FOLLOW-UP EVALUATION OF MASTEP

[Mathematics and Science Teacher Education Program]

Final Report

Submitted by
Tania J. Madfes, Ed.D.
Rachel Rosen

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TABLE OF CONTENT

FINAL REPORT
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1. Introduction

In 1996, the National Science Foundation awarded a five–year contract to the Math and Science Teacher Education Project (MASTEP) under its Collaboratives for the Enhancement of Teacher Preparation (CETP) initiative. MASTEP was a partnership of six campuses of higher education in the San Francisco–Bay Area of California. Headquartered at San Jose State University, the project also included San Francisco State University, City College of San Francisco, College of San Mateo, Evergreen Valley College, and San Jose City College. Faculty from the two universities and four community colleges began working on changing the way that mathematics and science courses were taught to undergraduates and teacher credential candidates through a series of faculty development workshops and funded course reform projects. They also initiated teacher recruitment efforts and new teacher support services. Previous WestEd reports document what was done during this time period and describe the outcomes of these activities (Madfes, 2001).

WestEd, evaluators of the original MASTEP project, was contracted to provide evaluation services during the supplementary funded portion of MASTEP for the time period January 2002 through December 2004. A set of four questions guided the evaluators' work for the three–year period:

1. How permanent are the programmatic changes instituted by MASTEP?
2. What is the longevity of the changes instituted in reformed courses?
3. What is the long-term commitment to change made by faculty who participated in MASTEP?
4. What is the impact of MASTEP-sponsored changes on the practice of new K-12 teachers and their students?

During the first two years of this evaluation, WestEd collaborated with the CORE CETP Evaluation Study at University of Minnesota and provided data to the CORE about MASTEP through the implementation of several of their survey instruments (faculty, deans, college students, K-12 teachers, and K-12 students). The Year One and Year Two Progress Reports (see Madfes & Rosen, 2002 and 2003) included a great deal of data gathered in response to the CETP CORE Evaluation instruments, however, WestEd bears no responsibility for the development of those instruments, their reliability, or validity. Further, those instruments were not aligned with the goals of MASTEP and thus made it difficult to extract enough information to answer the questions guiding this study. This document references some of that data, but the summative nature of this final report draws heavily upon our eight years of working with the six campuses involved in MASTEP and makes comparisons with earlier data collection efforts in order to respond to the guiding questions.

2. Findings

RESEARCH QUESTION 1
How permanent are the programmatic changes instituted by MASTEP?

Prior to the NSF-sponsored MASTEP project several events had helped to lay the groundwork at the six campuses for the efforts of the CETP. The California State University (CSU) system had begun to place a great deal of emphasis on undergraduate teaching over research, thus enabling faculty at SFSU and SJSU to justify devoting time to improved instruction. A few small NSF equipment grants were received by campuses for use in the reform of science and mathematics teaching, thus stimulating the use of technology as an instructional tool. In addition, both the California Community College system and the CSU system provided support for campus–wide professional development initiatives for faculty.

During our final data collection years, however, the State of California imposed severe budget cuts on all areas of education. These reductions in funds directly impacted some of the progress made by faculty involved with MASTEP since course offerings were streamlined, admissions to publicly funded institutions of higher education were decreased, and many new teachers at the K–12 level received layoff notices as did lecturers and adjunct faculty at the six MASTEP institutions. These events combined with the retirements of many people who had been active in MASTEP course reform efforts helped to create a landscape much different than the one envisioned in 1996. These events were above and beyond the control of the project or its participants.

Methodology

As we had done at the conclusion of the original project, we utilized a structured interview protocol to learn about the institutionalization of MASTEP at the campuses. We spoke with members of the project's Executive Advisory Board (EAB) as well as campus Deans and Presidents. Members of the EAB represented each of the campuses, included the PI and co-PI's of the project, and a high school science teacher who had served as a Teacher in Residence at one of the CSU campuses during the original project and two of three years of the supplemental project with responsibility for coordination of new teacher support services and recruitment of students into the teacher preparation program. When we interviewed key people at each of the six MASTEP campuses to assess what the status of reforms were on each campus and how well MASTEP initiatives had been institutionalized we found the informants to be quite candid and forthcoming with information.

In addition to the interviews with EAB members and administrators, we utilized a faculty survey (described more fully in discussion of Research Question 3), analysis of each school's class schedule, and formal and informal conversations and correspondence with individual faculty to provide details about institutionalization of MASTEP reforms on campuses.

What were the most important accomplishments of MASTEP?

Representatives of the six campuses did not find it difficult to reach consensus about the three most important accomplishments of MASTEP. Although people were interviewed independently, their responses to the prompt easily fell into three categories: improved instruction, a sense of community, and an increased awareness of teacher preparation.

Improved instruction

The Faculty Development portion of the project promoted more effective approaches to teaching and learning and people who participated in the events became more aware of not only why, but how to become more student centered in their courses. Tenured and non-tenured faculty learned about and implemented reformed approaches in their teaching practices. They also learned that there is an academic field of teaching about which they can study and share with others what they are doing within their own classes. As a co-PI stated, “people don’t like to move from their comfort range but they did. They interacted with each other about improving instruction.”

A community college representative told us that MASTEP

> [It] allowed us to be brave enough to do curriculum revisions. At one point we were told that if we did other things besides lecture it would hurt our evaluations. We were hired to lecture and that was what we were supposed to do. We didn’t agree, but that was how our system worked. With MASTEP, we had support of other people. We were free not to only lecture. We were brave enough to try new things and found out we had the support of the administration…. MASTEP brought legitimacy to our ideas.

At another community college we learned that three faculty members had recently been published in the *Journal of Chemistry Education.* Since research and publications are not emphasized at community colleges and this seemed to be a first for this campus, credit was given to MASTEP for validating the importance of instruction and for encouraging faculty to share their knowledge with others in the field.

The emphasis on improved instruction carried over to another major component of faculty life — hiring, promotion, and tenure policies. A campus president told us that they already considered teaching performance and/or instructional improvement in promotion/tenure and merit decisions, however they “didn’t have a way to measure it or a way to look at it in reviews. MASTEP provided a lens for judging good teaching.” Two Deans in the sciences reinforced this message. One told us:

> The evaluation of teaching and the desirable qualifications changed. I think it [MASTEP] affected what we put down on our position announcements and what we ask for in teaching.

The other Dean told us (and this was verified by two others from that campus) that there were now rewards for teaching and curriculum work due to changes instituted in promotion and tenure guidelines. “Faculty in science and math ed are treated fairly and provided promotions to fourth year faculty; there is no longer dual citizenship but prestige.”

A sense of community

When planning the activities to occur within MASTEP, the EAB envisioned a community of scholars looking at improved teaching for all. This type of community seems to be one of the chief legacies of the project. The community of scholars is evident in the collaborations that existed and still exist on campuses (within departments and across disciplines) and among groups composed of people from different campuses. The networking that took place between community college and university faculty during the initial five years of NSF-funding is still going on today. There is still exchange of ideas and a sharing of materials. This collaboration came about because MASTEP invited the community colleges to participate as equal partners. In several instances, the same courses taught at both types of institutions were reformed by teams of faculty, this then led to articulation agreements that provided increased benefits for students,

But equally impressive was the change that people talked about at two of the community colleges. One Dean told us

> We didn't meet as a division only as departments, but for the last 7-8 years we meet regularly as a division. We have people describe special projects they work on and it is shared among the bio, math, chemistry, physics, and engineering faculty. There is a lot more sharing that way. There is also a lot of discussion among science faculty and math faculty about how to improve. MASTEP got it started— never before had faculty in all disciplines gone to the same conferences for example. The math went to math conferences, and science to science conferences. They go all together now. Learning communities have come along somewhere late in MASTEP, and there is quite a bit of interest in that in this division. There is an environmental science and ethics learning community, and there is a basic math and study skills one now that that is pretty terrific.

And a member of the EAB from another community college described how groups of faculty now come together to write proposals and participate in faculty development activities (e.g., Howard Hughes summer programs). She exclaimed that,

> In the 30 years I've been here, I don't recall people getting together to get funding. This was the first time I've seen people do projects across disciplines and do things together.

Increased awareness of teacher preparation

> It redefined our role in the area of preparing teachers. We didn't realize that future teachers first went to community colleges, but it appears most of them do.

This sentiment was echoed by almost all community college people we interviewed. They spoke about MASTEP "raising our consciousness and putting in front of faculty the importance of training teachers." Along with the comments made during interviews, we heard from faculty who responded to the 2004 MASTEP Faculty Survey (see Research Question 3). When asked if they had any additional comments to make in relation to MASTEP, some wrote specifically about teacher preparation:

> I have much greater awareness of teacher preparation requirements and how these can be incorporated in educational goals for all students in the major. I am more mindful of modeling (for future teachers) and using (for all students) a variety of teaching/learning approaches in my classes.

These comments and informal conversations with faculty during observations of reformed courses lead us to believe that Arts and Sciences faculty and administrators are much more aware of their role in the preparation of new teachers, even though teacher preparation has long been a graduate program in California.

In addition, one of the universities has hired a new biology educator in the School of Science and the School of Education on that campus has hired two mathematics education faculty. These are new positions that were attributed to the work done by MASTEP to support better preparation of mathematics and science teachers in K-12 schools.

After eight years, the Future Teachers Club is still alive at half of the campuses even though there is no longer outside funding to support these efforts. One community college had long sponsored a science club, with the advent of MASTEP this club became a science club with an emphasis on teaching. The students prepare presentations and do demonstrations about science at K-8 campuses nearby. This activity provides the younger students with novel ways to learn science and the older students with “teaching experiences.”

At one of the CSU campuses, information about teaching and credential requirements is now a feature of advising days in the School of Science. And at both universities, two members of MASTEP’s EAB, both professors of biology, have become members of their campus committees to structure the Liberal Studies major (usually taken by future elementary teachers) so that more science courses are required. These efforts have also been responsible for new science courses specifically for Liberal Studies majors that take into account the importance of reformed instructional practices as good modeling for future teachers. One of these professors is very senior and told us that the impact on elementary teacher preparation was very unexpected by her. Last year she coordinated the multiple subject [refers to California credentialing designation for elementary teachers] program revisions and they included the series of three mathematics courses funded by MASTEP and a science course influenced by MASTEP. She continued,

> This is a pretty solid program. It’s the first time in years on this campus where things were coordinated with content people and education for the elementary program.

What new initiatives and funding have come about to continue what MASTEP began?

Surprising to us, many people who were active in MASTEP–sponsored activities continued to pursue outside funding to continue their reform work. This was surprising because faculty have heavy teaching (i.e., most faculty teach 12 units per semester) and advising loads. At the two universities they also have research and committee responsibilities, while faculty at the community college do not need to do research or publish in order to achieve tenure and promotion. But pursue outside funding they did.

We were told that because of MASTEP one campus now has:

- an NSF–funded *G–K12 Project* that is working with neighboring school districts;
- a reformed chemistry program that is becoming a national model, has received a FIPSE grant, and has an additional $2.6 million for continuing its work;
- a pending CCLI grant to revise the remaining genetics lessons in the biology curriculum now that MASTEP paved the way and supported revision of 6 of the 20 lessons.

At another campus, funding has been received from the Packard Foundation and the Board of Trustees of the college for continued support of the Integrated Science Center that provides a place for faculty to get together for curriculum development, students to find tutoring, and the science club to convene. The Integrated Science Center has led the way for the science faculty on this campus to come together in an organized way so they could present their needs for upgraded facilities and equipment to campus administrators and the Community College District. A recently passed bond initiative will provide for facility upgrades. A faculty member on that campus told us,

> The fact that we were active and involved as a group gave us more visibility. If we hadn't been organized, all the money would have gone to the PE department. As the result of our organized presence and involvement, it was recognized that we needed a facility upgrade.

To continue the work with K–12 schools stimulated by MASTEP, a feasibility study has been conducted and architectural plans have been approved for the enclosure of 17,000 square feet of space on a CSU campus in order to create a science resource center that would also handle disbursements of loaner kits for high school science teachers. This initiative has been labeled a direct outgrowth of MASTEP and now the campus is developing a business plan to raise the money to implement the plan.

RESEARCH QUESTION 2
What is the longevity of the changes instituted in reformed courses?

Are the funded reformed courses still taught?

In order to discover which of the 77 reform courses were still being taught, WestEd contacted MASTEP project leaders and staff in September 2004. Each person contacted was asked to provide information about whether or not reformed courses are still being offered, if they will be offered in the following academic year, and whether of not they are still offered in their reformed version. For the 2004-2005 academic year it seemed that the overall retention rate for reformed courses was high. Out of a total of 76 courses, WestEd was able to obtain current information about 62 courses, 52 of which are still taught with at least some of the reforms in place. Table 1 on the following page illustrates the numbers of reformed courses still taught by campus, and with the caveats offered by the campus contacts about specific courses.

