

The principal activities of the MASTEP Project have been: A. Establishing the Collaboration between the Various Institutions, B. Establishment of Future Teacher Clubs, C. Recruitment of Future Teachers, D. Offering New Teacher Support Networks, E. Offering Teaching and Learning Conferences for Faculty, and F. Course Revisions at the College and University Levels.

A. Establishing the Collaboration between the Various Institutions:

The MASTEP Project has involved six institutions of higher learning (City College of San Francisco, College of San Mateo, Evergreen Valley College, San Francisco State University, San Jose City College, and San Jose State University), local school districts, informal educational institutions, government laboratories, and contributing industries. We successfully involved all of these partners in our project. Our Executive Advisory Board (i.e., Executive Advisory Committee) met once per month and consisted of representatives of all six institutions of higher learning plus K-12 representation. This Board was responsible for directing project activities.

Our teaching and learning conferences and course revision activities were directed by a Teaching and Learning Committee that consisted of representatives from each of our six college campuses, plus Dan Walker (MASTEP PI from SJSU), and Nan Carnal (T and L Component Director and MASTEP Co-PI from SFSU.)

Our New Teacher Support Networks at San Jose State and San Francisco State Universities were directed by teams consisting of university science and math educators, plus local mentor teachers or school district personnel. Our K-12 outreach and recruitment efforts, including the Sci/Math Clubs in our K-12 professional development schools, involved people from across the spectrum of institutions in our Collaborative.

Each K-12 professional development school consisted of a team of science and math teachers that contributed importantly by: 1. Acting as Resident Supervisors for our student teachers during the teaching practicum phase of our credential programs; 2. Accepting our undergraduate students preparing to later enter teaching so that they could observe and assist in K-12 classrooms as part of early field experiences; 3. Acting as consultants to college level faculty course revision/development teams; and 4. Sponsoring student "Sci/Math Clubs" at their school sites as part of our outreach and recruitment efforts designed to attract students into teaching and STEM careers.

We received significant, additional support for the project. In Year One Tandem and Digital Corporations donated substantial furniture for our two project offices as well as for two multimedia laboratories; Intel donated a state of the art multimedia laboratory worth about \$150,000 for San Jose State University; and Sega donated about \$65,000 to establish a similar laboratory for San Francisco State University.

In Year Two Adobe donated a site license to the entire project (colleges plus K-12 schools) for many of its multimedia software products (money value = \$71,824) plus \$30,000 in cash. Davis Instruments provided massive discounts on its electronic weather stations that were installed in our K-12 participating schools. Langan Instruments provided massive discounts on its air quality monitoring equipment that was also being used in our K-12 schools. Computer Recycling of Santa Rosa donated thirty PC's for use in our K-12 professional development schools. NSF awarded us \$100,000 to support Teaching Scholars (i.e., scholarships for talented future teachers) for the academic year (i.e., Year Two of the Project).

In Year Three NSF awarded us \$400K to support our Teaching Scholar's Program for four additional years. Intel Corp. awarded us \$40K, plus over forty used laptop computers to help support science projects by students in some of our high school Sci/Math Clubs. Intel also gave us a new network server for our multimedia computer lab. at SJSU. Smart Valley provided 24 high end PC's that were installed in twelve MASTEP K-12 schools where we introduced "multimedia" approaches and activities to support our Sci/Math Clubs.

In Year Four, Intel gave us \$25K to offer multimedia workshops for K-12 students from our participating MASTEP schools. Intel also funded replacement computers for the multimedia lab at San Jose State that bears Intel's name. Computer Recycling of Santa Clara County donated twelve refurbished Pentium computers that were connected to our network of electronic weather stations in the MASTEP K-12 schools. Some of our Community Colleges leveraged participation in MASTEP and funding from MASTEP to obtain additional outside funds. San Jose City College attracted \$24,680 in NSF funds as part the Adapt and Adopt Workshop Chemistry project. Building on other MASTEP funds and activities, City College also received \$14,786 from Hewlett Packard Foundation for additional computer equipment. The College of San Mateo received about \$40K in support from the Packard Foundation to augment MASTEP activities. The Community Colleges also reported that MASTEP activities led to additional support from within their system to expand course reform activities.

In Year Five, our four Community College campuses were especially successful at attracting additional grant monies that were spin-offs of previous MASTEP funding and projects. San Jose State continued to receive support from Intel Corp. to sponsor multimedia workshops for students and to provide support for middle and high school science projects.

