviews were conducted with each participant during the last four days of the summer institute. The interviews followed a focused interview approach in which structured questions were followed by probes designed to elicit open-ended responses from the interviewees.

The first question asked participants for their overall assessment of the summer institute. The responses were overwhelmingly positive. One interviewee reported, "I feel really inspired ... and also overwhelmed." Many participants reported experiencing a considerable degree of frustration and cognitive dissonance during the early stages of the institute. Nevertheless, they perceived the institute as "very stimulating and well worth while." In fact, the task of grappling with initial frustration may have contributed to a positive outcome. One participant said, "During the first week I thought, 'my gosh what is going on here?' . . . but by this time it is absolutely amazing what's happened. I'm starting to think differently."

As a follow-up to the overall assessment question, participants were asked if they would have applied to attend the institute if they had prior knowledge of what it would be like. Twenty-two of the 23 participants responded categorically that they would have applied. When asked if they would recommend a future institute of this type to a colleague, 21 of the 23 responded that they would definitely recommend it to a colleague.

When asked whether the institute had made effective use of the participants' time, 15 of the 23 participants responded with an unequivocal positive statement. Five participants were somewhat more negative concerning the efficiency with which the time had been used and three provided answers which could not coded as positive or negative. Overall, the participants thought the instruction was well structured, but they also observed that activities were sometimes too rushed and/or too restrictive. Many participants would have welcomed the opportunity for more follow-up discussions about the implications of institute material for their own grade levels.

Participants' reactions to the content of the instruction varied. One participant suggested "Next time . . . cut the math, or get more time for stations . . . for things to be diagrammed and discussed." A contrary opinion was expressed by another participant who said that, "I would have liked to have more math . . . they did have a crammed schedule, but they were flexible enough . . . I liked the articulation sessions."

In an attempt to assess the institute's ability to maintain interest and attention, participants were asked if the institute seemed to go quickly, about right, or slowly. Overall, the majority of the participants perceived the time to have passed quickly. No one thought the institute moved slowly, although, as would be expected, a few participants indicated that some days passed more quickly than others.

In order to gain an impression of the value participants placed on activities such as the Institute, the question was posed, "If you were an administrator, faced with the pressures of competing demands for limited resources, would you allocate funds to inservice activities to follow up on topics introduced in the Institute?" Nineteen of the 23 participants said yes, two said no. Two responses could not be coded. In support of his affirmative response, one participant indicated that, "We need to get together and share the results of the application of the workshop to the classroom." The same sentiment was echoed by another participant who said, "That's what would make it a lasting thing instead of a summer diversion." One of the two participants who did not think resources should be spent on follow up activities indicated that, "I think the monies would be better spent for salaries."

A commonly heard criticism of training for teachers centers on the failure of inservice providers to treat teachers as intelligent professionals. Therefore, participants were asked if they felt they had been treated as intelligent professionals within the context of the summer institute. Eighteen people (78%)

gave an affirmative response to the question. Five voiced complaints that they had not been so treated. Reflecting this dissatisfaction by a minority of the participants, one believed "There was a flaw in the attitude toward us as participants ... they talked to us as students rather than teachers." A contrasting perspective on the same issue was voiced by a person who said, "I have heard the complaints ...(but) on the other hand, it's good when you ... see how the students are treated." It appeared that there was some loosening up and change in the structure after the first week or so. This change was captured by one interviewee who indicated that, "At first some people may have felt they weren't [treated like professionals] . . . but we aired it out [and] . . . they've asked us to assume a leadership role and provide a presentation." The net impact of these comments suggests that there was some initial resentment at being treated like students and a number of participants felt that their combined expertise was not utilized to the degree it might have been. Most participants, however, felt that they were challenged and stimulated intellectually and several felt that the initial strategy of placing them in the role of student was an effective way of generating empathy and understanding for their own students.

During the planning of the project, there was considerable discussion and debate concerning whether the project should attempt to provide for the needs of teachers across a broad spectrum of grade levels or focus its efforts on a more homogeneous group. Ultimately a decision was made to organize the project for teachers representing the entire K-12 sector, while recognizing the increased burden to workshop instructors and the organizational difficulties such an approach would entail. In order to obtain the participants' assessment of the degree to which the strategy proved effective, participants were asked directly if they would have preferred to participate with a more homogeneous group of teachers, or if they thought the heterogeneous grouping had been effective. Nineteen of the participants (82.61%) thought the heterogeneous grouping strategy had been effective, while four thought a more homogeneous approach might have been preferable. Many people commented on the relative isolation in which teachers work and on the general lack of opportunities for professional contact with teachers in grades above or below their own. There was a general perception that the heterogeneous grouping provided a very valuable experience, affording Fellows the opportunity to gain a better understanding of the problems encountered by teachers at other grade levels, and to become familiar with the expectations of teachers at those other levels. Lower grade teachers were overwhelmingly positive about the heterogeneous mix. Typical comments were that, "... This is the first time I've ever had any interaction with (upper grade teachers)." One junior high school teacher valued the heterogeneous experience because, "I get to see where my kids are going and where they've been... (but) ... it might have been better to have more groups: high school, intermediate, and primary." Several participants did indicate that they thought it would be useful to have more opportunities to interact and conduct follow-up discussions on the implications of the institute presentations among teachers from similar grade levels.

When asked if the institute would result in individual instructional change, all responded yes, and several comments reflect that the institute provided them with an insight to find what the students are thinking and how to teach them about what they're learning. Another pervasive point was that Fellows had changed their own outlook on math, which would in turn be reflected in their classrooms. One participant said, "I've gained some insight on how I can . . . coordinate cooperative learning and independent work." Another said, "One of my goals is to look into math as a way of thinking . . . (look at) basic skills . . . the real stumbling blocks of a lot of kids." Several participants noted specifically that a change in their teaching would be directly reflected in the students' learning. One participant commented that, "I know it is going to be fun for me. If it is fun for me the students are going to learn from it." With regard to expanding these changes in the classroom, such comments as "I can use math in other areas throughout the day," and "It has given me a lot of ideas for supplementing what I do in math" were common.

When asked if the institute would result in systemic instructional change, most participants did not see any radical change coming from a single institute. They did, however, see it as a step toward systemic change. One example of comments reflecting this belief is provided by the statement that "It's a step toward structural change, and "I don't believe that it is going to be a wholesale revolution, but there will be some change." A somewhat more enthusiastic respondent said ". . . [change] is going to take a long time, but if we do a little bit here and . . . there, maybe eventually the whole curriculum will change. This is a step in the right direction." Several participants noted the need for change taking place in the framework. "I think the framework is the basic instrument of change . . . the workshop acts as the translator," said one participant. Some doubt was expressed by one Fellow who said, "I don't know. Teaching is like a circle. You go through these different phases . . . I hope we're not changing just for the need of change."

The participants were asked what it would take for systemic change, and if it was needed at all. Eight responded that "yes", change was necessary, while two responded that it was not necessary. Thirteen did not provide a categorical response. The key to change, as cited by most participants, was support for follow-up services. A typical response was, "with the follow-up through the year, then you will be able to cultivate those seeds and perhaps institute some changes." One participant observed that, "It depends on the P.R. with the districts and administrators. [Systemic] change won't happen unless we go from here, we can't stop." Some participants suggested alternative methods for systemic change. One participant proposed that, "What we really need is a core of teachers building model math programs." Another suggested that, "We as individuals have to be the stimulus that convinces administrators to provide the opportunities to our colleagues." The remaining comments also underscored the importance of the follow-up to the success of the Institute.