Table 1: Status of MASTEP reformed courses as of Fall 2004

Campus & Department	Reformed Courses N=77	Still Offered 2004 N=68	Caveats
CCSF			
Biology	1	1	
Chemistry	4	4	
Physics	3	3	
Total	***8***	***8***	
CSM			
Biology	4	4	
Physics	4	4	
Mathematics	1	1	
Total	***9***	***9***	
EVC			
Biology	2	2	
Chemistry	3	3	
Physics	1	1	
Mathematics	2	1	*The course not offered is officially still available, but has been cancelled the last two semesters due to low enrollment*
Total	***8***	***7***	
SJCC			
Biology	4	3	*Information about reform or future status could not be obtained.*
Chemistry	6	6	*Titles of 2 courses changed. Status of reforms could not be determined*
Physics	3	3	*Status of reforms could not be determined.*
Mathematics	9	9	*The reforms in one course are only present when taught by the original instructor. Status of reforms in other courses could not be determined.*
Total	***22***	***21***	
SFSU			
Biology	2	2	
Chemistry	5	5	
Mathematics	1	1	*This course has been reduced from 4 credits to 3, and not all reforms are present*
Geosciences	4	2	*All 4 courses are still officially on the books. One will be offered again in 2006. There are no current plans to offer another, and only 1 of 3 sections of the third is still offered with the reforms.*
Education	2	1	*While one course is no longer offered, the reformed materials have been incorporated into two other courses.*
Total	***14***	***11***	
SJSU			
Biology	2	2	
Physics	2	1	*In the remaining course, the reforms only exist when it is taught by the original instructor.*
Mathematics	5	5	
Geosciences	1	1	
Education	6	3	*Only one of the remaining courses is still taught with all reforms intact.*
Total	***16***	***12***	

Methodologies used to respond to the question, *Are the reforms still present?*

To learn how time has effected the implementation of the proposed reforms, we observed a sample of 21 courses that had received funding for reforms through MASTEP. At least three classes were observed at each of the six campuses. Disciplines represented were Biology, Chemistry, Geology, Physics, Mathematics, Science Education, and Mathematics Education. People who had been involved in the course reform process taught 14 of the 21 classes observed. Class size ranged from 11 to 74 students, with a mean of 25.5 students. The structured observation protocol was adapted from the "1998–1999 Local Systemic Change Classroom Observation Protocol" developed by Horizon Research, Inc. (see Appendix A). This protocol allowed our observers to rate classroom instructional practices using well–validated measures of reform practice aligned with the goals of MASTEP.

What did faculty have to say about MASTEP?

Informal conversations with faculty whom we observed produced several unsolicited compliments for MASTEP. One instructor [in a course for future science teachers] told the observer that the program has had a positive impact on his ability to use technology and cooperative learning strategies in his teaching. This comment proved to be meaningful when the observer awarded the highest Capsule Description of the Quality of the Lesson to the session and provided the rationale as:

> The instructor checked for student understanding. He encouraged the students to share ideas, which they did enthusiastically. The teacher modeled excellent teaching strategies that the students can use with their own students. Excellent use of cooperative learning strategies.

The description of this lesson using the goals of MASTEP as an organizer further explained that:

> The entire lesson utilized cooperative learning strategies. Extensive use of well-organized and structured cooperative learning both modeled in the lesson and expected to be implemented in student teaching by the students.

Another instructor stated, "The impact [of MASTEP] on my teaching has been more psychological than intellectual by making me more aware of what I am doing." The observer later noted that:

> The instructor asked lots of probing questions to move the students along in their understanding of quadratics. He made good use of wait time. Selected students stated he was an excellent instructor who was well organized and competent. The students were responsive and engaged in high-level thinking. They seemed interested in the lesson and took their learning seriously.

What did the classrooms implementing *reformed courses* look like?

The observer, an experienced science educator who has considerable experience doing classroom observations for a number of program evaluations utilizing the instruments designed by Horizon Research, provided a variety of descriptions of classrooms he visited. One portion of the structured instrument requested that a few sentences be used to describe the lesson observed and its purpose. This short descriptive section included where the lesson fit into the overall unit of study, syllabus, or instructional cycle. In another section, the observer was instructed to provide any evidence of the five major MASTEP goals being implemented. Through these two sections, as well as the section providing rationale for an overall capsule rating of instruction, we were able to form a picture of each course as it was being implemented during the 2002–04 time period.

At an evaluation team debriefing, the observer commented that most of the faculty he observed modeled the type of teaching that MASTEP espoused: inquiry–based activities, use of technology (e.g., many Power-Point presentations), use of cooperative learning strategies. For example, in a large, lower-division Geology course for non–majors, the written description and evaluative comments stated:

> Geol/Metr102 (Oceanography) is a survey course for non–majors. The last lesson covered atmospheric currents. The lessons that follow will cover ocean currents and waves. The lesson observed started with announcements. This was followed by 20 minutes answering questions students had asked in recent sessions. The teacher answered these questions using a series of well thought out demonstrations (e.g., vapor cloud, heat exchange, and volume) to help the students conceptualize the content. The next 30 minutes were spent discussing/illustrating/demonstrating the divisions of the earth's surface-equator, poles, lines of latitude, and lines of longitude. During the last part of the lesson, a film and a check for understanding were planned but not included because of a fire alarm. *The lesson design and pacing were excellent. The teacher is enthusiastic, knows the content, has a good rapport with the students, and enjoys helping them in the understanding of the content. The teacher met the challenge of engaging 74 students in thinking and learning in a big elevated lecture hall by using creative demonstrations to increase student understanding and hold their interest.*

At one of the community colleges, the course implemented by a former course reform leader was described — and then evaluated — in the following way:

> The lesson observed was a 'conference' during which time the students work in cooperative learning groups solving electricity problems on a worksheet. The teacher started the lesson by having students form their groups of three and asking them a few probing questions to get them to think and be engaged. Periodically the teacher would get the attention of all groups, sharing an important hint in solving the problems. Formulas were recorded on the chalkboard. During the lesson the teacher would go from group to group helping as necessary. The teacher did not provide answers, but told them if their solutions were correct or incorrect…..*Evidence indicates that the teacher is implementing strategies to move the lessons in the direction of being student centered. This was a well–designed and implemented lesson moving the students forward in their understanding of how to solve challenging electricity problems. Students were engaged in peer teaching and learning. The teacher was friendly and displayed a caring attitude about her students and their success in physics.*

Additional entries allowed us to see that at least three major elements of MASTEP were evident in this course: technology, cooperative learning, and inquiry. Excerpts from this section of the observation report told us that the reforms were *alive and well*:

> *Technology:* Interactive software is used by the teacher in whole class lecture/discussion. Students use graphing calculators to assist them in solving electricity problems.
>
> *Cooperative Learning:* Students, in their cooperative groups, helped each other in solving problems. In other 'conference' lessons a variety of strategies are used including having groups master different problems with one member writing up the solution, a second member recording solution on the board, and the third student explaining the solution to the other groups.

> *Inquiry:* Good evidence of critical thinking by students. Students used good questioning strategies. Students approached the problems scientifically, applying and testing their ideas. In some labs, students are required to design their own procedures (not observed).

At another community college a course was visited that fulfills the mathematics requirement for an Associate of Arts degree and is intended for students preparing for a career in elementary or middle school teaching. This course was collaboratively redesigned very early in the MASTEP program by faculty from one of the universities and two feeder community colleges. The intent was to provide a more learner centered experience for students that incorporated instructional strategies the students could emulate later in their own classrooms. It was evident that the reforms were still being implemented, at least in this class at this institution.

> The instructor started the lesson by making announcements followed by an overview of the lesson (recorded on the white board). The instructor then led a discussion of mental math and estimation operations in solving problems. The instructor and students identified multiple ways to solve problems. The instructor provided a series of problems that are similar to those in the homework assignment. During the last 30 minutes, the students, in cooperative groups, completed an activity requiring the use of their calculator. The students turned in their homework as they left class……*A well designed and executed lesson. The instructor was knowledgeable, caring, and personable. He was complementary of student input and receptive to multiple ways to solve a mental math problem. Most of the students were on task and engaged in the lesson. The cooperative learning groups may have enhanced learning if they were more formal and structured. Class participation was good. Several students told me that cooperative groups were part of each lesson. Students stated they liked and valued cooperative learning. They said the instructor stresses the thinking of elementary or middle school students and that the teacher includes strategies that they can use later with their own students (e.g., progress reports, visuals, and ways to make solving math problems fun).*

How were the instructional goals of MASTEP reflected in the reformed courses?

During MASTEP's five year funded life, faculty at the six campuses attended workshops offered through the Faculty Development component of the project. These workshops focused on five major instructional strategies to be implemented in undergraduate mathematics and science classrooms. These strategies are referred to in this report as the MASTEP goals and include: cooperative learning, technology, new forms of assessment, problem solving, and inquiry. After the first year of the project, faculty requesting funds for course reform were asked to indicate which of these strategies they would be incorporating into their courses and how that implementation would occur. We asked the observer to provide descriptions of evidence of the goals being implemented during the class session he visited. Through conversation with faculty and students, the observer was able to gain further understanding of how these strategies were or were not being used.

Cooperative learning

A major reform strategy emphasized through MASTEP's Faculty Development strand was cooperative learning as adapted for college classrooms — especially in large lecture halls. Many of the faculty welcomed the training and worked hard to implement the components that would make these strategies effective in their classrooms; thus we were not surprised to find the use of cooperative learning group strategies evident in a majority of the classrooms visited. While not all attempts at using cooperative learning strategies were polished, notes from the observer about this goal as seen in classrooms included statements such as:

> Cooperative learning groups were used to engage students in determining important information about cellular respiration. Results were recorded on the chalkboard. Cooperative groups using a molecular model set simulated the events of glycolysis.
>
> The teacher engaged the students in activities that made the chemistry interesting and fun. Good use of cooperative learning was included. Students were assigned to their cooperative group based on performance so that a range of ability levels was included in each group. Teacher enthusiasm and student interest was high.
>
> Students are encouraged to check with other groups as to strategies used to determine the best solutions. The same procedure is encouraged after they get back their graded reports.

Technology

While technology was not as evident as cooperative learning in the classrooms on the days of the observations, we do know that almost all faculty communicate with students through email and this is a new phenomena since the inception of the project. PowerPoint presentations were observed during many of the lessons, as was the use of graphing calculators by students when solving quantitative problems. While the general population has also increased their use of technology, many MASTEP activities focused on enabling faculty to effectively use technology as a teaching and learning tool. Entries illustrating the use of technology included:

> Videos and overhead connected to a video camera are included in selected lessons.
>
> Students using I-Book computers in class used web sites to complete an alternative assessment assignment.
>
> Course has a website (Blackboard Learning System) that provides weekly announcements, the syllabus, exam schedule, and lab tips online for all students enrolled in the course. Real world connections to content provided online. Lab and lecture exams are online; each student given a different form of the exam. Primary course revision through MASTEP was for incorporation of technology as represented by lesson observed.
>
> Lots of evidence that technology is an integral part of the course. Approximately 20% of class time is devoted to use of technology. Students used computer simulation software to help them better conceptualize and understand the geometry and properties of molecules.

Assessment

Informal and formal assessment strategies that would provide formative feedback to faculty and students were featured over the five years of the program. The intent was to introduce faculty to new forms of assessing student understanding. As illustrated above, the use of technology as an assessment tool has also been integrated into courses. Evidence that many faculty incorporated these reforms into their teaching was found in the classrooms we observed.

> The lesson started with the students writing a short essay on the pattern of plant cell growth (directional growth). This essay models ones that will be included in future exams.
>
> The midterm, turned in during this period, required students in small groups to ‘brainstorm’ ideas relating to a polygonal ring and then independently describe their findings. Students told me they spent anywhere from 10 to 20 hours completing their midterm. A project due near the end of the course requires students, in groups of five, to

complete a report relating to an open-ended problem requiring high level thinking and problem solving skills.

Problem Solving

While many [routine] problem sets are assigned to students in mathematics and science classes, the act of solving those problems is not the same as providing students with situations that present a number of issues or facts and that require students to develop a strategy for solutions rather than just finding a unique answer. In the mathematics classrooms we observed, several instances seemed to support this mode of stressing critical thinking that would strengthen students' abilities to become *problem solvers.*

> The instructor encourages students to think of different ways to solve problems and asks 'what if' questions. The lesson engaged the students in critical thinking, asking questions, to generate insights into polygonal rings. The students used multiple ways to investigate polygonal rings and were articulate in sharing their ideas with the class.
>
> Students and teacher approached problems scientifically. They applied and tested their ideas, used multiple ways to find solutions, gathered and weighed the evidence and came up with solutions.

Inquiry

Students who ask questions, study a phenomena, probe, make hypotheses, and engage in solving problems as a way to understand concepts are actively engaged in learning. This way of approaching the learning of science and/or mathematics is somewhat different from the more traditional modes of memorization and categorization. It is perhaps the most difficult approach to plan and implement well; however, Inquiry learning is a major tenet of scientific understanding. In classrooms we visited, we did see evidence that inquiry learning was utilized as a regular practice.

> In lab, the students were required to develop their own hypotheses and experimental design to determine how the rate of transpiration is affected by altering the environmental conditions (wind, heat, and humidity).
>
> Students and teacher approached math problems scientifically. They applied and tested their ideas, used multiple ways to find solutions, gathered and weighed the evidence and came up with solutions.
>
> Students and teacher approached the phenotype/genotype problem scientifically. They applied and tested their ideas, used multiple ways to find solutions, gathered and weighed the evidence and came up with hypotheses. Students hypothesized by trial and error the yeast genotypes based on their phenotypes. Good evidence of higher order thinking skills used by students in their groups.