Our informal educational institutions provided valuable experiences for our future and newly produced teachers. In San Jose, the Tech Museum of Innovation (a major interactive science museum) sponsored programs for our Future Teachers' Club at San Jose State University. Summer programs of study and/or internships (both paid positions) were made available for some of our students by Lawrence Livermore National Laboratory and NASA-Ames Research Center, among others. Two of our largest school districts, San Jose Unified School District and East Side Union High School District, hired many of our students to serve as math or science tutors/aids as they expanded their own reform efforts. The Exploratorium (an interactive science museum) in San Francisco has partnered with San Francisco State University to co-sponsor science teacher preparation activities and share responsibility for the New Teacher Support Network begun by MASTEP at SFSU.

B. Establishment of Future Teacher Clubs:

All six of our college level campuses (i.e., two universities and four community colleges) created a Future Teachers' Club of some kind, although one of our Community College campuses inactivated its Club in Year Four because they had created courses for future teachers that served to network the students. The combined membership of future math and science teachers across the six Clubs was over three hundred by the end of the grant period. The Clubs continue to meet about every two weeks, and the operation of the clubs primarily is in the hands of the students themselves, but with the assistance and guidance of faculty sponsors. The clubs are officially chartered activities on each of the campuses. Club activities have included tutoring activities, guest speakers, visits to schools to assist the K-12 Sci/Math Clubs, and visits to other locations such as informal educational institutions. At our two universities, the clubs are focused on future science and math teachers only, both secondary level and elementary level specialists. At the community colleges, where fewer students have yet chosen to enter teaching, the clubs are configured differently. Some clubs are for teachers of all subject levels, while others are tied with a general Science/Math Club. The clubs have been excellent conduits for us to provide

advising opportunities, tutoring, and to notify the students of relevant educational opportunities, such as, the summer positions and various teacher aide and tutoring possibilities.

Our outside evaluators from West Ed in San Francisco have interviewed and surveyed both the faculty sponsors and selected students in these Clubs. They reported in the Year Three report that some Club sites were challenged by irregular attendance by students, who sometimes have scheduling conflicts from coursework or from work responsibilities. But, they also reported that, “Club members we interviewed were enthusiastic about the Future Teacher Clubs and expressed strong interest in continued participation, if their schedules allowed. At the very least, the clubs provided a sense of community that enhances the student experience. Students reported a greater appreciation for teachers and teaching.”

C. Recruitment of Future Teachers:

In addition to our recruiting efforts through our K-12 Sci/Math Clubs and activities and through our Future Teacher Clubs, we have recruited in college classes and using our MESA and AMP partnerships. We have had a program of presentations in college level science and math courses using a team of outstanding local K-12 teachers. This team presented a dynamic mini-lesson of inquiry-based instruction using magic tricks to capture students’ attentions, followed by career information on becoming a science or math teacher. Interested students filled out a brief survey of interest so we could contact them and invite them to a Future Teacher Club meeting to obtain additional information. The presentations have targeted the introductory level courses in order to attract undergraduates early in their college careers. Noteworthy is that about 50% of the students who have been attracted have been from underrepresented groups, an important target audience in our project (data presented as part of the CETP Data Collection System available online.)

The AMP (Alliance for Minority Participation) Chapters at both SJSU and SFSU have cooperated with us by distributing information on teaching careers and directing interested students to us and into our Future Teacher Clubs.

Currently, and for many years into the past, most (75-80%) of the students entering our credential programs to become science or math teachers have been “re-entry students,” i.e., students who already have earned a degree in science or math and who have served in other jobs before returning to become a teacher. Because our region has experienced a severe shortage of

qualified science and math teachers, we enhanced our recruitment efforts to attract more re-entry students at the same time that we were bolstering the pipeline for undergraduates to pursue teaching careers.

D. New Teacher Support Networks:

Both San Jose State and San Francisco State Universities put into place a network to support our new teachers once they had a permanent job. As mentioned earlier, SFSU is now partnering with the Exploratorium in San Francisco to provide New Teacher Support activities.

Our San Jose State team established a once per semester weekend, residential retreat to further bond the participants into the networks. In Fall Semesters we have been taking about forty members of the SJSU and SFSU networks on a flotilla of houseboats that cruise throughout the Sacramento Delta region of Central California to focus on science and math activities. The trips have been monstrous successes based on our assessment survey of the attendees. In Spring Semesters, our residential retreat is at the Point Reyes National Seashore along the coastline north of San Francisco, in an old Coast Guard Lifeboat Station that has been converted into a small conference center. The days are spent doing science and math activities appropriate to the coastal environment.