Summary

Responses to the Summer Institute were overwhelmingly positive. On the negative side, some concerns were expressed about the organization and pace of the initial week. There were also a few objections to being placed in the role of student, albeit others thought they gained a good deal of empathy for their own students from this experience. There was general consensus that whatever problems had been experienced during the initial stages of the Institute were soon cleared up. Most participants though the Institute staff had been flexible and responsive to suggestions and expressions of concern. It was especially interesting that some participants who initially felt overwhelmed and confused apparently came to feel that their initial frustration had been a necessary and growth-facilitating feature of the experience.

One concern that seemed to remain for resolution in planning for future Institutes was an expressed need for more follow-up of activities. In reading the entire transcripts of the interviews one gains more of an impression than the excerpts provided here may convey that there was a desire to bring more activities to some kind of closure. Participants expressed an appetite for analyses of how given topics or activities translate into specific teaching situations.

There was a general consensus that Institutes such as the one they had just completed merely provided an initial (but essential) step toward reform in mathematics instruction. There was some diversity in the degree to which Fellows agreed that reform was needed at all. No-one seemed prepared to return to their school and completely transform their program. There was general consensus that the possibilities for change brought to their attention during the Institute were overwhelming. Without exception, participants declared their individual intention to take selectively from the ideas with which they had been presented, and to implement them as their own sense of comfort and security, and their perception of the need for change permitted.

Participants were forceful in their view that follow-up was essential if the Institute was to have any lasting impact. They looked forward to the monthly meetings that would be held throughout the year. Beyond that, it was clear that administrative support would be vital to any attempt to disseminate what Fellows had learned through the Project to their colleagues.

Approval of the homogeneous mix of participants from the entire K-12 spectrum was pervasive. Even those few who would have preferred more work with teachers at their own level (these tended to be secondary teachers) acknowledged the value of the opportunity to interact with teachers from other instructional levels. More opportunities for grade level meetings and for analysis of the application of various topics to specific classroom situations would probably satisfy the few concerns that were expressed. In general, participants were grateful for the opportunity to gain a better understanding of the problems encountered by teachers at levels above and below them, and to become familiar with those teachers' expectations. Many Fellows talked about the isolation of teachers, not only from teachers at other levels, but from other teachers in their own schools. The chance to break out of that isolation, and to form networks with teachers who shared their problems and interests was seen as a major benefit to be derived from the Project.

Post-Institute Survey

The California Mathematics Project Post-Institute Survey Form was used at the end of the Institute to obtain information on a variety of topics, ranging from participants' plans for sharing of ideas with colleagues during the school year, to specific suggestions for improvement. The free-response items covered much the same topics as were examined in the Monterey Bay Area Mathematics Project's own evaluation, and information relevant to these topics were incorporated into the previous section. This section examines participants' responses to a series of Likert scale items that examined judgments of the degree to which the project increased or expanded the characteristic in question. Responses involved choosing from descriptors ranging from "Not at all" (1 point) to "A great deal" (5 points). Descriptive statistics for these responses are displayed in Table 8.

Table 8
Participant Perceptions of Self-Change

Item	Mean	SD	Min	Max
Please rate the extent to which the California Mathematics Project has increased or expanded your:				
a. knowledge or understanding of mathematics.	3.78	.95	2	3
b. repertoire of problem-solving strategies.	3.87	.63	3	5
c. awareness of resources for teaching mathematics.	4.12	.85	2	5
d. understanding of math curricula across grade levels.	4.30	.70	3	5
e. belief in the need for changes in math curricula.	3.87	1.06	2	5
f. repertoire of techniques for teaching mathematics.	4.44	.73	3	5
g. standards for evaluating student performance in math.	2.61	1.20	1	5
h. commitment to increasing minority and female participation in math.	3.50	1.10	2	5
i. pride in teaching as a profession.	3.74	1.10	1	5
j. familiarity with uses of micro-computers in math teaching.	3.30	1.02	1	5
k. ability to develop inservice presentations.	3.44	1.08	1	5
l. appreciation of process in learning.	4.17	.83	2	5

These data indicate that participants considered themselves to have made important gains in almost all areas included in the questionnaire. Perceptions of gains were especially strong with regard to an increased awareness of resources for teaching mathematics, understanding the math curricula across grade levels, enhancement of their repertoire of techniques for teaching mathematics, and appreciation of process in learning. The one area of notable weakness was in increasing knowledge of standards for evaluating student performance in mathematics.

Instructional Practices in Mathematics

A questionnaire entitled "Survey of Instructional Practices in Mathematics" was developed in an attempt to assess the degree to which instructional practices advocated in the California Mathematics Framework were being implemented by teachers who participated in the project during 1986-87 (Fellows), by a "Dissemination Group" of teachers who participated in training conducted by Fellows, and by a Comparison sample of local teachers who had neither direct nor indirect contact with the Monterey Bay Area Mathematics Project. In order to be relevant to teachers at all levels, matters of content were not addressed in the questionnaire. It was confined to instructional characteristics that should be applicable at all levels, as outlined in the "Delivery of Instruction" chapter of the Mathematics Framework (California State Department of Education, 1985). The intent was to test for the direct effects (statistical) of the program on the teaching practices of Fellows, and to search for dissemination effects that might be attributable to inservice workshops conducted by Fellows.

Subjects and Procedures

The survey was distributed during late May and early June, 1987. Copies were sent to all 1986-87 MBAMP Fellows. Fellows were asked to complete and return their own survey forms and to ask colleagues who had attended the inservice activities they had conducted to participate in the survey. All respondents were assured that their replies would be anonymous. In addition, responses were solicited from mathematics teachers in one local high school and six elementary schools. One elementary school represented a small, one-school district, and the remaining five were from the two large school districts in the county. A copy of the survey and the cover letter soliciting cooperation is displayed in Appendix B.

The intent of the questionnaire was to identify instructional practices at a point sufficiently late in the year that all inservice had been completed. The timing was unfavorable because it coincided with the pressures of closing the school year and placed an undue burden on those teachers who, nevertheless, took the time to respond to the instrument. The return rate was less than desired, but reasonable in view of the timing.

A total of 112 completed forms were received: 15 from Fellows, 27 from Dissemination teachers, and 60 from Comparison teachers. Ten additional teachers who returned survey forms did not provide the information required to identify them with one of these three groups. It should be noted that the training activities conducted by MBAMP Fellows were often provided under regular school or district inservice auspices without explicit identification of a relationship to the Monterey Bay Area Mathematics Project. Consequently, some teachers who attended mathematics inservice sessions that were planned or conducted by Fellows may not have associated the training they received with the Project.

The format of the questionnaire was adapted from the self-perception scales developed by Harter (1985, 1986). Each item consisted of two contrasting statements. For each item, subjects directed to select the statement that best represented their own teaching practices. They were then to mark a box indicating whether that statement was "Really true for me" or "Sort of true for me." Harter developed this format in her research on social competence to overcome some of the tendency of items in traditional self-report scales to elicit socially desirable responses. Harter has employed this format successfully in various scales designed for use with subjects ranging from early elementary through college age samples.