How did the instruction in MASTEP–reformed courses rate on indicators of effective instruction?

The observer was asked to rate key indicators of effective instruction using items adapted from a validated instrument developed to evaluate mathematics and science classrooms in sites receiving funding through NSF's Local Systemic Change initiative. The observer has used the instrument for approximately eight years for evaluations of other projects and therefore is quite familiar with what the ratings require in the way of evidence. Each indicator was to be rated as descriptive of the lesson observed from *1 (not at all)* to *5 (to a great extent);* knowing that any one lesson is not likely to provide evidence for every single indicator, *DK* was to be used to indicate *Don't know* where there was not enough evidence to make a judgment, and *NA* was to be used to indicate *Not applicable* when the indicator was inappropriate given the purpose and context of the lesson. Three of the 14 indicators focused on an assessment of the *likely effect* of the lesson on student learning.

Out of the 294 individual rating possibilities (i.e., 21 courses rated on 14 separate indicators), only 9 occurrences of *not at all* were reported and only 10 ratings in the "2" column were noted. All other ratings — 275 in all — were noted as occurring, with 63 being noted as *to a great extent.* A summary of ratings for each indicator can be found in the Appendix. Particularly noteworthy were the ratings on two items associated with cooperative learning.

Table 2: Ratings of key indicators of effective instruction related to cooperative learning in MASTEP—reformed courses

4. The lesson was designed to engage students as members of a learning community

Rating Value	1 Not at all	2	3	4	5 To a great extent	N/A	DK
Number of courses receiving rating		1		15	5		

6. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher and students.

Rating Value	1 Not at all	2	3	4	5 To a great extent	N/A	DK
Number of courses receiving rating	1	1	7	6	6		

Over the several semesters of observations, the mean rating for item 4, on a 5-point scale, was 4.14. The mean rating for item 6 was 3.71. These ratings appear to provide some evidence that the MASTEP goal of cooperative learning is still being implemented in these courses.

Mean ratings on all items, calculated only to include actual ratings of 1 through 5, were found to be quite positive and in fact were over 3.5. The highest mean rating for any of the items on the instrument was 4.55. Eighteen of 21 courses provided evidence that "Elements of abstraction (i.e., symbolic representation, theory building) were encouraged when it was important to do so." This was not surprising, however, for courses in mathematics and science.

In the final rating on the structured instrument, the observer was asked to consider all available information about the lesson, its context and purpose, the complete instructional cycle, and his own judgment of the relative importance of the previous ratings. The directions to observers was to select the capsule description that best characterizes the observed lesson. This capsule rating is not intended to be an average of the previous ratings but an encapsulation of the overall assessment of the quality and likely impact of the lesson. The capsule descriptions were arranged in five levels, from "Level 1:

Ineffective Instruction" to "Level 5: Exemplary Instruction." The description of the mid-level, "Level 3: Beginning Stages of Effective Instruction," states "Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are *some weaknesses* in the design, implementation, or content of instruction…" Due to this broad range, observers are asked to designate whether lessons accorded a Level 3 were a *low*, *solid*, or *high 3.* Observers are also asked to provide a rationale for their capsule rating. Table 3 presents this data for the 21 observed courses.

Table 3: Capsule description ratings of the quality of the lessons observed in MASTEP—reformed courses

Number receiving rating	Description of the rating
0	***Level 1: Ineffective Instruction*** *There is little or no evidence of student thinking or engagement with important ideas of mathematics/science. Instruction is unlikely to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics/science. Lesson was characterized by either (select one below):* ***Passive "Learning"*** *Instruction is pedantic and uninspiring. Students are passive recipients of information from the teacher or textbook; material is presented in a way that is inaccessible to many of the students* ***Activity for Activity's Sake*** *Students are involved in hands-on activities or other individual or group work, but it appears to be activity for activity's sake. Lesson lacks a clear sense of purpose and/or a clear link to conceptual development.*
0	***Level 2: Elements of Effective Instruction*** *Instruction contains some elements of effective practice, but there are substantial problems in the design, implementation, content, and/or appropriateness for many students in the class. For example, the content may lack importance and/or appropriateness; instruction may not successfully address the difficulties that many students are experiencing, etc. Overall, the lesson is quite limited in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics/science*
Low 3= 3 **Solid 3= 3** **High 3=3**	***Level 3: Beginning Stages of Effective Instruction*** *Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are some weaknesses in the design, implementation, or content of instruction. For example, the teacher may short-circuit a planned exploration by telling students what they "should have found"; instruction may not adequately address the needs of a number of students; or the classroom culture may limit the accessibility or effectiveness of the lesson. Overall, the lesson is somewhat limited in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics/science.*
9	***Level 4: Accomplished, Effective Instruction*** *Instruction is purposeful and engaging for most students. Students actively participate in meaningful work (e.g., investigations, teacher presentations, discussions with each other or the teacher, reading). The lesson is well-designed and the teacher implements it well, but adaptation of content or pedagogy in response to student needs and interests is limited. Instruction is quite likely to enhance most students' understanding of the discipline and to develop their capacity to successfully "do" mathematics/science*
3	***Level 5: Exemplary Instruction*** *Instruction is purposeful and all students are highly engaged most or all of the time in meaningful work (e.g., investigation, teacher presentations, discussions with each other or the teacher, reading). The lesson is well-designed and artfully implemented, with flexibility and responsiveness to students' needs and interests. Instruction is highly likely to enhance most students' understanding of the discipline and to develop their capacity to successfully "do" mathematics/science*

Supporting evidence accompanying the observation ratings illustrates the elements involved and leading to awarding different capsule ratings. We were pleased to see that not one of the courses was rated below Level 3: Beginning Stages of Effective Instruction.

A community college course rated at a Low Level 3 because of the quite limited teaching skills observed had only 13 students, utilized cooperative learning strategies, and had a good lesson design. The session, however, was being instructed by a student who had successfully taken the course and been provided with some training and the lesson structure. The incorporation of the peer leadership model within several science courses at this campus was funded by MASTEP as a way to provide early teaching experiences to undergraduates.

> The last workshop lesson covered fermentation/energy. The next workshop lesson will cover nutrition/energy. In the lesson observed the purpose was to help the students conceptualize and better understand cellular respiration. After reviewing the homework the teacher divided the students into 3 groups. Each group was assigned one part of cellular respiration: glycolysis, Kreb cycle, or chemiosmosis/electron transport. The groups used their text, recording the important information on the chalkboard. The teacher explained the recorded information to the entire class. The students in their same group used molecular model sets to simulate glycolyis. During both cooperative learning sessions the teacher helped/guided the students. Near the end of the lesson the teacher passed out the homework and responded to questions about the lab practicum. Class was dismissed 10 minutes early. *The teaching skills were limited (engagement of all students, use of high level thinking questions, checking for understanding, use of appropriate wait time, etc.) as expected by a peer team leadership "teacher" who was selected to lead the workshop because of his success in the same course last year. Many opportunities to engage the students in their own learning were missed because the teacher provided the explanations and answers. The lesson design was good. There was good use of cooperative learning. Students in the groups worked well together. Appropriate activities using model sets helped the students conceptualize cellular respiration. A good rapport existed with the teacher as well as among the students*

Excerpts from the reports on another course rated a Low Level 3 were still quite encouraging. This course, taught to 58 students by the person who had received reform funding, stated:

> The lesson started with the teacher returning papers, announcing homework, and sharing the lesson topics. The rest of the lesson consisted of a 40–minute lecture on the topics of voltage and current. The previous class covered potential and kinetic energy and the next session will cover the relationship between voltage and current. *The teacher used the chalkboard effectively and included good analogies to help students better visualize and understand. The lesson, however, was extremely teacher–directed. Many of the students were not engaged/paying attention: they were carrying on side conversations, sleeping, playing a word game, reading a book, sitting quietly, or trimming their fingernails. Minimal "wait time" by the teacher, with the teacher answering most of his own questions.*

What was interesting about this teacher was his resistance to the use of cooperative learning because it took time away from his lectures. We wonder if the students might have been more engaged if there had been more active learning and less lecture.

Two of the courses awarded Level 5 capsule ratings were mathematics courses — one at each of the two universities. The third course was a requirement in the credentialing program for teachers of middle and high school science. In fact, these three courses received almost straight "5's" ("To a great extent") on the 14 indicators of effective instruction. Two of these courses are specifically focused on the preparation of new teachers of mathematics and science. Descriptions of the classes visited, along with the rationale for the capsule ratings contain many examples of what MASTEP aimed to produce in the way of course reform and in the way of improving the preparation of new teachers.

> The course is designed to model and provide knowledge, basic skills, experiences, and resources for teaching science courses for middle and senior high school courses. The lesson is the first of three on teaching and learning: how students learn and how to plan for instruction to facilitate their learning. The teacher using PowerPoint conducted a demonstration lesson relating to grasses. Students explored/observed representative grasses provided at their table. Few directions were provided. The teacher skillfully helped the students learn without giving them all the information. Following the demo lesson the teacher led a discussion on "What must a teacher plan for a lesson?" Student responses were recorded on the chalkboard. The teacher provided students with her lesson plan on grasses. The students compared info on board with lesson plan and then they compared the lesson plan with one used in an earlier lesson….*The teacher used technology, inquiry, and cooperative learning effectively. She modeled good teaching techniques and skills and engaged them in meaningful activities. The students were interested and actively engaged in both the grasses activity and the classroom discussions. Students were comfortable talking with the teacher and with each other. An excellent rapport has been established. The teacher was very skillful in helping students answer their own questions or those raised by other students. The lesson moved the students forward in developing the skills necessary to become effective teachers.*

> Before the lesson officially started, most students were in their seat and actively engaged in 'math talk.' The instructor requested the students to form cooperative groups with students not in their midterm group. Each group then brainstormed/shared their big ideas relating to polygonal rings (outer, inner, perimeters, area of hole formed). Groups recorded their results on paper secured to front chalkboard. The instructor reviewed information and asked if any students were perplexed or skeptical. When appropriate, students explained their results/solutions with the class…*A well-designed and implemented lesson that moved the students forward in their understanding of mathematical principles. Problem solving, inquiry, cooperative learning don't get any better. Thinking, sharing, and engagement were extremely high. The instructor empowered the students to have ownership in their learning and understanding of mathematics.*

These comments seem to reinforce the notion of 'exemplary instruction' and also provide some evidence that future teachers of mathematics and science are engaged in learning atmospheres that model the type of instruction that NSF hoped to encourage through the CETP initiative.

RESEARCH QUESTION 3
What is the long-term commitment to change made by MASTEP faculty participants?

Faculty survey

In order to help answer this research question, WestEd hoped to make use of the survey data provided by the CORE; however, several factors led us away from this potential source of data. One issue was the declining number of survey participants. In 2002, 51 of 252 faculty responded to their survey and in 2003, only 19 of those 51 completed the instrument. Although the CORE administered the survey, we heard directly from a number of MASTEP faculty concerning their confusion in attempting to be cooperative in the data collection attempt. We also found that comparisons between faculty responses in the two years could not be drawn because the CORE changed response choices on some questions from one year to the next (e.g., In 2002, response choices for questions related to instructional practice before and after the implementation of MASTEP were "Seldomly", "Occasionally", "Regularly", and "Almost Always". In 2003, those choices were changed to "Never", "Seldom", "Occasionally", and "Regularly".) Further, when we attempted to align specific questions to the key instructional goals of MASTEP, we found that not all goals were addressed and that when they were addressed, the items could not be relied upon as providing much information. While we reported data from both of these administrations in our previous two progress reports, we chose not to use the CORE instruments during this final year.

Thus in Spring, 2004, we administered our own online survey (see Appendix A) similar to those we had administered during the initial MASTEP project. On November 2, 1996 we collected baseline data from 93 faculty members while they attended the very first MASTEP Faculty Development event. This was followed by a May 1997 email follow-up questionnaire, and a mailed survey administered in May 1999. These instruments were aligned with the goals of MASTEP and results have been described in earlier reports (see Guth & Madfes, 1998; Guth & Madfes, 1999; Madfes, 2000; Madfes, 2001). Our interest this time was in seeing what changes may have occurred in both knowledge of specific teaching strategies and actual implementation of instructional practices over an eight-year period.

The MASTEP faculty database includes the names, campus and department affiliations, and email addresses of all faculty who attended any MASTEP Faculty Development events during the initial five years of funding or who received funding for course reform. The six MASTEP campuses contributed 391 names over this time period, with 306 entries having email addresses. On April 19, 2004 we sent a letter via email to each person on the MASTEP faculty list inviting them to complete a follow-up survey (see Appendix A). However, by Spring, 2004, 95 of the people on the list no longer were reachable at the provided email address and a number of additional faculty had retired or moved to other campuses. Although we offered an incentive for completion of the survey, the completion rate was still only 24.6% (52 out of 211 addresses without 'error' returns). While this is not an overly impressive return rate, and certainly cannot be construed to provide a comprehensive picture of the impact on faculty, we believe that the data does shed light on the commitment to change undertaken by faculty due to MASTEP. In addition, the percentages of returns per campus (see Table 4) and discipline for this survey administration seem to be similar to prior attempts to survey faculty and reported earlier.