We have partial electronic networks of our new teachers in place, and we are continuing to expand these features in terms of adding the additional participants and providing more services electronically. The MASTEP website at SJSU (mastep.sjsu.edu) also has a “room” that consists of interesting lesson plans submitted by the network members, plus, we provide links to useful sites for educational resources that can be used by our teachers.

Our outside evaluators from West Ed in San Francisco have monitored our New Teacher Support Networks through review of reports, interviews with NTSN sponsors, as well as interviews and surveys conducted with NTSN participants. They reported in the Year Three report that, “. . . at the end of the 1997-98 academic year it appeared that both campuses were on the right track toward providing new teachers assistance, professional development, and support that may encourage them to continue teaching. Nearly all novice teachers surveyed reported that they *agree* or *strongly agree* that they would like to participate in more NTSN activities. And, more importantly, all 22 new teachers surveyed reported that they planned to continue teaching the next year.” Based in part on this feedback, the MASTEP leadership at San Jose State

University embarked on a project to determine the rate of retention in secondary science classrooms of MASTEP educated science teachers. Our 2001 results (based on a 95% return rate) indicated that 92% of the new science teachers have remained in teaching (1996-2001 graduates).

In the Year Four Evaluation Report by our evaluators, an important conclusion was, “New K-12 teachers of mathematics and science report feeling fairly well or very well prepared to implement reformed practices.” The assessment also suggested that these new teachers could benefit from additional training in the use of alternative assessment strategies and computer-related approaches. We enhanced our offerings in both areas subsequently.

E. Teaching and Learning Conferences for Faculty:

The Teaching and Learning (T and L) Committee was responsible for designing MASTEP's faculty development program, soliciting proposals for course/curriculum development and revision, and for reviewing and recommending proposals for funding.

Faculty Development:

The focus of MASTEP's faculty development workshop program was to enhance faculty teaching with the dual overall goals of improving student learning and modeling effective instructional methods in science/math courses, particularly for those students who were future K-12 teachers.

A primary focus of our project activities in our first few years was conferences for university/college faculty to explore new approaches to teaching and learning. In Year One, we had five major conferences, one each addressing:

Cooperative group learning

Connecting faculty across our six campuses and K-12

Inquiry-based and open-ended problem solving modes of instruction

Classroom Assessment & Research

Technology Assisted Instruction.

A total of over 300 faculty, including several K-12 teachers, attended these conferences. Many attendees reported to us that they immediately began to incorporate these new approaches into their teaching. The conferences were evaluated using participant survey feedback. The first two workshops (the initial networking and kickoff conference and the cooperative group learning

workshop) were given extremely high ratings by the participants. Our lead evaluator summarized the faculty feedback as “they thought they had died and gone to heaven.” Also, we offered workshops on the Use of Multimedia Technologies in Instruction in Summer, 1997, both at San Jose State and San Francisco State Universities

During Year Two (1997-8), we continued offering workshops to introduce and reinforce new pedagogical approaches to college teaching. The four workshops were:

Collaborative Learning Part II

Technology as a Teaching Partner

Literacy in Science, Math and Technology (AAAS Project 2061 presentation)

Assessment and Evaluation

To end the academic year, we sponsored our first MASTEP Project Showcase where our faculty who had conducted projects during Year One presented their work in concurrent sessions. During Summer, 1998, we again offered a series of multimedia workshops for both college and K-12 teachers.

A survey conducted by the T & L Committee early in Year Three indicated that workshops would likely attract greater participation if they were discipline-based, closer to home campuses, and not scheduled as day-long Saturday events. The T and L Committee also felt that this approach, coupled with the reputation of MASTEP events, would attract "second tier" faculty to workshops, especially those who could be enticed by a more direct application of workshop topics to their subject matter or those who were unable to commit entire days or Saturdays to attend faculty development activities. MASTEP's 1998-99, 1999-00, and 2000-01 workshop series were designed to accommodate these recommendations. We were pleased that many second tier faculty attended these more focused and locally offered workshops, and that this attendance appeared to have energized additional faculty to begin reform approaches. During these same years, we interacted extensively with the other CETP projects based in California (located in Los Angeles, Fresno, Long Beach, and Sacramento).