Even with the guarantee of confidentiality and an emphasis on the importance of providing responses that represent actual teaching practices, the social desirability bias that besets all self-report instruments was not overcome completely. The social desirability problem is illustrated by an anecdote told by one of the Fellows during the last of the Project's monthly meetings for the year. When asked to complete the survey, one teacher's frustrated response was, "Am I supposed to fill this out the way

I know I should teach, or fill it out like I really teach and admit I'm a lousy teacher?" Nevertheless, the fact that responses displayed substantial variation gives us some assurance that social desirability tendencies did not overwhelm the ability of subjects to respond honestly.

Analysis and Results

Responses to each Framework item fall along a 4-point scale, with 1 representing the lowest and 4 the highest degree of congruence with practices advocated in the Framework. Items were summed for the main analyses, with the Framework Total Score forming the dependent variable. We hypothesized that responses of MBAMP Fellows would manifest the highest overall congruence with the Framework, followed by those of the Dissemination group, with Comparison teachers having the lowest Framework congruence scores. We also wondered if differences in the level of teaching assignments (elementary, junior high or middle, high school) would influence the outcome. Interactions between group membership and teaching level were not hypothesized. In addition, we anticipated that Framework scores could be predicted by the total amount of time subjects had spent during the academic year participating inservice activities relating to mathematics.

Table 9 presents the descriptive statistics on the total Framework scores achieved by each group. The scores of the Dissemination Group and Comparisons were remarkably similar, while the mean of the Fellows group was 7.55 points greater than the Dissemination Group and surpassed the mean for Comparisons by 8.23

points.

Descriptive statistics on Framework scores aggregated by teaching level are shown in Table 10. Elementary and junior high/middle school teachers had comparable scores, but the scores of high school teachers lagged 7.28 points behind those of middle school teachers.

Table 9
Descriptive Statistics for Mathematics Framework

Group	n	Mean	SD
MBAMP Fellows	15	76.00	10.52
Dissemination Gp	27	68.45	7.54
Comparison	60	67.77	9.76

Table 10
Descriptive Statistics for Framework Aggregated by Teaching Level

Group	n	Mean	SD
Elementary	48	71.06	9.07
Jr. High/Middle	10	71.33	11.08
High School	19	64.05	7.68

To test for joint and individual influences of Group and Teaching Level on Framework scores, a series of hierarchical tests were conducted. This approach was chosen because of the nonorthogonal design created by differences in sample size among the three groups. The initial analysis employed the model FRAMEWORK (dependent variable) = CONSTANT + GROUP + LEVEL + GROUP*LEVEL. The Group x Level interaction term did not achieve significance, so the interaction component of the model was dropped for the next analysis. A 3 (Group) x 3 (Level) Analysis of Variance (omitting the interaction from the equation) revealed significant main effects for both Group [$F = 3.664$, (df 2,68), $p < .03$] and Level [$F = 4.879$, (df 2,68), $p < .01$]. The multiple R for the joint influence of Group membership and teaching Level was .441 ($R^2 = .194$) indicating that Group and Level accounted for 19 percent of the variance in Framework scores.

A follow-up t test comparing the Framework scores of Fellows with those of the closest adjacent group, the Dissemination teachers, was significant [$t = 2.316$, (df 5,30), $p = .028$]. A similar contrast of Framework scores for Junior High and High School Teachers was marginally significant ($t = 2.004$, df 25, $p = .056$). The analyses used only those cases ($n = 73$) for which all data were available on all variables. The effect of sample loss due to incomplete data on the descriptive statistics ranged from non-existent to negligible. The means and standard deviations for the 10 Fellows and 15 members of the Dissemination Group members included in this analysis were identical to those reported in Table 9. For the 41 Comparisons whose data were included in the analysis, the mean and standard deviation of 68.22 and 9.77, respectively, were nearly identical to the 67.77 and 9.76 of the larger sample. Thus, there appeared to be no systematic bias associated with instances of missing data due to failure to respond to every item.

Estimates of time spent in mathematics inservice activities conducted by MBAMP Fellows and in comparable training provided by other sources were summed to form the independent variable for an analysis of the relation of time spent in mathematics-oriented inservice to Framework scores. Descriptive statistics on amount of inservice activities in which subjects had participated are presented in Table 11. Note that the values in the table represent ordinal data based on the categories provided in items 4 and 5 of the survey (see Appendix B). The means suggest that, on the average, both MBAMP Fellows and Comparison teachers had been involved in slightly more than 4 to 6 hours of mathematics inservice. Teachers in the Dissemination Group participated in approximately eight to ten hours of such training.

Table 11
Descriptive Statistics for Mathematics Inservice Time

Group	n	Mean	SD
MBAMP Fellows	15	3.47	2.85
Dissemination Gp	27	5.56	2.66
Comparison	60	3.18	2.24

Hours of mathematics inservice was regressed on Groups, with MBAMP Fellows omitted from the analysis. Fellows were eliminated from this analysis because they were frequently involved in providing inservice training, and the question about participation was worded in such a way that participation as a trainee may have been confounded with participation as a trainer. For a sample of 65 teachers for whom complete data were available, the multiple R

was .895 (p < .001), indicating that group membership accounted (statistically) for 80 percent of the variance in hours of participation in mathematics inservice (R^2 = .801). Although the non-random nature of the comparison group prohibits concluding that there was a causal connection, the findings do suggest the possibility that the Project, via the inservice activities of its Fellows, may have stimulated more professional development activities relating to mathematics instruction than is typical.

Descriptive statistics for total hours of mathematics inservice are broken down by teaching Level in Table 12. The means indicate that elementary teachers participated in somewhat more than 4 to 6 hours of inservice work in mathematics, while secondary school teachers reported involvement in approximately 6 to 8 hours. This finding seems reasonable, considering that secondary teachers generally have specialized assignments teaching mathematics whereas elementary teachers are responsible for a broader range of subjects which also may require some inservice participation.

Table 12
Descriptive Statistics for Mathematics Inservice Time Aggregated by Teaching Level

Group	n	Mean	SD
Elementary	72	3.60	2.73
Jr. High/Middle	10	4.40	2.99
High School	23	4.00	2.37

Regression analysis (with Fellows omitted) was also employed to examine the relation of hours of inservice to scores on the Framework variable. The result (R = .196, $p < .109$) was not significant, although the trend was toward a positive relation between hours of mathematics inservice and Framework congruence.

The main analyses employed the total score for Framework items. In most cases, it is unlikely that individual items pertaining to such a broad set of guidelines as the Framework would be sufficiently sensitive to detect group differences. Nevertheless, response frequencies by group were tabulated for exploratory purposes. Interestingly, Chi-square tests of the cross breaks identified three items that did suggest significant group differences. More frequently than the Comparison group, both the Dissemination Group (Chi-square = 9.783, $p < .002$) and Fellows (Chi-square = 10.115, $p < .001$) structured problem-solving experiences so students might encounter temporary frustrations in their problem-solving efforts. Teachers in the Comparison group were more likely to make an effort to provide problem-solving experiences that assure avoidance of frustration and assurance of success. The practice indicated by the Fellows and Dissemination teachers is congruent with the view that genuine problem-solving challenges will stimulate some frustration, albeit it temporary.