Table 4: Survey respondents by campus for four years

Campus	Survey Year			
	1996	1997	1999	2004
CCSF	7	4	15	11
CSM	17	6	7	8
EVC	8	5	8	4
SFSU	20	12	22	17
SJCC	15	4	10	1
SJSU	26	19	14	9
Totals	*93*	*50*	*81*	*52*

Also similar in demographic classification were the disciplines of survey respondents, with mathematics, chemistry, and biology faculty continuing to provide similar portions of the data.

Table 5: Survey respondents by discipline for four years

Discipline	Survey Year			
	1996	1997	1999	2004
Biology	23	14	24	8
Chemistry	13	8	19	13
Education	4	3	3	2
Geoscience	3	3	3	3
Mathematics	22	11	18	14
Physics	10	6	9	5
Other sciences*	3	4	3	7
Not indicated	15	1	2	0

**Includes Engineering, Computer Sciences, Nursing, Nuclear Science*

While we will not attempt to trace changes in findings to individual respondents as we did in the comparison of 1996 and 1999 data analyses, we will present the 2004 data and then compare it to earlier findings in order to show the impact over time and the continuing commitment of faculty to reformed teaching and learning practices.

How involved were survey respondents with reformed courses?

Of the 52 respondents to this year's survey, 36% had received funding from MASTEP to either develop or reform a course. Although not asked to do so, twenty people provided additional comments when they responded to this item explaining the status of the course or related information.

> Actually, my work on one type of reform led to application of a different type of reform I learned from MASTEP. I used the first as impetus for the second. These (problem-based learning) are in place and I am improving and increasing their use in other classes. The original funding was for integrated science lab exercises — sounds unrelated but it really isn't because the labs we designed had some beginnings of problem-based learning.
>
> I am not involved in teaching anymore.

> Yes, the course is institutionalized.

What do people remember about MASTEP Faculty Development?

The majority of people responding to the survey remembered attending two to four events between 1996 and 2001. They also remembered specific events as being interesting or memorable.

Table 6: Number of MASTEP Faculty Development Events attended by 50 survey respondents between 1996 and 2001

Number of Events	Responses
0	3
1	11
2 — 4	21
5 — 7	5
8 — 10	6
11+	4

Twenty-five of 47 respondents wrote about specific events as being particularly valuable to them. 22 of these comments were sorted into four distinct categories because they referred to cooperative group learning techniques, the use of technology, specific course content, and forming community. These comments and categories were similar to those we received at the end of years one and three of the original project. Sample comments in each category include:

> Roger Johnson's first workshop on cooperative learning approaches was very useful (I gained enough information to initiate use of these methods and eventually gain reasonable competency) and also the problem-based learning workshop (again for the same reason).
>
> I took a summer course on how to build web pages for my courses. This was a very significant course that helped launch me into using the Internet to support the courses I teach and take a leadership role in applying the Internet toward the educational mission in our department.
>
> It was the event in the Santa Cruz mountains with the physics demo of musical instruments. It was spectacular and memorable. It essentially changed my teaching.
>
> Chance to meet other science faculty in the West Bay Area who are interested in teaching.

Did MASTEP influence teaching and professional involvement?

In 1999, 96% of survey respondents either agreed or strongly agreed with the statement "As a result of MASTEP, I was stimulated to implement new approaches to my teaching." In 2004, 27% of those responding to the survey strongly agreed with the statement and 51% agreed. Still a strong (78%) showing that faculty had been influenced by MASTEP to not only try new things but continued to incorporate them into their practice.

A follow-up item asked respondents to describe any new teaching approaches they had tried or implemented in their courses as a result of MASTEP. Forty-one of the 52 survey participants provided a response to this item. Six people explained that they hadn't implemented anything new, one said that nothing new was learned but that MASTEP helped to refine his ideas, two wrote that they were no longer teaching as they were now administrators, and two comments illustrate why attribution is so difficult to establish when people are exposed to a variety of resources.

> Gosh, the meetings I went to were so long ago. I probably did use stuff, but can't recall exactly what.
>
> I really don't remember which I learned via MASTEP and which via other workshops I have attended.

The remaining 30 descriptions included 38 specific references to specific strategies implemented as a result of MASTEP: cooperative learning strategies, 14; use of technology, 7; inquiry-based learning, 2; new assessment techniques, 7; active learning, 4; and problem solving, 4. These strategies are the same as those espoused by MASTEP through Faculty Development events. Comments included:

> Cooperative learning – problem based learning (more formalized than what I did before) – group activities in lecture courses – better at probing prior knowledge – designed specific interventions based on student misconceptions (some thoughts about this were tweaked by the physics presentation by Lillian McDermott, U Washington).
>
> Has given me some guidance in developing my CD. Most of my course instruction is now via the CD the students use each week on their home computers. Nearly every frame requires some type of response, which is recorded and they send to my web site each week so I have a record of their performance. Class time is mostly spent on cooperative problem solving on white boards, which I monitor, and lab activities.
>
> With funding (in part) from MASTEP, we implemented new discovery group project labs (non-verification, with data pooling of results).
>
> Expanded our first course for majors to 4 units so they could spend more time working on problems in groups.

While most descriptions were of what happens in classrooms, one person also wrote how MASTEP changed personal practices by stating that he now engages in "**. . .** follow-up on the literature in the field and more exploration of new assessment techniques."

When asked how strongly they agreed or disagreed with the statement "Participation in MASTEP Conferences or Events motivated me to initiate or be involved in other activities related to teaching and learning in my discipline" almost 3/4 of respondents agreed (47%) or strongly agreed (24%). Thus providing more data about the leveraging effect of the project in the professional development of university and community college mathematics and science faculty. Specific notes following this item explained how some people were encouraged to initiate new projects or become involved in related activities:

> MASTEP influenced me to join the Eric Mazur web site at Harvard.
>
> As a result of MASTEP I was encouraged to branch out and develop a MUSE class. This is a GE class for first time frosh. In my case I blend literature with science. One of the main objectives of the class is to encourage students to think about the questions

> encountered — there are no “correct answers,” only well–thought out or poorly developed answers**.**

Further evidence of commitment and institutionalization of MASTEP

Along with data collected through the faculty survey we have corresponded with a number of faculty and campus administrators over the past three years to assess the status of reformed courses. Through this correspondence we have learned about the successes and disappointments faculty have experienced (e.g., increased number of sections being offered of new courses due to student demand as well as cancellation of courses due to lack of interest). One particularly enlightening note explained that the new capstone science course was no longer being offered but that it had led to a number of other indirect impacts on the campus and for individual faculty. We share that note because it helps to explain what quantitative data cannot convey.

> The course was taught only once, in Fall 1999. It was offered in Spring 1999 but cancelled due to low enrollment. It was offered again in Spring 2000 but again cancelled due to low (zero) enrollment. It has not been revived since, probably because (1) it lacks a clear departmental sponsor, and (2) individual faculty who might push to teach it have generally been overwhelmed with other responsibilities.
>
> This is not to say that the course didn’t have much impact — on the contrary, in my opinion it did. Speaking for myself (Dr. X and I co-taught the course), I can say that this course gave me the freedom to depart radically from some of my traditional teaching practices and experiment with strongly student-centered strategies. It also gave me a chance to co-develop and co-teach an integrated science course with a good teacher from another discipline; an experience that I found personally valuable and that I believe benefited the students as well.
>
> These several aspects of my experience have reverberated in my teaching and professional life ever since. [The capstone course] came near the beginning of a period in which I’ve become an active participant in science education reform efforts, including two curriculum development grants (NASA-NOVA, NSF-CCLI) leading to the creation of two new geosciences courses aimed at future teachers, both of which implement pedagogical practices advocated by science education reformers. One of those courses is aimed at future high school science teachers and covers topics closely related to those covered in [the capstone course] as we taught it in Fall 1999. In the [new course] I’ve adapted several pedagogical strategies that Dr. X and I developed first in [the capstone course]. [the new course] is fundamentally interdisciplinary, so I co-teach the course with a geologist (I’m a meteorologist), which benefits both instructors and the students.
>
> Hence, in several important respects some of what we did in [the capstone course] lives on in Planetary Climate Change, which I’m currently teaching for the fourth time, and is institutionalized as a course taught annually in the Department of Geosciences.
>
> I don’t know if your assessment methodology can detect some of these clear, albeit indirect, impacts of [the capstone course] — if not, it would miss some of the impact that MASTEP has had as an important planter of seeds, some of which have flourished far beyond the initial activity funded by MASTEP.

Research Question 4

What is the impact of MASTEP-sponsored changes on the practice of new K-12 teachers and their students?

To respond to this question, a group of MASTEP teachers and a comparison group of non-MASTEP teachers were followed over a two–year period. Incentives for their participation were provided by the MASTEP project. During the first year, the new teachers in each category were asked to respond to a survey instrument about instructional practices developed by the CETP CORE evaluation. Similar instruments were used to capture information from the students in these grade six through 12 classrooms. Data from these surveys were described in the prior report. Also included in the prior report were survey responses from the new teachers, as well as some informal interview responses. The surveys administered to the students and the new teachers in the 2003-2003 school year utilized instruments developed by the CETP Core Evaluation program, but that did not elicit information specifically useful for the WestEd evaluation of MASTEP. Therefore, in order to learn about the impact of MASTEP specifically, in this last year we replaced the student and teacher surveys with a targeted interview protocol administered to each new teacher by the classroom observer, on the same day as the classroom observation. Classroom observations were conducted utilizing a structured protocol adapted from the “1998–1999 Local Systemic Change Classroom Observation Protocol" developed by Horizon Research, Inc. (see Appendix A) and sensitive to the reform practices advocated by MASTEP.

Who are the new teachers?

In spring of 2002, WestEd contacted the project leaders at each of the 6 campuses seeking nominations for K-12 teachers who might be able to participate in a two–year study designed to follow a group of new MASTEP teachers, as well as a comparable group of new non-MASTEP teachers. Although both San Jose State and San Francisco State universities have quite sizeable teacher preparation programs, not all students who graduate from these programs take teaching positions in nearby communities. The high cost of living and low teacher salaries encourage many credentialed mathematics and science teachers to accept positions in areas where they can afford to live comfortably. Since the evaluation budget did not provide for extensive travel, we limited our sample to schools within a ninety-minute driving radius from our offices. Finding teachers to participate in the study proved to be a difficult task and the criteria used to define a MASTEP teacher had to be revised several times in order to be able to include enough teachers to study. The working definition of a MASTEP teacher was:

- within the first 3 years of teaching
- received (or close to receiving) a teaching credential from either SFSU or SJSU
- teaching at a San Francisco-Bay Area middle or high school

In total, WestEd received a list of 76 names — 37 science teachers and 39 mathematics teachers. In May 2002 all of those nominated were e-mailed and telephoned in an attempt to solicit interest in participating in the study. 19 teachers expressed interest and 9 of those met the criteria for participation. After the 2002-2003 school year, one of these teachers moved out of state leaving us with 8 MASTEP teachers for the 2003-2004 school year. Two teach mathematics, and six teach science. Once these teachers agreed to participate, permission was sought from each of their school principals.

In addition, a control group of Non-MASTEP teachers for the study was also created. Finding these teachers proved to be even more difficult. We began by asking the MASTEP teachers to nominate math and science teachers at their schools who had been teaching for approximately the same amount of time but had not received teaching credentials from either SJSU or SFSU. Only two of the MASTEP teachers were able to provide names; one of these nominees agreed to participate. In an attempt to find more control group teachers, WestEd then contacted the principals of the MASTEP teachers to provide further nominations. This effort yielded one teacher who agreed to participate in the study. BTSA coordinators for Bay Area school districts were also contacted, yielding 2 more teachers. Principal permission was then secured for the control group teachers who agreed to participate.

During the 2004 Spring semester, 8 MASTEP and 4 non-MASTEP teachers were observed while teaching one of their mathematics or science classes.

Table 7: New teacher demographics

Characteristic	MASTEP n=8	Non–MASTEP n=4	Total N=12
Middle School	3	1	4
High School	5	3	8
Mathematics	2	3	5
Science	6	1	7
Gender	4 Male 4 Female	2 Male 2 Female	6 Male 6 Female
Class Size	Range: 20 – 35 Mean: 27.1	Range: 10–31 Mean: 21.8	Range: 10–35 Mean: 25.3

What do the new teachers have to say about their preparation programs?

While we were conducting our Spring 2004 classroom observations, we also conducted short but formalized interviews with each of the novice teachers. Those who participated in MASTEP were asked specifically about MASTEP reformed courses they may have taken at either SFSU of SJSU. Many of the teachers did not remember all the specific courses they took, but two of the courses, SED 759 at SFSU and ScEd 375 at SJSU were mentioned as being valuable by 7 of the 8 MASTEP teachers. Comments about these specific courses included:

> The course that stands out is one taught by [Faculty Name]. I liked her teaching style; she had good ideas as to how to teach math – *in reference to SED 759.*
>
> [Faculty Name] modeled good teaching and explained the theory well– *in reference to SED 759*
>
> ScEd 375 This and other methods classes were beneficial. They taught me different ways to do experiments, how to use cooperative learning, inquiry and technology.
>
> ScEd 375 The methods class was good. They emphasized learning through inquiry. They modeled and we applied the inquiry/hands-on activities. This was the first time I was introduced to these ideas of using inquiry and hands-on activities for different ability levels."