In Year Three (1998-9), our Program focused on the smaller, discipline-based workshops. The workshop series included 5 workshops. Four of the workshops were offered twice, on Friday afternoons and Saturday mornings, with each workshop hosted by a north-Bay and a south-Bay MASTEP campus. The last workshop (geoscience

emphasis) was hosted only once, on a Friday afternoon, since geoscience consultants indicated Saturdays for many were committed to field trips. Workshop topics and presenters were:

Teaching Calculus: Issues and Possibilities, Deborah Hughes Hallett, U. Ariz.

Computer Simulations for Teaching Genetics and Evolution: BioQUEST Curriculum Modules, Patti Soderberg and Sam Donovan, Beloit College (Wis.)

Bridging Gaps in Teaching and Learning: (Developing and Using Tutorials to Teach Physics), Lillian McDermott and Paula Heron, Univ. of Washington

Biomolecule Visualization using RASMOL and CHIME, Eric Martz, Univ. of Mass.

Strategies for Engaging Students and Assessing Work in Non-Traditional Classrooms, Barbara Tewksbury. (Geology), Hamilton College (N.Y.)

The format of the workshops and proximity to home campuses proved successful in attracting "second tier" faculty to this faculty development series. A total of 161 faculty participated in various workshops. Of these 55 (i.e. 34%) were faculty who had not previously attended a MASTEP workshop

In Spring Semester, we sponsored a Showcase Conference, at which our colleagues from LACTE (the Los Angeles Collaborative) participated as well. Because three other California State University campuses (Fresno, Long Beach, and Sacramento) were becoming active in NSF Teacher Preparation activities, we invited representatives from these campuses to attend this event as well, which they did. As in past summers, we again offered multimedia training for both college level and K-12 level teachers.

In Year Four (1999-00), the year's activities mirrored those from the previous year where we concentrated on discipline-based workshops to attract second tier faculty. We hosted subject specific workshops at selected campuses. The sponsored workshops were:

Teaching Math and Science Effectively

Developing Inquiry-based Laboratory Activities

Problem-based Learning

Assessment

Multimedia Technologies

As in the last few years, we continued to interact with the other CETP projects based in California (located in Los Angeles, Fresno, Long Beach, and Sacramento).

In Year Five (2000-01), our budget for presenting workshops was nearly depleted, and we were able to sponsor only a single MASTEP Showcase to allow our most recently funded faculty to present their projects. Attendance at the one day Showcase was good, and most of the attendees expressed regret that our workshop activities were finally coming to an end. Note that we received permission from NSF to continue some activities through a Year Six, but we had no funds to sponsor workshops or showcases in Year Six.

F. Course Revisions Completed:

Faculty Awards Process

MASTEP devoted approximately 40% of its budget to support faculty projects to develop or revise courses. Faculty awards were made through a competitive process, established in year one and modified in year two and again in year three. Assessment of project needs, feedback from T and L Committee members and WestEd evaluators, and analysis of proposals and reports from prior years, were considered as the proposal criteria for each funding cycle.

Our general awards procedure was: Education, science, engineering, and mathematics faculty at all six campuses received an announcement of the Request for Proposals. Full proposal guidelines were obtained from the Campus T and L Committee representative and from other designated sites on each campus (Math/Science Division Offices for Community Colleges, and Department and/or MASTEP Offices for CSU campuses). Members of the T and L Committee received copies of all submitted proposals for independent review and rating (based on RFP criteria and required supplements) prior to meeting as a group to determine which proposals were

recommended for funding. The project leader for any proposal that was recommended for funding was notified of the pending award, and any clarification or additional information needed by the Committee was requested. Project leaders for proposals not recommended for funding received specific feedback on areas for improvement. Following receipt of responses from team leaders for recommended projects, letters detailing the award were sent to the team leader and the department chair/dean for each project member. The award period was for the summer and/or the academic year. The SFSU MASTEP Office had the primary role in all aspects of this process, except budget preparation for each campus.

In Year One (1996-7) of our project, we targeted courses in our science and mathematics credential programs. The faculty who teach in these courses were well versed in teaching methodologies and were in a position to revise key courses that all future secondary science and math teachers took. The following courses were revised to incorporate recent State of California standards that relate to a new teacher's ability to teach English learners. The SF Bay Area is rich in immigrants, and about 30% of K-12 students are assigned to science or math classes that integrate English language acquisition along with the content instruction:

Courses at San Jose State University:

Methods of Teaching Secondary School Science- required of all secondary science teachers.

Methods of Teaching Secondary School Math- required of all secondary math teachers.

Socio-humanistic Foundations of Secondary Education- required of all secondary teachers, including in science and math.