Compared to Fellows, both Dissemination (Chi-square = 3.737, $p < .05$) and Comparison (Chi-square = 8.118, $p < .004$) groups reported less encouragement of varied approaches to problem-solving, including inventions. Dissemination and Comparison teachers more frequently provided students with a series of components or rules to be followed in problem solving.

Fellows reported more frequent use than did Dissemination teachers of practices that place a high priority on helping students to identify global relations. This approach was contrasted with one in which students are taught to solve problems by identifying sequential steps to be followed. Fellows and Comparison teachers did not differ on this item.

Considering the large number of comparisons involved in the exploratory analysis of response patterns, group differences by item should be scrutinized with caution. Any comparison yielding a probability value greater than .01 is suspect. Patterns of response (groups pooled) are shown on the copy of the questionnaire in Appendix B. Item response data may play a useful role in subsequent efforts to improve the instrument.

Summary

The hypothesis of a diminishing degree of congruence with the Mathematics Framework, from Fellows, to Dissemination Group teachers, to Comparison teachers, was only partially supported. The instructional practices reported by Fellows did exhibit a significantly higher degree of congruence with the Framework than did those of either of the other two groups, but Dissemination and Comparison teachers did not differ on this dimension. Therefore, it appears that the goal of promoting change among Fellows was accomplished with some degree of success. However, there was no evidence of a dissemination effect. We should also caution that data on differences between Fellows and the other groups must be regarded with some discretion, because those who elected to become participants in the Project may have been more motivated and interested in instructional reform in mathematics than most teachers. It is important to remember, however, that most of the Fellows had little or no familiarity with the Mathematics Framework at the beginning of the Summer Institute. Moreover, as we reported in a previous section, much of what was presented during the project was perceived as new and interesting. The elementary teachers among the Fellows seemed especially to have gained a new perspective on mathematics instruction. It therefore seems likely that the observed effect is real.

The question of whether teachers at different instructional levels display differential degrees of congruence with the Framework was answered in the affirmative. Elementary and junior high/middle school teachers reported a higher degree of congruence with the Framework than did high school teachers. Acting jointly, teaching Level and Group membership were strong predictors of Framework scores.

Dissemination Group teachers participated in more mathematics inservice training than did comparison teachers. Thus, the Project goal of promoting professional development in mathematics education may have achieved some success. Nonetheless, the analyses failed to establish a relationship between amount of inservice activity in mathematics and congruence of instructional practices with the Framework. This finding should be considered in perspective. Whereas the size of the between-groups differences in mathematics inservice (e.g., Fellows versus non-Fellows, Elementary versus Secondary) are probably substantial when considered as a proportion of all inservice in which teachers participate during an academic year, the amount of time is infinitesimal when considered in the light of the extremely broad scope of the Framework. We will examine this issue further in the conclusion.

Year-End Interview

Project participants were interviewed by telephone at the end of the academic year. The results for each question are presented here. The interview schedule is presented in Appendix C. Item content is summarized for the presentation below. The first item inquired whether Fellows had participated in other (additional to MBAMP activities) professional development pertaining to mathematics during the past year. The vast majority (17 of the 19 responding) indicated they had participated in additional professional development work specific to mathematics teaching. Table 13 presents the pattern of responses, broken down by teaching level.

Those participants who answered "yes" to this question were asked to compare their participation in such activities to the previous year. Specifically, they were asked if their participation has been considerably more than last year, more than last year, about the same as last year, less than last year, or considerably less than last year. Of the 17 responding, four

Table 13
Participation in Professional Development in Addition to MBAMP

Teaching Level	Yes	No	TOTAL
Primary	3	0	3
Intermediate	4	1	5
Middle School	5	1	6
High School	5	0	5
TOTAL	17	2	19

reported considerably greater participation, 8 reported greater participation, 4 reported no change, and 1 reported less participation than last year. These results are presented by teaching level in Table 14.

Table 14
Changes in Professional Development Participation

Teaching Level	Participation				
	Considerably greater	Greater	Same	Less	Considerably Less
Primary	0	3	0	0	0
Intermediate	2	2	0	0	0
Middle School	1	1	3	0	0
High School	1	2	1	1	0
TOTAL	4	8	4	1	0

The "Considerably greater" and "Greater" participation categories were pooled, as were the "Less" and "Considerably less" categories, for further analysis. A Chi-square test with Yates correction for continuity indicated that significantly more participants reported an increase in professional development pertaining to mathematics compared to those who reported no change or a decrease in such activities (Chi-square = 9.31, p = .009). Examples of the activities in which participation was reported (with the number participating in them indicated in parentheses) were school district inservice training (7), private workshops (5), workshops sponsored by organizations (4), participation on the County Curriculum Council, or other county involvement (8), contacting other teachers outside of own district (5), curriculum writing or other leadership role at school (8).

Subjects were then asked if they had planned and presented any mathematics oriented inservice activities or workshops for others during the academic year. Fourteen had participated in such dissemination activities, while five had not. Of those who had conducted dissemination sessions, three were primary teachers, three taught upper elementary grades, five worked in middle schools, and three were high school teachers. A follow-up question determined the total number of such activities for each individual who participated. Collectively, they accounted for the presentation of a total of 31 workshops or inservice meetings, with participation being quite evenly distributed across teaching levels. Subjects were also asked to report the total number of teachers who attended the training sessions. The number of teachers participating in these sessions totaled 618.

As a means of identifying more informal dissemination influences, MBAMP participants were asked if they had been approached by colleagues for suggestions relating to curriculum and instruction in mathematics. Eighteen of the 19 who responded reported they had received such inquiries. Subjects were then asked to estimate whether such contacts had been more or less frequent than during the previous year. Responses to a 5-point scale are displayed in Table 15.

Table 15
Frequency of Requests by Colleagues for Suggestions

Teaching Level	Participation				
	Considerably More Frequent	More Freqn't	Same	Less Freqn't	Considerably Less Frequent
Primary	1	0	1	0	0
Intermediate	2	1	3	0	0
Middle School	2	4	0	0	0
High School	1	3	1	0	0
TOTAL	6	8	4	0	0

Data for levels and categories (Considerably More Frequent + More Frequent and Considerably Less Frequent + Less Frequent were collapsed for purposes of conducting a Chi-square test to determine if the apparent increase in contacts for consultation was statistically significant. The Chi-square (14.79, df 2, p < .001), with Yates correction for continuity, indicated that the increase in such requests was substantially more frequent than might be expected on the basis of chance.

When asked if they had changed their teaching of mathematics in any way as a result of participation in the Monterey Bay Area Mathematics Project, seventeen of a total of eighteen responded in the affirmative. Participants were then asked to give examples of ways in which their teaching of mathematics had changed as a result of the Project. Seventeen participants gave examples of changes in their mathematics that were attributable to the Project. These responses were then categorized and the number of participants mentioning each category tallied. Thirteen reported that they had taught a broader range of skills than formerly. This category was especially prominent among the middle school teachers, where 6 gave responses that fell into this category. The use of cooperative groups had been adopted by 7 teachers. Of these, 2 represented middle schools and three were high school teachers. The fact that only two elementary teachers reported the adoption of cooperative groups may reflect the fact that cooperative learning groups are already used more frequently in elementary than in secondary schools, and/or the fact that several inservice activities on cooperative learning were conducted by various agencies in the Monterey Bay region during the past year. Most of the participants in these workshops were elementary teachers, so it may not have been possible for elementary participants to attribute any cooperative learning strategies they may have adopted solely to the Project.