The interviewer also asked teachers to reflect on anything that they did not feel prepared for by their credentialing programs. Of the 8 MASTEP teachers, 6 discussed issues related to classroom management. Comments included:

> I did not receive sufficient training in classroom management. This is a big issue- classroom control. I feel I was not well prepared, I wish I knew more as to how the adolescent mind works!
>
> The course work and instructors taught us how it should be, but didn't prepare us for how it would be when we started teaching. There should have been more emphasis on realistic expectations in the first years of teaching.
>
> The biggest thing is that there was not a class on classroom management. While it was mentioned in some courses it was not emphasized enough.

Of the four Non-MASTEP teachers, one also responded that training in classroom management skills was lacking from her credential program.

What did the classrooms of the new teachers look like?

Observations of classrooms occurred during Spring 2003 and Spring 2004. At a debrief session in summer 2004, the observer stated that the teachers appeared to be friendlier, more cooperative, and more relaxed this year. He commented that there were still far too many teacher–directed lessons, and that while cooperative learning strategies were evident, they were not well done. Further, he found that teachers needed more support for doing inquiry lessons and checking for student understanding — especially the use of *wait time*. The observer had not been told earlier which teachers were MASTEP teachers and which were comparison group teachers, however at the end of the 2004 observation cycle he stated, "There is no question at the high school — you can tell a MASTEP teacher from one who isn't, with one exception."

The descriptions of the lessons observed provided many details that reflected MASTEP goals in the classrooms of those teachers who had received their credentials from SFSU or SJSU. Descriptions of MASTEP taught classes and subjective evaluations included:

> The lesson started with the teacher requesting the students to record a minimum of three external characteristics of echinoderms. After a few minutes the students shared their information with other students nearby. The teacher passed around living arthropods, mollusks, and echinoderm organisms that he collected from the tide pools earlier in the day. The teacher demonstrated how to use the dissecting microscope to observe the sea urchin and sea star. During the remainder of the lesson, the students, using a dissecting microscope, observed the behavior and external anatomy of a sea star and a sea urchin recording their findings on a lab sheet provided. —*High School Zoology Class*
>
> The lesson is part of a genetics unit. In this lesson the students will focus on modern advanced (sic) in the field of genetics. Prior to the lesson, the students learned that traits are controlled by genes located in chromosomes. They also learned about the chromosome theory, meiosis, protein synthesis, and mutations. The lesson started with a warm up. The teacher introduced the warm up and gave students 15 minutes to complete it. The teacher reviewed the warm up with class input. After the students turned in their homework and the teacher answered questions, the students started a cooperative learning activity "Find The Fiction". Students in groups completed the tasks at each of the five stations. During the last five minutes of the period (not observed) their activity sheet was collected and the students were reminded that there will be a laboratory notebook check tomorrow. —*Middle School Science Class*

Descriptions of the non-MASTEP classrooms and the subsequent subjective evaluation of what was observed were positive although they appeared to be more teacher-directed in nature:

> When the observation started the students in cooperative groups were independently engaged in completing a quadratic equation problem. During the remainder of the lesson the teacher set up quadratic equation problems and explained and recorded the steps to solve them. Periodically students were able to work independently giving the teacher time to check for understanding and identify any difficulties they were having. The lesson ended with the teacher assigning homework.
>
> The lesson started with the students completing a "warm up" consisting of three quadratic problems recorded on the white board. The teacher shared information about the STAR test schedule and assigned homework. During the "warm up" the teacher helped students and checked their homework. The teacher recorded solutions to the "warm up" problems on the white board. The teacher then gave the students the solution information with limited input from the students. Time was taken from the lesson to talk about cheating and a new integrity policy for next year. The teacher was having a discipline problem with one student who needed constant attention so she had him record his solution to the third "warm up" problem on the white board. The lesson continued with a twenty-minute quiz requiring the students to solve two quadratic equation problems (find discriminate, axis of symmetry and vertex, and graph). The next 25 minutes were spent with the teacher lecturing on the quadratic formula by solving two quadratic problems (one with and one without a real solution) on the white board. Students took notes. There was minimal student input/questions. During the last 5 minutes video announcements were broadcast in each classroom on campus.

The observer also included comments comparing each teacher's observed lesson in Spring 2004 with that of the lesson observed in 2003. Overall, most teachers exhibited growth, but the MASTEP teachers were more likely to exhibit growth in areas reflective of the overall goals of MASTEP. In particular, four of the seven MASTEP teachers who were observed in both years (one teacher was only observed in year 2) increased the use of technology in their classrooms in the year between observations. Notable changes included:

> Since the last observation in May 2003, the teacher…has increased the use of technology by learning and using pearl language and html software and by expanding his website to include automated homework assignments so that each student gets a different set of questions, posted worksheets and homework with answers provided, and curriculum notes.
>
> Since the observation in May 2003, the teacher has set up a website where the students can download test prep, practice quizzes, games, review information, homework, and check their grades. The teacher has expanded the use of the computer in addition to gathering information for a research paper to prepare Power Point for presentations and Excel for graphing data.

The observer also commented on the progress for three of the four Non-MASTEP teachers, however none of these comments indicated noticeable growth in any of the areas related to the MASTEP goals. Examples of comments about the growth of Non-MASTEP teachers include:

> Comparing the lesson with the one observed in 2003 [Teacher's Name] exhibits more confidence and has improved her classroom management skills. She does not include the use of inquiry, problem solving or cooperative learning to any extent.
>
> Since the last observation in May 2003 there is little evidence that the teacher has moved forward in using cooperative learning or inquiry. During the interview he admitted that he

wants and plans to shift the lessons to be more student-centered and include cooperative learning activities.

How did the instruction of MASTEP and non-MASTEP teachers compare?

The observer was asked to rate key indicators of effective instruction using items adapted from a validated instrument developed to evaluate mathematics and science classrooms in sites receiving funding through NSF's Local Systemic Change initiative. The observer has used the instrument for approximately eight years for evaluations of other projects and therefore is quite familiar with what the ratings require in the way of evidence. Fourteen key indicators were used to compare the classrooms of the MASTEP and non-MASTEP novices. Each indicator was to be rated as descriptive of the lesson observed from *1 (not at all)* to *5 (to a great extent);* knowing that any one lesson is not likely to provide evidence for every single indicator, *DK* was to be used to indicate *Don't know* where there was not enough evidence to make a judgment, and *NA* was to be used to indicate *Not applicable* when the indicator was inappropriate given the purpose and context of the lesson. Three of the indicators focused on an assessment of the *likely effect* of the lesson on student learning. Because the number of teachers in each category was small, no statistical tests were performed to compare the ratings. Data provided in Table 8 illustrates that there were not great differences between the two categories of novice teachers on these indicators. Further, this result does not seem surprising due to the small sample sizes and the timing of the observations — towards the end of the academic year.

Table 8: Ratings of key indicators of effective instruction: MASTEP and non-MASTEP novice teachers

a. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so

Rating Value	1 Not at all	2	3	4	5 To a great extent	N/A	DK
MASTEP teachers receiving rating			1	3	3	1	
Non-MASTEP teachers receiving rating			1	2	1		

b. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.

Rating Value	1 Not at all	2	3	4	5 To a great extent	N/A	DK
MASTEP teachers receiving rating				2	2		4
Non-MASTEP teachers receiving rating				2			2

c. The lesson promoted strongly coherent conceptual understanding

Rating Value	1 Not at all	2	3	4	5 To a great extent	N/A	DK
MASTEP teachers receiving rating			2	5	1		
Non-MASTEP teachers receiving rating			2	2			

d. The teacher displayed an understanding of mathematics/ science concepts (e.g., in his/her dialogue with students)

Rating Value	1 Not at all	2	3	4	5 To a great extent	N/A	DK
MASTEP teachers receiving rating				1	7		
Non-MASTEP teachers receiving rating				1	3		

Two items on the general indicators were related to a key goal of MASTEP — the implementation of cooperative learning strategies in the classroom. Although no statistically significant claims can be made about the differences between the two groups, it is interesting to note that the means of the two groups on the item related to use of cooperative learning does show some more positive implementations for MASTEP teachers than for non-MASTEP teachers.

Table 9: Ratings of key indicators of effective instruction related to cooperative learning: MASTEP and non-MASTEP novice teachers

a. The lesson was designed to engage students as members of a learning community

Rating Value	1 Not at all	2	3	4	5 To a great extent	N/A	DK	Mean
MASTEP teachers receiving rating			1	5	2			**4.13**
Non-MASTEP teachers receiving rating			1	2	1			**4.00**

b. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher and students.

Rating Value	1 Not at all	2	3	4	5 To a great extent	N/A	DK	Mean
MASTEP teachers receiving rating		1	4	13				**3.25**
Non-MASTEP teachers receiving rating		1	3					**2.75**

In the final rating on the structured instrument, the observer was asked to consider all available information about the lesson, its context and purpose, the complete instructional cycle, and his own judgment of the relative importance of the previous ratings. The instruction was to select the capsule description that best characterizes the observed lesson. This capsule rating is not intended to be an average of the previous ratings but an encapsulation of the overall assessment of the quality and likely impact of the lesson. The capsule descriptions were arranged in five levels, from "Level 1: Ineffective Instruction" to "Level 5: Exemplary Instruction." The description of the mid-level, "Level 3: Beginning Stages of Effective Instruction," states "Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are *some weaknesses* in the design, implementation, or content of instruction…" Due to this broad range, observers are asked to designate whether lessons accorded a Level 3 were a *low, solid,* or *high 3.* Observers are also asked to provide a rationale for their capsule rating. Table 10 presents the data submitted by the observer.

Table 10: Capsule description ratings of the quality of the lessons observed in classrooms of MASTEP and non-MASTEP K-12 Teachers

Number of ratings		Description of the rating
MASTEP	Non-MASTEP	
0	**0**	***Level 1: Ineffective Instruction*** *There is little or no evidence of student thinking or engagement with important ideas of mathematics/science. Instruction is unlikely to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics/science. Lesson was characterized by either (select one below):* ***Passive "Learning"*** *Instruction is pedantic and uninspiring. Students are passive recipients of information from the teacher or textbook; material is presented in a way that is inaccessible to many of the students* ***Activity for Activity's Sake*** *Students are involved in hands-on activities or other individual or group work, but it appears to be activity for activity's sake. Lesson lacks a clear sense of purpose and/or a clear link to conceptual development.*
0	**0**	***Level 2: Elements of Effective Instruction*** *Instruction contains some elements of effective practice, but there are substantial problems in the design, implementation, content, and/or appropriateness for many students in the class. For example, the content may lack importance and/or appropriateness; instruction may not successfully address the difficulties that many students are experiencing, etc. Overall, the lesson is quite limited in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics/science*
Low 3=1 **Solid 3=2** **High 3=1**	**Low 3=1** **Solid 3=1** **High 3=1**	***Level 3: Beginning Stages of Effective Instruction*** *Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are some weaknesses in the design, implementation, or content of instruction. For example, the teacher may short-circuit a planned exploration by telling students what they "should have found"; instruction may not adequately address the needs of a number of students; or the classroom culture may limit the accessibility or effectiveness of the lesson. Overall, the lesson is somewhat limited in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics/science.*
3	**1**	***Level 4: Accomplished, Effective Instruction*** *Instruction is purposeful and engaging for most students. Students actively participate in meaningful work (e.g., investigations, teacher presentations, discussions with each other or the teacher, reading). The lesson is well-designed and the teacher implements it well, but adaptation of content or pedagogy in response to student needs and interests is limited. Instruction is quite likely to enhance most students' understanding of the discipline and to develop their capacity to successfully "do" mathematics/science*
1	**0**	***Level 5: Exemplary Instruction*** *Instruction is purposeful and all students are highly engaged most or all of the time in meaningful work (e.g., investigation, teacher presentations, discussions with each other or the teacher, reading). The lesson is well-designed and artfully implemented, with flexibility and responsiveness to students' needs and interests. Instruction is highly likely to enhance most students' understanding of the discipline and to develop their capacity to successfully "do" mathematics/science*

While it was surprising that the set of capsule ratings for new teachers was high, it is here that the ratings appeared to show differences between the two groups. Four of the eight MASTEP novices were awarded capsule ratings that implied effective instruction was taking place (i.e., ratings of Level 4 or Level 5) while only one of the non-MASTEP teachers was rated in this manner.

Supporting evidence accompanying the observation ratings illustrate the elements involved and leading to awarding different capsule ratings. Excerpts from the reports on the lowest–rated teachers stated:

> The lesson was too teacher directed with the teacher doing the work and telling the students steps necessary to solve the algebra problems. The pace was slow (one hour for a three problem warm up)…The use of probing questions ineffective because they were directed to the class at large resulting in many students shouting out the answer at the same time, leaving the rest of the class behind and feeling no pressure to stay on task.

> This class is a challenge. The teacher is new to the profession (3 years), new to a school in its first year, and teaching a class of unmotivated students. The lesson design was good. The teacher made good use of the chalkboard and overhead projector. Throughout the lesson many students were off task- playing games using a calculator, sleeping, doing homework, or not listening. A lot of time had to be devoted to disciplining the students. A casual, informal atmosphere did not lend itself to a climate for learning.