Two participants reported using more projects (including computers and journals) in their teaching. The adoption of manipulatives as an instructional medium was reported by 8 participants. Broken down by teaching level, those reporting this change were: high school teachers = 1, middle school = 2, upper-grade elementary = 4, and primary = 3. Four participants reported teaching more advanced concepts, such as algebra and geometry. These responses were evenly split between elementary and middle school teachers.

Finally, seven respondents reported changes in attitudes regarding the use of resources, which included textbooks and parents. Such changes were reported by teachers at all levels except high school. It must be recognized that the changes reported here reflect only those practices spontaneously mentioned during the telephone interview. The fact that a particular interviewee did not mention a given practice does not necessarily mean that person did not adopt the change. Nevertheless, the responses appear to reveal a general pattern of the kinds of changes these teachers would attribute to their participation in the Program.

Participants were then asked if there were changes they had hoped to make, but couldn't. Fifteen of the eighteen who responded said "yes," with the affirmative responses being proportionally distributed across teaching levels. When asked what factors prevented them from making changes they had hoped to, four cited a lack of funds, while an additional seven mentioned other barriers relating to unavailability of materials, computers, and so on. Only one of the 17 who responded saw an unsupportive administration as an impediment to the changes they would have liked to implement.

Eight teachers perceived class size and limited facilities to constitute barriers to change, while lack of time was specified by 5 of those who provided examples of barriers to change. Four individuals cited deficiencies in student ability or motivation as factors that inhibited the adoption of practices they would like to try. Five participants mentioned skepticism o; the part of peers or administrators who wanted proof that the innovative practices would produce results as the reason for failing to implement practices they would have liked to. Such insistence on "proof" was cited most frequently by middle school teachers. Three of the 5 instances were reported at this level, with one instance each at the primary and upper elementary levels.

Given that a goal of the Project was for participants to communicate new curricula and instructional practices in mathematics to others, participants were asked if their level of comfort in leading discussions of mathematics with peers, administrators, or parents had increased or decreased. The response mode consisted of a 5-point scale with categories ranging from "Much more comfortable" to "Much less comfortable". The results, by level, are displayed in Table 16.

Data were pooled by level and category (More, Same, Less) for purposes of examining changes in comfort level by means of a Chi-square Test. The Chi-square (with Yates correction for continuity) of 24.0 (df 2, p < .001) indicates solid achievement of the goal of helping participants to feel more comfortable in communicating instructional practices in mathematics to colleagues, administrators, and parents.

Table 16
Expressions of Comfort Communicating About Mathematics Instruction to Others

Teaching Level	Participation				
	Considerably More Comfortable	More Comfr't	Same	Less Comfr't	Considerably Less Comfortable
Primary	2	1	0	0	0
Intermediate	2	3	0	0	0
Middle School	2	3	1	0	0
High School	0	4	1	0	0
TOTAL	6	11	2	0	0

In order to determine the post-Project level of involvement in professional mathematics education associations, participants were asked if they were members of national, state or local associations of mathematics educators, and whether they participated in the meetings of these organizations. The results are presented in Table 17.

These data are not strictly comparable to those gathered at the beginning of the 1986 Summer Institute. There is no assurance that the same subset of participants responded on each of the two occasions, and rather than inquiring about actual participation during a given time period, as was done for the present data, the earlier survey asked a more general question about whether individuals participated often, occasionally, or never, in these organizations. With these limitations in mind, a comparison of

Table 17
Membership and Participation in Mathematics Education Associations

Type Activity	NCTM		CMC		L/RMA	
	Yes	No	Yes	No	Yes	No
Member	4	15	8	11	5	14
	Yes	No	Yes	No	Yes	No
Attend Mtg's or Conf's	4	15	6	13	5	14

the present data with those presented earlier gives no reason to believe that participation in the Program has led to increased membership or participation at either the national or state levels. The raw frequencies, however, suggest a trend toward increased membership and participation in local and/or regional mathematics associations, since 5 of those responding to the year-end interview reported membership in such associations, compared with two at the time of the earlier survey. Similarly, 5 individuals now report having participated in meetings or conferences of local or regional organizations during the year of their involvement in the Monterey Bay Area Mathematics Project, compared to 2 who previously reported ever having participated in such activities. However, Chi-square tests of contingency tables for pre and post Project reports of membership and participation in local and regional mathematics associations indicated that the trends did not achieve significance.

The final question asked "Do you have any final comments to offer that would be helpful to the evaluation of the project?" A number of responses were unique to individual respondents whereas others fell into categories that expressed the views of a number of individuals. The following list summarizes all response categories and indicates the frequency of comments or suggestions falling into each:

1.	Learned about the Framework	3
2.	Learned about textbooks	1
3.	Wanted more solid math	2
4.	Loved it. Would recommend it.	11
5.	More opportunity for same grade level together	3
6.	Enjoyed diverse backgrounds & levels of teachers	4
7.	Involve principals and parents more	6
8.	Follow-up (monthly meetings) was very important	7
9.	Wanted more evaluation (esp. mid-year)	3
10.	Wanted more structure in monthly meetings	7
11.	Encouraged indiv. to get involved at larger level	3
12.	Enjoyed a specific topic (e.g., logic)	3
13.	Would have liked more respect as a professional	1
14.	Made math fun/enjoyable	2
15.	Too much material covered not in useful form	4
16.	All participants should have partner from same school	3
17.	Learned a lot of math. Helped me pass CBEST	4
18.	Wanted to learn how to teach math, not to enrich it	4

Summary

Results of the telephone interview provided evidence of movement in the direction of several of the Project goals. One of these goals is that of encouraging Fellows to engage in activities that would enable them to serve as leaders in mathematics education in their schools and districts. Evidence of progress toward this aspiration seems quite strong. Fellows participated in many professional development activities that were relevant to mathematics instruction, but independent of the on-going ventures of the Monterey Bay Area Mathematics Project. This participation represented an increase over what Fellows had done prior to their association with the Project. It also appeared that there may be a trend toward increased membership and participation in local and regional mathematics education associations, although if there is a trend it is not yet significant. If membership in national and state professional associations of mathematics educators is a valid unobtrusive index of interest in professional development as mathematics educators, Project aspirations in this regard fall well short of realization.

Fellows do appear to be assuming leadership roles, and to be contributing to the dissemination of practices intended to contribute to reform in mathematics education. Ninety-four percent of them reported that they now feel more comfortable leading discussions of curricular and instructional issues in mathematics than they did prior to participation in the Project. The majority actually did participate in dissemination activities. Their dissemination ventures resulted in at least 31 inservice sessions, reaching an estimated 600 or more teachers. Furthermore, Fellows were approached more frequently by colleagues for informal suggestions about mathematics curriculum and instruction than had been the case prior to participation in the Project.

The majority (94%) reported that they had made changes in their own teaching of mathematics, and many (83%) would have made more changes had it not been for factors preventing it. The most frequently mentioned barriers to change were a lack of funds, materials, and equipment. Class size and limited facilities were also perceived as obstructions. Lack of administrative support was not specifically identified as a problem (with 1 exception), but several Fellows cited administrative and peer skepticism about the efficacy of innovative practices as an impediment to implementation. Viewed in the context of the discussion that took place at the last of the monthly meetings for this group of Fellows, it seems likely that standardized testing contributes to this concern. Many Fellows were apprehensive about the possibility that the standardized achievement scores of their students would suffer if they spent too much time in activities they viewed as valuable, but which might not be reflected on the tests.

It is also instructive to examine the responses to the general invitation for suggestions that might be useful to the evaluation of the project. We should bear in mind that just because a Fellows did not come forth with a given comment spontaneously does not mean they would not (or would, for that matter) have agreed with it had it been put to them directly. With that in mind it is noteworthy that the majority of the Fellows voiced a strong positive assessment of the Project, saying they loved it, would recommend it to others, and so on. There was also a strong demonstration of support for the monthly meetings, although several Fellows also suggested more structure for these gatherings. A number of those who responded also recommended greater involvement of parents and principals.

Discussion

The California Mathematics Project was established with the intent of inducing reform in the teaching of mathematics. The ultimate target, of course, is enhancement of mathematical competence among all students in the public schools of California. The program places special emphasis on groups of students who have not perceived mathematics as relevant to their lives, and who have tended to exercise their option to drop out of the mathematics curriculum prematurely.

To accomplish this ultimate purpose requires that mathematics teachers be better prepared to guide the learning of their students. They especially need the knowledge and skills required to nurture the development of higher order mathematical reasoning and problem solving abilities, in contrast to the emphasis on computation that presently dominates both curriculum and assessment. The task of providing pre-service education for teachers consistent with these aims is left to other initiatives. The California Mathematics Project focuses its resources on the tens of thousands of teachers who are already in the field.

The resources available to the Project could never provide direct training for all of these teachers, even if there were an existing mechanism by which it might be accomplished. The strategy, therefore, is to select teachers with potential to influence the instructional practices of their peers, provide direct and follow-up training for them through regional projects, and encourage them to disseminate what they have learned to their peers. Because it is difficult to be a lone innovator in a school, local projects are encouraged to admit teams of teachers who represent their schools.

Our evaluation parallels the sequence of events implied by this strategy, concentrating on the earlier links in the hypothetically causal chain of events. A Summer Institute in 1986 provided the base from which the Monterey Bay Area site of the California Mathematics Project got underway. Therefore, the first major component of the evaluation plan centered on the operations and outcomes of the Institute. Formative evaluation data (e.g., how interesting, useful, and clearly presented were the ideas and activities) were considered critical because teachers could not be expected to implement ideas they found uninteresting, confusing, or esoteric.

Overall, data from the daily evaluations demonstrated a very positive response by the vast majority of the participants. More importantly, this information enabled the Institute staff to monitor assessments of activities on a daily basis, and to adjust their plans accordingly.

The exit interview and post-Institute survey both confirmed the overall positive assessment of the summer effort. Participants clearly thought they had gained valuable skills, insights, and competencies. Concerns that did arise tended to be concentrated during the early days of the Institute, and the staff was generally commended for its responsiveness and flexibility in dealing with these problems.

Most Fellows were optimistic that the Program would influence change in mathematics instruction, but they expected the transformation to be evolutionary rather than revolutionary. Each Fellow anticipated making changes selectively. They also felt strongly that continuing support and follow-up in the form of the projected monthly meetings would be essential.

There was broad-based approval of the heterogeneous composition of the Institute participant group. Wide variations in mathematics background and teaching assignments did create some problems, but Fellows suggested that these could be ameliorated by providing more follow-up and analysis of possible applications to specific grade levels or situations. This recommendation is consonant with the counsel offered by evaluators of other instructional change efforts. Prospects for success seem to be enhanced when participants are provided adequate time, during training, to plan how they will use what they have learned. (cf., Robbins, 1985).

Of the topics examined in the post-Institute survey, the one that seemed to call for increased attention in subsequent efforts was that of evaluating student performance in mathematics.

Telephone interviews conducted at the end of the year provided additional evidence of Project effects. The level of participation by Fellows in professional development activities related to mathematics increased, above and beyond the continuing Project activities in which they participated. They came to feel more comfortable leading discussions of mathematics education with peers, administrators, and parents. They exercised leadership in mathematics education by conducting inservice sessions for other teachers, and their colleagues looked to them more often for informal suggestions on math instruction. They also made changes in their own teaching of mathematics, based on project experiences.

During the exit interviews at the end of the Summer Institute, one Fellow made the perceptive observation that ". . . the framework is the basic instrument of change . . . the workshop acts as the translator." A similar assumption supports the logic behind our survey of instructional practices in mathematics. The analysis of data from that survey disclosed the self-described instructional practices of Fellows to be more congruent with the Framework than those of either of the other two groups. The practices of Dissemination teachers, however, were no more consonant with the Framework than those of Comparison teachers, resulting in the rejection of the dissemination effect hypothesis. The analysis also failed to detect an association between Framework scores and the amount of time Dissemination and Control teachers were occupied in mathematics inservice.

Whereas Fellows did indicate that some of their instructional practices had changed as a result of Project training, most made fewer changes than they had hoped to. Deficiencies in funds, materials, equipment, and appropriate instructional facilities stood as impediments to change. So also did class size and time limitations. Serious though these barriers are, they may be more amenable to change than the skepticism of peers and administrators who ask for proof of the efficacy of practices that would be viewed as "innovations." Such skepticism works in tandem with apprehension about possible effects on standardized test results that may attend deviations from traditional practices. It seems quite clear that teachers would feel freer to implement the ideas they have acquired in the Project if achievement assessment were modified to reflect practices advocated in the Framework more adequately. A step in this direction would be to follow the advise of those Fellows who suggested increased involvement of administrators and parents in the Project.

The failure to detect a dissemination effect does not necessarily mean there was none. Quite possibly the survey instrument was not sufficiently sensitive to ascertain an effect. Nevertheless, we have no evidence that there was an effect. That fact may give cause for a reexamination of the multiplier strategy, whereby Project participants are expected to pass the knowledge and skills gained through their own training on to colleagues. The principle may be quite viable for relatively circumscribed goals, but the scale of change envisaged by the California Mathematics Project's creators is very extensive. The multiplier principle should work if objectives are defined with sufficient clarity, and if there is a well articulated plan to achieve those aims. We do not question the quality of the individual inservice meetings conducted by Fellows. But, when considered in their totality, the efforts seem fragmented and somewhat haphazard. A more coherent plan, negotiated with school administrators, may be needed to assist Fellows in meeting dissemination expectations.

The strategy of encouraging Fellows to work for change in their schools, and especially the emphasis on encouraging participation in the Project by teams from schools, is consistent with conclusions from the literature on educational change. This literature suggests that reform is most successful when local school sites serve as the locus of change. But this same literature also emphasizes the importance of 1) teacher involvement in innovation and decision-making, 2) a problem-solving orientation at the school site level, and 3) a focus on problems that teachers consider important to their day-to-day routine (Bentzen et. al., 1974; Berman & McLaughlin, 1973-78; Goodlad, 1975,; Williams & Cannings, 1981). These conclusions suggest that it may be important to assist participants in developing strategies whereby the they may work with their colleagues to adapt Project activities and content to perceived needs at the school site. Such an approach may be needed to help teachers at individual school sites develop a sense of ownership of reforms.