Whereas, from highly rated MASTEP classrooms, we found the following supportive statements:

> A well designed and implemented lesson. Lots of evidence of technology used throughout the lesson. The lesson was much more meaningful and engaging for students by providing them living organisms to observe and study. Good rapport established.

> An excellent well organized lesson design and nicely implemented. The students were engaged, seemed interested, and on task. Throughout the lesson the teacher made sure all students were on task and understood what they were doing.

Thus it was the perception of the observer that in the classrooms of MASTEP teachers more effective implementation of inquiry, cooperative learning, and technology was taking place than in non-MASTEP classrooms.

How Do The New Teachers See Themselves?

In addition to the observation, each teacher was formally interviewed. Questions were designed to reveal how teachers themselves think they incorporate elements related to MASTEP goals into their teaching. The first of these questions asked teachers "For what purpose do you have students work together?" Teachers were then asked to provide examples of the types of group work their students typically engage in. The difference in responses between MASTEP and non-MASTEP teachers to this question was marked in that all MASTEP teachers claimed to use cooperative learning and had a variety of examples of ways they have students work together, while one of the non-MASTEP teachers does not ever have students work together, and another does so only because it is a school requirement. In addition, the ways teachers' reported organizing group work also differed. Two of the non-MASTEP teachers reported using groups solely to allow students to solve problems together. By contrast MASTEP teachers reported such techniques as labs, projects, weekly peer tutoring sessions, presentations, review, homework correction, brainstorming, and games. Additionally, three MASTEP teachers also reported using jigsaw style techniques.

Descriptions of specific group work were also illustrated by teachers:

“Current events where they have to discuss issues and find solutions.” — *Middle School Science Teacher*

> Investigating Pi, where the students use jigsaw to investigate the origin of Pi. Students investigate polyhedron to help them with the vocabulary, and students share in the construction of a variety of shapes.” — *High School Math Teacher*

Teachers were also asked about techniques they use to assess students, other than traditional tests and quizzes. The difference between MASTEP and non-MASTEP teachers was less striking. Teachers in both groups mentioned informal assessments, lab reports or notebooks, journals, and projects.

Responses of two MASTEP teachers are as follows:

> Homework, short and long term projects, group/individual projects, and debates. In some cases the class develops the hypothesis together and the students design the procedure, and form their conclusion. — *High School Science teacher:*

> I assess students using individual and group projects, individual lab write ups that include follow up questions, building 3-D models, reviewing homework, and test packs that contain multiple assignments. — *Middle School Science Teacher*

Teachers were asked to reflect upon ways they think they foster critical thinking in students. The responses of all but one of the MASTEP teachers included a variety of concrete examples and illustrations. For example:

> I intentionally do not give them all the required information, forcing them to ask questions and/or go elsewhere for answers. I think it helps when I include “real world” connections. I try no to answer their questions, but to get them to answer their own questions with prompts and clues. —*High School Science Teacher*

> Questioning strategies, conclusions required for lab write ups that include possible errors and what they would do next time, projects that can be done as a cartoon, creative story or model. —*Middle School Science Teacher*

By contrast two of the non-MASTEP teachers gave similar responses with examples of techniques they use, but two others were vague and unfocused in their answers:

> I hope I have the ability to motivate my students to understand the steps in solving difficult math problems.—*High School Math Teacher*

> I say ‘You will need to be thinking this.’ I define key words they will need to use in problem solving. —*High School Math Teacher*

The final question of the interview asked separate questions of math and science teachers. The question for science teachers asked for an example of an activity or project the teachers have assigned that has given students the opportunity to explore phenomena the way a scientist would. Only one of the non-MASTEP teachers was a science teacher, so it is not possible to make a meaningful comparison between the two groups. However, a sample of responses from five of the six MASTEP science teachers who responded positively to the question highlight a variety of investigative lessons.

> Students in groups of three were required to create a model of a swim bladder. Using supplies provided they had to build a model that would maintain natural buoyancy. They had to develop a hypothesis, write a protocol, collect data, and record a conclusion. — *Middle School Science Teacher*

> One of the labs I do is the iodine clock reaction investigation. The students are required to design a plan and conduct a procedure and predict to the second the reaction time for a chemical reaction to be completed.— *High School Science Teacher*

> The Brand X activity where the students select a product and then choose a property that can be measured. The students test the product with three different brands. The students design the protocol, collect and analyze the data, and come up with a conclusion. — *Middle School Science Teacher*

Similarly, the math teachers were asked to provide examples of activities or projects they have assigned that allow students to discover concepts of their own such as rules, laws, or relationships. However, the responses of the two groups of teachers did not show any obvious differences between the groups of teachers, particularly given that there were just two math MASTEP teachers, and three math non-MASTEP teachers.

4. Conclusions

Eight years after the inception of MASTEP-sponsored reforms, what can we say about the impact of the project and the realization of its goals? What evidence is there that the program has been worthwhile for teachers, students, faculty, and institutions? In summarizing each of the research questions individually, we paint a picture of how MASTEP faired, three years after the end of the initial five–year grant period.

RESEARCH QUESTION 1
How permanent are the programmatic changes instituted by MASTEP?

Over time, forces that are larger than either MASTEP or the six campuses intervened to effect the climate within which MASTEP grew and developed. For example, during our final data collection years the state of California imposed severe budget cuts on all areas of education. These reductions in funds directly impacted some of the progress made by faculty involved with MASTEP since course offerings were streamlined, admissions to publicly funded institutions of higher education were decreased, and many new teachers at the K–12 level received layoff notices as did lecturers and adjunct faculty at the six MASTEP institutions. These events combined with the retirements of many people who had been active in MASTEP course reform efforts helped to create a landscape much different than the one envisioned in 1996. That said, there is still strong evidence that many of the MASTEP reforms, as well as networks, relationship and attitudes influenced by MASTEP have been institutionalized.

Improved instruction

The Faculty Development portion of the project promoted more effective approaches to teaching and learning. People who participated in the events told us they became more aware of not only why, but how to become more student centered in their courses. Tenured and non-tenured faculty learned about and implemented reformed approaches in their teaching practices. They also learned that there is an academic field of teaching about which they can study and share with others what they are doing within their own courses.

A sense of community

The community of scholars is evident in the collaborations that existed and still exist on campuses (within departments and across disciplines) and among groups composed of people from different campuses. The networking that took place between community college and university faculty during the initial five years of NSF-funding is still going on today.

Increased awareness of teacher preparation

Arts and Sciences faculty and administrators are much more aware of their role in the preparation of new teachers, despite the fact that teacher preparation has long been a graduate program in California. Additionally, new science courses designed specifically for Liberal Studies majors (i.e., future elementary teachers) now take into account the importance of reformed instructional practices as good modeling for future teachers.

Continued resource development to support reform work

Surprising to us, many people who were active in MASTEP–sponsored activities continued to pursue outside funding to continue their reform work. This was surprising to us because at all six campuses, faculty have heavy teaching (i.e., most faculty teach 12 units per semester) and advising loads, and at community colleges resource development and publishing are not expected

RESEARCH QUESTION 2

What is the longevity of the changes instituted in reformed courses?

Out of a total of 76 courses impacted by MASTEP funding, we were able to document that 52 courses are still being taught with at least some of the reforms in place. This is a retention rate of 68% for course reforms, eight years after the inception of the MASTEP project. Most faculty whom we observed in reformed courses modeled the type of teaching that MASTEP espoused: inquiry–based activities, use of technology (e.g., many Power-Point presentations), and use of cooperative learning strategies.

Cooperative learning

A major reform strategy emphasized through MASTEP's Faculty Development strand was cooperative learning as adapted for college classrooms — especially in large lecture halls. Many of the faculty welcomed the training and worked hard to implement the components that would make these strategies effective in their classrooms; thus we were not surprised to find the use of cooperative learning group strategies evident in a majority of the classrooms visited.

Technology

While the general population has increased their use of technology, many MASTEP activities focused on enabling faculty to effectively use technology as a teaching and learning tool. Although technology was not as evident as cooperative learning, we do know that almost all faculty communicate with students through email, which is a new phenomena relative to the beginning of the project. PowerPoint presentations were observed during many of the lessons, as was student use of graphing calculators when solving quantitative problems.

Assessment

Over the five years of the original grant, both informal and formal assessment strategies designed to provide formative feedback to faculty and students were emphasized. The intent was to introduce faculty to new forms of assessing student understanding. We observed the use of technology as an assessment tool, the use of frequent essays to convey conceptual understanding, and project–based assessments requiring a great deal of problem solving.

Problem Solving

In the mathematics classrooms we observed, several instances seemed to support the mode of stressing critical thinking in the act of finding solutions, rather than the more traditional method of solving problems to find a unique answer. These techniques were in keeping with the MASTEP goal of strengthening students' abilities to become problem solvers.

Inquiry

In classrooms we visited, we did see evidence that inquiry learning was utilized as a regular practice. Promoting inquiry learning was a central goal of MASTEP because it encourages students who ask questions, study phenomena, probe, make hypotheses, and engage in solving problems as a way to understand concepts. Furthermore, this way of approaching the learning of science and/or mathematics is somewhat different from the more traditional modes of memorization and categorization. It is perhaps the most difficult approach to plan and implement well; however, Inquiry learning is a major tenet of scientific understanding.

RESEARCH QUESTION 3
What is the long-term commitment to change made by faculty who participated in MASTEP?

In addition to the evidence of reforms initiated in courses funded by MASTEP, 78% of faculty responding to a survey stated that they had been influenced by MASTEP to try new things and that they continued to incorporate these ideas into their instructional practice. Many faculty provided descriptions of specific strategies they implemented as a result of their MASTEP participation and these strategies reflected the project's goals.

RESEARCH QUESTION 4
What is the impact of MASTEP-sponsored changes on the practice of new K-12 teachers and their students?

For the MASTEP teachers we followed, two specific courses stood out from their preparation programs as having been particularly valuable. Both of these courses were specifically designed for the preparation of new science or mathematics teachers; one of them incorporated changes to the curriculum through MASTEP funding and the other was initiated through MASTEP. Furthermore, while most of the K-12 teachers — both MASTEP and non–MASTEP — wished they'd had more preparation in classroom management, no MASTEP teacher wanted better preparation for teaching their subject.

In the classrooms of those teachers who had received their credentials from SFSU or SJSU, instructional practices reflected MASTEP goals: cooperative learning strategies were evident, however, teachers still needed more support for doing inquiry lessons. Overall, non-MASTEP classrooms appeared to be more teacher-directed in nature.

CONCLUSION

A member of MASTEP's Executive Advisory Board seemed to express best the positive nature of MASTEP during a recent interview. When he was asked, "Do you have an answer to a question that you had hoped I would ask?" his response was:

> *Was it worth it? Yes—on a personal level, though exhausting, it was satisfying to make the personal connections I did; and I saw encounters of others who benefited from meeting colleagues at other campuses. The times at workshops when people got to talk with each other and learn from well-known people were inspiring (Bruce Alberts, Glen Seaborg). I saw people who don't usually attend conferences begin to think about teaching processes and be open to new ideas. This brightened the week. It was a real morale booster to see intellectual excitement. I enjoyed working with students — those who already knew they wanted to be teachers or who were exploring it. I wouldn't have normally met some of these students, except they had an interest in kids.*

At the end of an eight-year relationship with the MASTEP project, we also believe that *it was worth it.* The evidence leads us to conclude that this was a successful venture that made positive impact on a variety of populations:

- Faculty who participated in the MASTEP events during the initial five years of funding learned new strategies for engaging students in learning and formed new collegial communities.
- Students enrolled in courses reformed through MASTEP funding or in the courses taught by faculty implementing new instructional strategies were engaged in more student-centered learning that emphasized understanding over memorization.
- Academic departments became more aware of their role in the preparation of new teachers and began to engage in cross-campus conversations to improve that preparation.

However, we are convinced that the strongest impact of this venture has not yet become evident. That impact will be on undergraduate students enrolled in courses influenced by MASTEP who eventually become K–12 teachers. The age–old axiom that *people teach the way they were taught* will come into play in the many classrooms of these future teachers. These classrooms will reflect student–centered, inquiry–based instruction. These classrooms will make use of technology as both a teaching and learning tool. These classrooms will encourage students to pursue the ideas inherent in the mathematics and science curriculum. And for those undergraduate students in MASTEP–influenced courses who become parents, the expectation will be that their children will have opportunities to learn mathematics and science in a more student–centered, inquiry–based context. Thus it is this prediction that corresponds to the original vision of the National Science Foundation sponsored Collaboratives for Excellence in Teacher Preparation.