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APPENDIX A

Monterey Bay Area Mathematics Project
Institute Evaluation

Day Six: Tuesday, July 15 Name:______________________

I. Please give your general impressions of each of the following topics from today's program by circling the number that best represents your perception.

a. Function Machines

Interesting	5	4	3	2	1	Uninteresting
Useful	5	4	3	2	1	Not useful
Clear	5	4	3	2	1	Unclear

b. Cooperative Learning/Minority Res.

Interesting	5	4	3	2	1	Uninteresting
Useful	5	4	3	2	1	Not useful
Clear	5	4	3	2	1	Unclear

c. Stations

Interesting	5	4	3	2	1	Uninteresting
Useful	5	4	3	2	1	Not useful
Productive	5	4	3	2	1	Unproductive

d. Great Shapes Contest

Interesting	5	4	3	2	1	Uninteresting
Useful	5	4	3	2	1	Not useful
Clear	5	4	3	2	1	Unclear

II. Please respond to each of the following items by circling the letter(s) that best represent(s) your opinion.
SA = Strongly Agree
A = Agree
NO = No Opinion
D = Disagree
SD = Strongly Disagree

1. This topic/activity is applicable to my teaching situation.

a. Function Machines	SA	A	NO	D	SD
b. Cooperative Learning/Minority	SA	A	NO	D	SD
c. Stations	SA	A	NO	D	SD
d. Great Shapes Contest	SA	A	NO	D	SD

2. Next year I will probably try new instructional practices based on this topic/activity.

a.	Function Machines	SA	A	NO	D	SD
b.	Cooperative Learning/Minority	SA	A	NO	D	SD
c.	Stations	SA	A	NO	D	SD
d.	Great Shapes Contest	SA	A	NO	D	SD

3. Most teachers in my school are already familiar with the instructional implications of this topic/activity.

a.	Function Machines	SA	A	NO	D	SD
b.	Cooperative Learning/Minority	SA	A	NO	D	SD
c.	Stations	SA	A	NO	D	SD
d.	Great Shapes Contest	SA	A	NO	D	SD

4. Most teachers in my school are already using instructional practices based on the ideas this topic/activity dealt with.

a.	Function Machines	SA	A	NO	D	SD
b.	Cooperative Learning/Minority	SA	A	NO	D	SD
c.	Stations	SA	A	NO	D	SD
d.	Great Shapes Contest	SA	A	NO	D	SD

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Merrill College

Santa Cruz, California 95064

May 14, 1987

Dear Colleague:

We know that this is a very busy time of the year for you, but we hope you will take a few minutes to complete the attached questionnaire. Your responses will be completely confidential. The analysis of data will use only aggregated data, and no individual, school district, or individual school will be identified. The information you provide will be used in planning future mathematics institutes.

The first section of the questionnaire requests background information. Part II asks you to reflect on your teaching practices in mathematics, and to indicate which of two contrasting practices is most like your own. Separate instructions are provided for Part II.

We greatly appreciate your cooperation in this effort. If you would like to receive a summary of the results of the survey, just contact either of us at UCSC. Ron's telephone number is 429-4740 (message, 429-2855) and Ed's is 429-2423 (message 429-2085).

Sincerely,

Ronald W. Henderson
Professor of Education
and Psychology

Edward M. Landesman
Professor of Mathematics

Survey of Instructional Practices in Mathematics

Part I

(1) School Type: (Check the one that applies)

_____ Elementary _____ Middle _____ Junior High _____ High

(2) What grade(s) do you teach? (Check all that apply)

_____ K

_____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6

_____ 7 _____ 8 _____ 9 _____ 10 _____ 11 _____ 12

(3) Did you attend the Monterey Bay Area Math Project (MBAMP) institute during the summer, 1986?

_____ No _____ Yes

(If your answer is "yes," skip to question 5.)

(4) During the 1986-87 academic year, did you participate in any math in-service meetings or workshops conducted by teachers who attended the MBAMP Institute last summer?

_____ No _____ Yes

If you answered "yes" to question 4, please mark the appropriate box to indicate the approximate time spent in all mathematics in-service work led or organized by MBAMP teachers.

_____ less than two hours _____ two to four hours

_____ four to six hours _____ six to eight hours

_____ eight to ten hours _____ over ten hours

(5) Please estimate the total time you were involved during the 1986-87 in-service meetings or workshops that were not conducted by past participants in the Monterey Bay Area Mathematics Project.

_____ less than two hours _____ two to four hours

_____ four to six hours _____ six to eight hours

_____ eight to ten hours _____ over ten hours

Part II

The following items contain statements that describe instructional practices. Each item contains two contrasting statements, separated by the word BUT. A pair of boxes appears at each end of each item. These boxes represent the phrases that appear above them: "Really True for Me," and "Sort of True for Me." The statements are not intended to identify opposite or opposing practices. Rather, they may be thought of as representing approaches that vary along a continuum. Most teachers use some of each approach, but practices do vary on the basis of personal preference, educational philosophy, and competing pressures for time and resources.

Read each of the statements for each item and decide which of them is the best description of you. Most people will find that both statements are true to some extent, but pick the ONE that seems to describe your practices best, even if the choice is difficult. Then, mark an "X" in one of the boxes beside that statement. If the statement describes your approach quite well, mark the box that indicates "Really True for Me." If the statement is a somewhat less accurate description of your practices, mark the "Sort of True for Me" box. Mark only ONE box for each item.

Your responses to these items will be held strictly confidential.

◆ ◆ ◆ ◆ ◆

Look at the Sample Sentence below. Then mark the appropriate box for the statement that describes your practices best. Only one box is to be marked for each item, even if the choice is very difficult.

Sample Sentence:

Really True For Me	Sort of True For Me				Sort of True For Me	Really True For Me
☐	☐	Some math teachers emphasize the practical applications of mathematics.	BUT	Other math teachers rarely mention the practical uses of mathematics.	☒	☐

Really True For Me	Sort of True For Me				Sort of True For Me	Really True For Me
☐	☐ (29)	Some teachers spend very little time demonstrating relationships among concepts and skills from different strands of the curriculum framework.	BUT	Other teachers spend a great amount of time providing activities designed to demonstrate relationships among concepts and skills from different strands of the curriculum framework.	☐ (71)	☐
☐	☐ (26)	Given the pressures to cover a wide range of topics, some teachers allocate little classroom time to problem-solving activities.	BUT	Other teachers allocate a substantial amount of instructional time to problem-solving activities.	☐ (76)	☐
☐	☐ (82)	Some teachers provide parents with information on matters such as expectations regarding student learning and homework, current student status, and things parents can do to promote student progress.	BUT	Other teachers communicate with parents primarily by means of report card marks.	☐ (20)	☐
☐	☐ (46)	Some teachers encourage students to solve problems by following a sequential set of steps.	BUT	Other teachers encourage students to conjecture about the nature of a problem solution before working on it in detail.	☐ (52)	☐
☐	☐ (19)	Some teachers confine math for low functioning students primarily to computational skills.	BUT	Other teachers provide a comprehensive program, across the strands, for low functioning math students.	☐ (81)	☐
☐	☐ (92)	Some teachers provide cooperative learning activities for students in math classes.	BUT	Other teachers question the value of cooperative learning activities.	☐ (8)	☐

Numerals in parentheses indicate raw frequency of teachers who selected the statement. Data for "Really true for me" and "Sort of true for me" were pooled.

Really True For Me	Sort of True For Me				Sort of True For Me	Really True For Me
☐	☐ (63)	Some teachers feel it makes math more interesting to vary, to some extent, the terms they use for math skills and concepts.	BUT	Other teachers use mathematical terms in a strictly consistent fashion.	☐	☐ (38)
☐	☐ (84)	Some teachers encourage students to pose mathematical questions of their own.	BUT	Other teachers rarely encourage students to pose their own mathematical questions.	☐	☐ (18)
☐	☐ (43)	Some teachers assign homework designed to involve students' families in their homework.	BUT	Other teachers prefer homework assignments that require students to do their own work.	☐	☐ (52)
☐	☐ (98)	Some teachers ask students questions that require them to explain how they solved a problem.	BUT	Other teachers are more interested in whether students get the right answer than in the thinking processes they used to reach a solution.	☐	☐ (3)
☐	☐ (57)	Some teachers encourage students to invent problems of their own, based on quantitative information made available to them.	BUT	Other teachers rely mostly on teacher-constructed problems or problems from published materials.	☐	☐ (42)
☐	☐ (68)	Some teachers concentrate their attention on teaching a relatively small number of generalizations.	BUT	Other teachers focus more of their effort on teaching a fairly large number of rules.	☐	☐ (24)

76

77

Really True For Me		Sort of True For Me				Sort of True For Me		Really True For Me
☐	(45)	☐	Some teachers reinforce previously learned concepts and skills by providing periodic review for their students.	BUT	Other teachers reinforce concepts and skills by providing new contexts and settings for the application of previously learned concepts and skills.	☐	(52)	☐
☐	(53)	☐	Some teachers structure problem-solving experiences for students in a way that provides avoidance of frustration and assurance of success.	BUT	Other teachers structure problem-solving experiences so students are likely to encounter temporary frustrations in their problem-solving efforts.	☐	(45)	☐
☐	(32)	☐	Some teachers provide students with a series of components or rules to be followed in problem-solving.	BUT	Other teachers encourage the use of varied approaches to problem-solving, including student inventions.	☐	(65)	☐
☐	(35)	☐	Some teachers use concrete materials with students who are having trouble dealing with abstract concepts and symbols.	BUT	Other teachers provide some concrete manipulative experiences even for those students who function quite well at the abstract level.	☐	(60)	☐
☐	(27)	☐	Some teachers rely primarily on one or two methods of instruction, such as whole-group instruction and seatwork.	BUT	Other teachers use a wide variety of instructional methods.	☐	(74)	☐
☐	(21)	☐	Some teachers confine their assessment activities mostly to testing for progress and/or standardized achievement testing.	BUT	Other teachers analyze student responses to identify students needs and weaknesses throughout the year.	☐	(79)	☐

Really True For Me		Sort of True For Me				Sort of True For Me	Really True For Me	
☐	(68)	☐	Some teachers take special care to make sure their students acquire appropriate mathematics vocabulary.	BUT	Other teachers are less concerned that students learn the formal terminology for the concepts and skills they are learning.	☐	☐	(32)
☐	(30)	☐	Some teachers ask questions that mostly require students to recall facts and skills.	BUT	Other teachers give more attention to questions that require synthesis and analysis.	☐	☐	(68)
☐	(64)	☐	Some teachers help students learn to solve problems by identifying sequential steps to be followed.	BUT	Other teachers place a higher priority on helping students to identify global relations.	☐	☐	(32)
☐	(81)	☐	Some teachers make extensive use of concrete materials and visual aids to support their students' learning of mathematical vocabulary.	BUT	Other teachers rarely make use of concrete materials and visual aids to assist students' learning of mathematical vocabulary.	☐	☐	(18)
☐	(1)	☐	Some teachers want students to respond quickly to questions posed to the class.	BUT	Other teachers pause to make sure everyone has time to think about the question.	☐	☐	(100)
☐	(95)	☐	Some teachers reinforce students for their problem-solving efforts, even if they get the answers wrong.	BUT	Other teachers are more concerned with having students get the correct solution.	☐	☐	(6)

Really True For Me	Sort of True For Me				Sort of True For Me	Really True For Me
☐	☐	Some teachers ask students to clarify or extend their responses.	BUT	Other teachers hold the view that clarifications and extensions by students are likely to confuse other students.	☐	☐
☐	☐	Some teachers seldom find time to encourage students to check their answers against estimates or standards of "reasonableness."	BUT	Other teachers encourage students to check their problem solutions against initial estimates and standards of "reasonableness."	☐	☐
☐	☐	Some teachers incorporate the use of hand-held calculators into their math instruction.	BUT	Other teachers prefer not to allow students to use calculators in class.	☐	☐
☐	☐	Some teachers conduct almost all of their instruction either in large groups or with individual students.	BUT	Other teachers provide students with many opportunities to work in small groups of four or five students.	☐	☐

APPENDIX C

MONTEREY BAY AREA MATHEMATICS PROJECT
Year-End Participant Interview
1986-87

1. During this past year (and not including the MBAMP summer institute and its monthly meetings), have you participated in other professional development activities pertaining to mathematics?

   - If yes, has your participation in such activities been

     considerably more than last year? __
     more than last year? __
     about the same as last year? __
     less than last year? __
     considerably less than last year? __

   - (If answer to #1 was yes): What are some examples of these activities?

2. Have you planned and presented (or assisted in planning and presenting) any mathematics oriented in-service activities or workshops for other teachers?
   Yes__ No__

   - If yes, in how many such activities have you participated? ______

   - How many teachers would you estimate have participated in these activities? _____

3. During the past year, have any of your colleagues approached you for suggestions about mathematics curriculum or instruction? Yes __ No ___

   - If yes, have these requests been

     considerably more frequent than last year? __
     more frequent than last year? __
     about the same frequency as last year? __
     less frequent than last year? __
     considerably less frequent than last year? __

4. Has your teaching of mathematics changed any way as a result of participation in the Monterey Bay Area Mathematics Project?

.If yes, What are some examples of these changes?

5. Are there changes you hoped to make, but couldn't?

.If yes, Please give some examples:

6. Are there any factors that make it difficult to make changes you would like to? Yes __ No __

.Please give some examples.

7. In leading discussions of mathematics instruction with your peers, administrators, or parents do you feel

much more comfortable, __
more comfortable, __
less comfortable, __
much less comfortable, __
about the same, __

as compared to your feelings prior to this past year?

8. For each of the following organizations, please tell me if you are currently a member, and if you attended any meetings sponsored by the organization during the past year.

National Council for Teachers of Mathematics

- Member? Yes __ No __
- Attended conference or meetings? Yes __ No ___

California Mathematics Council

- Member? Yes __ No __
- Attended? Yes __ No __

Local or Regional Mathematics Association

- Member? Yes __ No __
- Attended? Yes __ No __

9. Do you have any final comments to offer that would be helpful to the evaluation of the project?