6. References

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Appendix A: The Instruments

Observation instruments
Interview protocols
Letter to faculty
Faculty survey

MASTEP CLASSROOM OBSERVATION PROTOCOL

I. BACKGROUND INFORMATION

Date of Observation: ________________________________ Observer: __________________________________
Time of Observation:
Start___________ End___________ Length of observation:________________

For college courses only:	*For K-12 courses only:*
Institution: ○ CCSF ○ CSM ○ EVC ○ SFSU ○ SJCC ○ SJSU	District Name: ________________________________
Type of Course: ○ Intro ○ Core ○ Lower Division ○ Upper Division	School Name: ________________________________
Observed MASTEP Project Leader? ○ Yes ○ No	Grade Level: ________________________________

Subject Observed/Course Title & #____

Name of Instructor:__________________________________ Scheduled length of class:_____________

II. CLASSROOM DEMOGRAPHICS

A. What is the total number of students in the class at the time of the observation?

[ ]

B. What is the approximate percentage of white (not Hispanic origin) students in this class?

- ❍ 0–10 percent
- ❍ 11–25 percent
- ❍ 26–50 percent
- ❍ 51–75 percent
- ❍ 76–100 percent

C. Indicate the *teacher's*:

1. Gender
   ❍ Male ❍ Female
2. Race/Ethnicity
   - ❍ African-American (not Hispanic origin)
   - ❍ American Indian or Alaskan Native
   - ❍ Asian or Pacific Islander
   - ❍ Hispanic
   - ❍ White (not Hispanic origin)
   - ❍ Other

D. If applicable, indicate the *teacher aide's*:

1. Gender
   ❍ Male ❍ Female
2. Race/Ethnicity
   - ❍ African-American (not Hispanic origin)
   - ❍ American Indian or Alaskan Native
   - ❍ Asian or Pacific Islander
   - ❍ Hispanic
   - ❍ White (not Hispanic origin)
   - ❍ Other

IV. Description of Lesson Observed

In a few sentences, describe the lesson you observed and its purpose. Include where this lesson fits in the overall unit of study, syllabus, or instructional cycle. Note: This information may need to be obtained from the teacher.

V. MASTEP Goals Reflected During Instruction

In a few sentences, describe any evidence of the major MASTEP goals

MASTEP Goal	Describe any evidence of goal being used
Technology	
Assessment	
Cooperative Learning	
Problem Solving	
Inquiry	

VI. RATINGS OF KEY INDICATORS

In this section, you are asked to rate each of a number of key indicators as descriptive of the lesson in four different categories, from 1 (not at all) to 5 (to a great extent). Note that any one lesson is not likely to provide evidence for every single indicator; use DK, "Don't Know," when there is not enough evidence for you to make a judgment. Use N/A, " Not Applicable," when you consider the indicator inappropriate given the purpose and context of the lesson.

	Not at all				*To a great extent*		
1. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving………...……………………...…….	1	2	3	4	5	DK	N/A
2. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so…....…………..………	1	2	3	4	5	DK	N/A
3. Students were reflective about their learning…………………...…...……	1	2	3	4	5	DK	N/A
4. The lesson was designed to engage students as members of a learning community…..…………………..………………………………….	1	2	3	4	5	DK	N/A
5. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein……….……....…	1	2	3	4	5	DK	N/A
6. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher and students..………….………………	1	2	3	4	5	DK	N/A
7. Intellectual rigor, constructive criticism, and the challenging of ideas were valued………………………………………………………...….	1	2	3	4	5	DK	N/A
8. The lesson promoted strongly coherent conceptual understanding………	1	2	3	4	5	DK	N/A
9. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence…………………...……….	1	2	3	4	5	DK	N/A
10. The teacher displayed an understanding of mathematics/ science concepts (e.g., in his/her dialogue with students)……………………..…	1	2	3	4	5	DK	N/A
11. Appropriate connections were made to other areas of mathematics/ science, to other disciplines, and/or to real-world contexts, social issues, and global concerns….………………….…………………………….	1	2	3	4	5	DK	N/A

For the following questions, select the response that best describes your overall assessment of the *likely effect* of this lesson in each of the following areas.

	Not at all				*To a great extent*		
12. Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation.…………………	1	2	3	4	5	DK	N/A
13. Students' understanding of important mathematics/science concepts….	1	2	3	4	5	DK	N/A
14. Students' capacity to carry out their own inquiries……………………..	1	2	3	4	5	DK	N/A

VII. Capsule Description of the Quality of the Lesson

In this final rating of the lesson, consider all available information about the lesson, its context and purpose, the complete instructional cycle, and your own judgment of the relative importance of the ratings you have made. Select the capsule description that best characterizes the lesson you observed. Keep in mind that this rating is *not* intended to be an average of all the previous ratings, but should encapsulate your overall assessment of the quality and likely impact of the lesson. Please provide a brief rationale for your final capsule description of the lesson in the space provided.

❍ **Level 1: Ineffective Instruction**

There is little or no evidence of student thinking or engagement with important ideas of mathematics/science. Instruction is *unlikely* to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics/science. Lesson was characterized by either (select one below):

o **Passive "Learning"**

Instruction is pedantic and uninspiring. Students are passive recipients of information from the teacher or textbook; material is presented in a way that is inaccessible to many of the students.

o **Activity for Activity's Sake**

Students are involved in hands-on activities or other individual or group work, but it appears to be activity for activity's sake. Lesson lacks a clear sense of purpose and/or a clear link to conceptual development.

❍ **Level 2: Elements of Effective Instruction**

Instruction contains some elements of effective practice, but there are *substantial problems* in the design, implementation, content, and/or appropriateness for many students in the class. For example, the content may lack importance and/or appropriateness; instruction may not successfully address the difficulties that many students are experiencing, etc. Overall, the lesson is *quite limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics/science.

❍ **Level 3: Beginning Stages of Effective Instruction** (Select one below.)

o Low 3 o Solid 3 o High 3

Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are *some weaknesses* in the design, implementation, or content of instruction. For example, the teacher may short-circuit a planned exploration by telling students what they "should have found"; instruction may not adequately address the needs of a number of students; or the classroom culture may limit the accessibility or effectiveness of the lesson. Overall, the lesson is *somewhat limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics/science.

❍ **Level 4: Accomplished, Effective Instruction**

Instruction is purposeful and engaging for most students. Students actively participate in meaningful work (e.g., investigations, teacher presentations, discussions with each other or the teacher, reading). The lesson is well-designed and the teacher implements it well, but adaptation of content or pedagogy in response to student needs and interests is limited. Instruction is *quite likely* to enhance most students' understanding of the discipline and to develop their capacity to successfully "do" mathematics/science.

❍ **Level 5: Exemplary Instruction**

Instruction is purposeful and all students are highly engaged most or all of the time in meaningful work (e.g., investigation, teacher presentations, discussions with each other or the teacher, reading). The lesson is well-designed and artfully implemented, with flexibility and responsiveness to students' needs and interests. Instruction is *highly likely* to enhance most students' understanding of the discipline and to develop their capacity to successfully "do" mathematics/science.

Please provide your rationale for the capsule rating:

MASTEP 2 INTERVIEW PROTOCOL: CAMPUS & PROJECT REPRESENTATIVES

Campus: ____ **Date:** _____________

Department: ____

Interviewee: ____

Interviewer: ____

As you know, I am one of the evaluators for the Math and Science Teacher Education Project or MASTEP for short. I am interested in talking with you today about the impact of MASTEP on this campus since the inception of the NSF–funded project in 1996.

I will be making notes as we talk. We will not quote you directly without permission, although we may report the gist of what you say. You should be assured that the focus of this evaluation is to look at the project as a whole and not to evaluate each individual campus.

- What are the three most important things you believe MASTEP accomplished?

- It is uncommon for a single initiative by itself to accomplish significant change, with this in mind, could any of these things have been achieved without MASTEP?

- Were there any mechanisms or processes in place before MASTEP began that facilitated the achievement of MASTEP goals?

- What were some of the barriers that inhibited achievement of MASTEP goals?

- To what extent has the MASTEP program at your campus made a difference beyond what would have happened if it had not existed? How would you describe the impact it has had?

- To what extent have project activities been institutionalized? What specific barriers were there to institutionalization? What changes in institutional practice or administrative procedure have occurred to ensure institutionalization of project activities/goals?

- What didn't happen [that you expected/thought would/should have] ?

- What evidence do you have now or do you plan to obtain in the future about the impact you have had on preservice teachers? on undergraduate students?

9. To what extent do you believe the CETP caused positive changes in the way:

	No Change	A little	Some Improvement	*Substantial Improveme nt*	A great deal of improvement
a. SMT faculty interact about improving instruction?	O	O	O	O	O
b. SMT faculty and education faculty interact about improving instruction at the CETP **four-year institutions** of higher education?	O	O	O	O	O
c. SMT faculty and education faculty interact with the faculty at the CETP **two-year institutions** of higher education?	O	O	O	O	O
d. SMT and education faculty and K-12 schools and teachers interact about improving instruction?	O	O	O	O	O
e. Institutions of higher education and K-12 schools interact?	O	O	O	O	O
f. Institutions of higher education consider teaching performance and/or instructional improvement in promotion/tenure and merit decisions?	O	O	O	O	O

What evidence do you have to support the beliefs rated in items 9 a-f?

- Do you have an answer to a question that you had hoped I would ask?

Thank you for your time.

MASTEP NEW TEACHER INTERVIEW PROTOCOL

1. Have you finished your credential?

    If not, when do you anticipate being finished?

3. How did the course work in your teacher prep program prepare you for your teaching assignment?

    Which courses were most helpful, and why?

    Were there any other activities you participated in outside of the credential classes that were beneficial to you?

4. What weren't you prepared for that you wish had been covered by your teacher prep program?

5. What kind of support have you had as a new teacher?

    Were you involved in New Teacher support activities at SJSU and SFSU?

    Have you been involved in BTSA?

    Do you have a mentor, formally or informally assigned, and is the relationship beneficial to you? In what ways?

    If you have not had any support, what kind of support do you wish you had?

6. What has been the most difficult part about being a new teacher?

7. Do you enjoy teaching?

8.Do you still see yourself in teaching in 5 years?

    Why of why not?

Questions Related to MASTEP Goals

9. For what purposes do you have students work together?

    Can you provide a few examples of group work that students typically engage in

10. In what ways do you incorporate technology into your teaching?

    Can you provide examples of how you use technology?

    (Note to interviewer: technology includes computers, internet, electronic microscopes, graphing calculators with display, etc.)

11. Other than traditional tests and quizzes, how do you assess student understanding?
Probe for use of journals, group projects, informal assessment etc.

12. In what ways do you think you foster students' critical thinking?
Can you give some examples of methods you use to get students to think critically?

13a. *Question for science teachers only.* Can you give me an example of an activity or project you have assigned that has given students the opportunity to explore phenomena the way a scientist would?

13b. *Question for mathematics teachers only.* Can you give me an example of an activity or project you have assigned that has allowed students to discover concepts on their own such as rules, laws, or relationships?

Is there anything else you would like to tell me about your teaching, or your experience as a new teacher that I have not already covered?

Thank you for your time.

EMAIL SOLICITATION FOR FACULTY SURVEY

PLEASE DON'T TRASH THIS MESSAGE!

During the past EIGHT years, you participated in one or more of the faculty development activities sponsored by the **Math and Science Teacher Education Project (MASTEP). Between 1996 and 2001, MASTEP was an active collaboration of six campuses (CCSF, CSM, EVC, SFSU, SJCC, and SJSU) with funding from the NSF. Faculty surveys were conducted in 1996, 1997, and 1999. Asking similar questions in 2004 will allow us to describe some of the residual impact of the project on teaching and learning at the six campuses.**

As MASTEP's external evaluator I am asking you once again to respond to a short survey that can be completed online. There are only 14 items on the survey (most have check boxes for your responses). If you respond to the survey by May 5 you will be entered in a drawing. We will be giving away 5 Palm Personal Digital Assistants (PDA's) compatible with both Windows and Mac platforms as a way to thank you for participating in a timely fashion.

So, please participate by clicking on this link:
http://www.zoomerang.com/survey.zgi?p=WEB2GAFMKVR4

Although your email address is requested at the end of the survey so we can enter you in the drawing, please be assured that all individual responses are confidential and that your email address will be stripped prior to any analysis of data. **If you have any questions about the survey, the Palm PDA, or MASTEP, please contact me by email or at 415.615.3103**

Thanks so much,

Tania

**Tania Madfes, Ed.D.
Senior Research Associate
WestEd
730 Harrison Street
San Francisco, CA 94107
415.615.3103
tmadfes@wested.org**

MASTEP FACULTY FOLLOW-UP SURVEY

This survey was administered through Zoomerang.com and it is thus difficult to provide the exact visual.

DEMOGRAPHIC DATA AS CHECK-BOXES

AT WHICH CAMPUS DO YOU WORK?

CCSF
CSM
EVC
SFSU
SJCC
SJSU

IN WHICH DEPARTMENT DO YOU WORK?

Biology
Chemistry
Computer Science
Elementary Education
Engineering
Geoscience
Mathematics
Physics
Secondary Education
Other: ________________

PARTICIPATION DATA

Were you a recipient of funding through MASTEP to develop or reform a course? Yes/No
If Yes, are those reforms still in place?
Yes/no
If No, why not?

Between 1996 and 2001, approximately how many MASTEP-sponsored Faculty Development Conferences or Events did you attend?
0 1 2 – 4 5 – 7 8 – 10 11 +

Was there any particular event that stands out as having been especially interesting or valuable to you?
Yes/No
If Yes: What was special about this event?

How strongly would you agree or disagree with the following statements:

As a result of MASTEP, I was stimulated to implement new approaches in my teaching.
Strongly Agree Agree Disagree Strongly Disagree

Participation in MASTEP Conferences or events motivated me to initiate or be involved in other activities related to teaching and learning in my discipline.
Strongly Agree Agree Disagree Strongly Disagree

FAMILIARITY/USE OF MASTEP GOALS

Please indicate how familiar you are with how the following practices could be applied in a college course and if you have utilized the practice yourself.

Active learning strategies

Unfamiliar	*Have heard the term*	*Somewhat familiar*	*Very familiar*	*Have utilized*	
1	**2**	**3**	**4**	***yes***	***no***

Cooperative learning

Unfamiliar	*Have heard the term*	*Somewhat familiar*	*Very familiar*	*Have utilized*	
1	**2**	**3**	**4**	***yes***	***no***

Diverse questioning strategies

Unfamiliar	*Have heard the term*	*Somewhat familiar*	*Very familiar*	*Have utilized*	
1	**2**	**3**	**4**	***yes***	***no***

Multi-media instructional tools

Unfamiliar	*Have heard the term*	*Somewhat familiar*	*Very familiar*	*Have utilized*	
1	**2**	**3**	**4**	***yes***	***no***

Alternative assessment

Unfamiliar	*Have heard the term*	*Somewhat familiar*	*Very familiar*	*Have utilized*	
1	**2**	**3**	**4**	***yes***	***no***

Problem solving/critical thinking

Unfamiliar	*Have heard the term*	*Somewhat familiar*	*Very familiar*	*Have utilized*	
1	**2**	**3**	**4**	***yes***	***no***

Please describe any new teaching approaches you have tried or implemented in your courses as a result of MASTEP?

Are there any other comments you would like to make in relation to MASTEP?

THANK YOU!

TO REGISTER FOR THE PDA DRAWING, PLEASE PROVIDE YOUR EMAIL ADDRESS

Appendix B: The Data Tables

Faculty survey results

MASTEP Faculty Follow-up Survey

Demographic Data

At which campus do you work?	N=50	%
CCSF	11	22%
CSM	8	16%
EVC	4	8%
SFSU	17	34%
SJCC	1	2%
SJSU	9	18%

In which department do you work?	N=50	%
Biology	8	16%
Chemistry	13	26%
Computer Science	0	0%
Elementary education	0	0%
Engineering	3	6%
Geosciences	3	6%
Mathematics	14	28%
Physics	5	10%
Secondary educationn	1	2%
Other: Nuclear Science, School of Sci/Math, Nursing, Special Ed	4	8%

Participation Data

Were you a recipient of funding through MASTEP to develop or reform a course?	N=50	%
Yes	18	36%
No	32	64%

Comments:

Actually my work on one type of reform led to application of a different type of reform I learned from MASTEP; I used the first as impetus for the second. These (use of problem based learning) are in place and I am improving and increasing their use in more classes. The original funding was for integrated science lab exercises--sounds unrelated but it really isn't, because the labs we designed had some beginnings of problem based learning.

YES -- but, for a variety of reasons we have not had the opportunity to offer those courses again

I didn't request funding because I already had a NSF grant for that purpose.

The reformed Arithmetic Review course is still in place. The TA training is not due to lack of funding and enrollment.

yes, institutionalized in the course

Course is no longer offered, but the content and pedagogy have been subsumed into another course.

Yes, We continue to use them in our organic lab courses.

Budget cut. New class not approved

Between 1996 and 2001, approximately how many MASTEP-sponsored Faculty Development Conferences or Events did you attend?	N=50	%
0	3	6%
1	11	22%
2 — 4	21	42%
5 — 7	5	10%
8 — 10	6	12%
11	4	8%

Was there any particular event that stands out as having been especially interesting or valuable to you?	N=47	%
YES*	22	47%
NO	25	53%

COMMENTS:

Workshop held with SFSU faculty and Exploratorium

The workshop on cooperative learning really got me started on re-thinking and getting serious about my approach to student learning; the interactions with other faculty were the most productive of all the events I attended, and the speakers were the most impressive, as I recall.

Web development

I am sorry but it was too long ago.

initial meetings when the program began. gave me an opportunity to meet the candidates and the faculty who were teaching in the program

Chance to meet other science faculty in the West Bay Area.

I took a summer course on how to build web pages for my courses. This was a very significant course that helped launch me into using the Internet to support the courses I teach and take a leadership role in applying the Internet toward the educational mission in our department.

Statistics discussions and presentations.

Getting different points of view on what should be in a math class.

The web tools/development workshop at SFSU (the only event I went to) was quite an eye-opener, and was run very well.

Sponsoring Edward Redish from Maryland Univ. talk at San Mateo. I've followed up on his ideas.

Cooperative learning workshops.

The hands on workshop that helped me to understand how to handle group problem solving in a large classroom.

Roger Johnson's first workshop on cooperative learning approaches was very useful (I gained enough information to initiate use of these methods and eventually gain reasonable competency) and also the problem based learning workshop (again for same reason). I have also used a good deal of the assessment workshop led by Gloria Rogers and wish I had captured more of this at the time. Other general statement: all workshops with examples of approaches in the sciences, given by science faculty who use them....this was so much more useful than the generalized college faculty type workshops. Working with colleagues, sharing information/approaches at the showcase events, gaining greater appreciation for community college environment and excellence of science faculty at these institutions

A meeting featuring Glen Seaborg, who spoke on K-12 standards.--it was good to have such a celebrity giving his opinions on the topic. A similar meeting with the head of the nat. acad. of sciences was similarly special.

I found the geology teacheer to be very helpful. But I could not tell you her name.

Have incorporated techniques learned in case studies workshop into a course I teach regularly

It was the event in the Santa Cruz mountains with the physics demo of musical instruments. It was spectacularn and memorable. It essentially changed my life and teaching

web-page design

I met faculty on my campus who were interested in teaching

Many of the events had valuable information but it is hard right now to remember individual events. The weekend meeting which also involved discussing possible projects was valuable since I met people that I worked with on a project. I think I learned something from practically every event I attended.

xcellent information from educational physics teaching - Johnson/Johnson small groups, Jigsaw technique, etc. Excellent! Changed my teaching forever

Being treated like a professional at every meeting.

The speaker was informed and entertaining, on cooperative learning.

I liked the hands-on workshops. The summer ones on web developemtn materials (at SFSU) were particularly useful for me.

How strongly would you agree or disagree with the following statements:	Strongly Agree	Agree	Disagree	Strongly Disagree
As a result of MASTEP, I was stimulated to implement new approaches in my teaching.	27% 3	51% 25	12% 6	10% 5
Participation in MASTEP Conferences or Events motivated me to initiate or be involved in other activities related to teaching and learning in my discipline.	24% 12	47% 23	18% 9	10% 5

FAMILIARITY/USE OF MASTEP GOALS

Please indicate how familiar you are with how the following practices could be applied in a college course	Unfamiliar	Have heard term	Somewhat familiar	Very Familiar
Active Learning Strategies	8% 4	8% 4	22% 11	61% 30
Cooperative Learning	6% 3	6% 3	38% 18	50% 24
Diverse Questioning Strategies	33% 16	19% 9	31% 15	17% 8
Multi-media Instructional Tools	4% 2	8% 4	45% 22	43% 21
Alternative Assessment	13% 6	23% 11	42% 20	23% 11
Problem Solving/Critical Thinking	2% 1	4% 2	23% 11	70% 33

Please describe any new teaching approaches you have tried or implemented in your courses as a result of MASTEP *41 responses*

Rethink how to phrase and ask questions both on exams and in the classroom.

gosh, the 1 meeting I went to was so long ago. I probably did use stuff from it, but can't recall exactly what.

Hands on activity in the laboratory

See #4: cooperative learning and problem based learning are the approaches I have introduced, and am continuing to work on and introduce, into my classes.

i really don't remember which i learned via MASTEP and which via other workshops I have attended.

Since becoming a dean, I have not taught any classes in the last four years.

Increased use of small-group learning.

'talk to your neihbor'classroom group problelm solving

None as a result of MASTEP.

I have encouraged students to work together to solve problems and have provided time during class for such group activities. Feedback is provided after they have had chance to work things out.

problem based learning

Short science term papers and student voted final exam character but not content.

Use of the Internet to provide course materials and aid in instruction.

None new to me, just refined ideas.

With funding (in part) from MASTEP, we implemented new discovery group project labs (non-verification; with data pooling of results)

Expanding our first course for majors to 4 untis so that they could spend more time working on problems in groups.

cooperating learning

Web-based resources, primarily outside of class time but occasionally within the lab setting.

Has given me some guidance in developing my CD. Most of my course instruction is now via the CD the students use each week on their home computers. Nearly every frame requires some type of response, which is recorded and they send to my web site each week wo I have a record of their performance. Class time is most spent on cooperative group problem solving on white boards, which I monitor, and lab activities.

Over the last seven years I have developed many new experiments and several new short courses. I try to incorporate active learning exercises into curriculum materials I have created for these courses.

Student centered learning, active learning in the lecture classroom; guided inquiry and discovery based learning in the laboratory

- cooperative learning- problem based learning (more formalized than what I did before)- group activities in 'lecture courses'- better at probing prior knowledge-designed specific interventions based on student misconceptions (some thoughts about this

web-based instruction; CPR writing exercises

Grading strategy of 5 pts per quiz.

implemented web-based and multimedia instruction into my courses

Greater use of computer-based instruction; use of case studies

Team teaching

none as a result of MASTEP

I have implemented active learning in my larger classes in attempt to build problem-solving skills. I have also encouraged cooperative learning as a way to leverage the learning process and build study groups.

multi-media through computer simulations

I implement cooperative and active leaaning strategies, but I would not say that these were a result of MASTEP

I am no longer teachhing and so have not had the opportunity to try out what I learned from MASTEP.

none as a result of MASTEP

I have tried the 5 min question -this was an approach that I had not heard of and found it useful and thinking about it has made me think more about my teaching.

I have used more cooperative learning in my courses; especially in the course developed with MASTEP funds.

work in groups on one problem - one member puts problem on blackboard, another member describes problem to classwork in groups to comeplely learn a homework problem. Then go to another group and explain it to them.write question on card - turn it in to meone-minute quiz on lecture. not graded used for feedback on what they picked up from lecture

Poster presentations. Class questions.

Use of more collaborative learning in my classes; follow up on the literature in the field, and more exploration of new assessment techniques.

Are there any other comments you would like to make in relation to MASTEP?

The interaction between the faculty at different levels has worked very well and that somehow needs to become routine between the faculty at all levels. Easier said than done.

I wish the program could continue. I miss the workshops.

I found the outcomes valuable, particularly Jon Celesia's efforts to establish a physics preparation course

MASTEP was an exceedingly well-organized program and very successful

As a result of MASTEP I was encouraged to branch out and develop a MUSE class. This is a GE class for first time frosh. In my case I blend literature with science. One of the main objectives of the class is to encourage students to think about the questions encountered--there are no 'correct' answers, only well-thought out or poorly developed answers.

Please note that I did not respond to questions 7 through 10 as I am not teaching in the classroom nor was I teaching at the time I participated in MASTEP.

very useful...should have more opportunities like this for junior faculty and lecturers....to interact and learn

Mastep influenced me to join the Eric Mazur web site at Harvard.

I have personally benefitted from MASTEP, and I suspect that many others have as well.

I was simultaneously invovled in NSF-funded projects for Systemic Reform in Chemistry; MASTEP was highly complementary

I am very grateful for the opportunity that it gave me.

We were given a Mac lap top, computer projector, and multimedia software, all of which I utilized to great advantage.

MASTEP's approach to aiding faculty disseminate their work is commendable.

The funding received by us from MASTEP was instrumental in getting us going on a very large scale curriculum change in General Chemistry that has benefitted a very large number of students.

miss seeing MASTEP colleagues at other institutions; program was a good experience, useful. I have much greater awareness of teacher preparation requirements and how these can be incorporated in educational goals for all students in the major. I am more mindful of modeling (for future teachers) and using (for all students) a variety of teaching / learning approaches in my classes

Its initial mission, to develop a pool of K-12 teachers trained in science in math, is being continued on our campus, particularly through the Child Development Dept in collaboration with sciencve and math depts.

Can we revive it?

I got to know more faculty in another college on my campus and this has had lasting and beneficial effects.

MASTEP provided a forum for interchange of ideas that has been leveraged and created a strong network of educators.

Even though I haven't had the chance to implement what I learned, it was a great experience for me and I have used what I learned in other settings

I think MASTEP has had little impact on our math dept. Those of us who were interested in implementing practices such as listed above were already doing so before MASTEP and have continued to do so but not because of MASTEP.

Overall, MASTEP was a positive experience. The chance to interact and discuss teaching with people from different disciplines and campuses was great.

Great program! One of the best uses of taxpayers money ever. The early lectures on science education were the best. Reporting on our projects was really good.

Thank you for MASTEP. It is the way educators should be treated. Every event I came away being glad I was an educator.

My involvement was minimal.

I believe participation in the program and workshops was extremely beneficial and reinvigorating for my approach to teaching. The connections with colleagues at other institutions in the MASTEP collaborative were also extremely fruitful.