Evaluation- required of all secondary teachers, including in science and math.

Calculus workshops: San Jose State was the only one of our six cooperating campuses that had not adopted the Harvard Calculus approach. During Year One, Dr. Bem Cayco offered a series of workshops to the math faculty on how to implement the new approach.

Courses at San Francisco State University:

Methods of Teaching Secondary School Science- required of all secondary science teachers.

Methods of Teaching Secondary School Math- required of all secondary math teachers.

Multi-campus Effort:

Mathematics courses for future elementary school teachers at San Jose State University, San Jose City College, and Evergreen Valley College:

In Year Two of our Project, we supported revision of the following courses. Note that almost all efforts were collaborations across at least two of our campuses, and most across at least three campuses:

Revision of introductory physics courses across all six of our campuses, with an emphasis on the use of collaborative learning groups and open-ended, problem-solving approaches.

Introductory and Organic Chemistry at San Jose State University.

Introductory Biology laboratories at San Francisco State University: Incorporation of collaborative learning and problem-solving laboratories into the introductory level biology courses for biology majors.

Oceanography: a technology-assisted course taken by many future science teachers at San Jose State and San Francisco State Universities, including oceanography resources on the Internet for use by college and pre-college teachers.

Introductory level Biology for future elementary school teachers: San Jose State University together with the College of San Mateo and K-12 advisors developed “technology-assisted” modules of study that were incorporated into the General Education courses taken by future elementary school teachers. This effort emphasized instructional approaches that addressed different student learning styles, while incorporating computer-assisted instruction in order to model the use of emerging technologies for instruction.

Mathematics courses for future elementary school teachers at San Jose State University, San Jose City College, and Evergreen Valley College (i.e., the Southern Region campuses). This project continued from its beginnings in Year One.

In Year Three, the T and L Committee funded 9 of 14 proposals submitted for a total of \$287,000.. Twenty-eight faculty and over 14 school district personnel were involved in these projects. The courses were:

Revision of Genetics Laboratories in Introductory Major’s Biology (SFSU and CCSF).

Introductory level Biology for future elementary school teachers: SJSU together with the CSM and K-12 advisors continued to develop “technology-assisted” modules of study that were incorporated into the General Education courses taken by future elementary school teachers. 2nd year of funding for this project.

Geological Excursions for Prospective Teachers (SFSU).

Science Capstone Course for Future Science Teachers (SFSU).

Learning and Teaching in Partnership, courses and field experiences for future elementary and middle school math teachers (SFSU).

Capstone Courses for Secondary Math Teachers (SJSU).

Revision of introductory physics courses across multiple campuses, with an emphasis on the use of collaborative learning groups and open-ended, problem-solving approaches (CSM, CCSF, and SFSU). 2nd year of funding for this project.

Multimedia Approaches for K-12 Science Teachers (SJSU).

Mathematics courses for future elementary school teachers (SJSU, EVC, and SJCC).

Additional year of funding for this project.

In Year Four, the T & L committee received 23 proposals and recommended funding for 16 of these. These projects were subsequently funded; total budget allocated was about \$285,000. Funded projects involved 44 MASTEP campus faculty, at least 11 school district personnel and three other consultants. Courses were:

Building a New Integrated Core Biology Sequence (EVC and SJCC)

Expansion of Inquiry Methodology to College of San Mateo (Biology) (CSM)

Integrative Science in the Outdoor Classroom (SJSU)

Biology 101: Finalizing Reform (SFSU)

Getting Majors Biology Students into K-12 Classrooms to Teach Investigative Science (CCSF)

Comprehensive Project to Enhance Chemistry Instruction at CCSF (CCSF)

Molecular Modeling in a PC Environment (Extension) (SFSU)

Restructuring the First Two Year's Chemistry Curriculum (SFSU)

Preparing Future Science Teachers Through Workshop Chemistry at San Jose City College (SJCC)

GC/MS Studies and Revamping General Chemistry Laboratories (EVC)

Writing Discovery-Based Lab Experiments in Chemistry (SJCC)

Integrating Geology, Oceanography and Meteorology: The SF Bay Area (SFSU)

Active Learning in Physics Classrooms (CCSF and CSM)

Building a Teaching Experience for Prospective Teachers (Math) (CSM)

Partnership in Learning and Teaching, Phase II (Math) (SFSU and SFUSD)

Inclusive Teaching for Science and Mathematics Educators (SFSU)

Course Revisions During Years Five-Six: In our original proposal, we planned to fund no new revisions during Year Five. However, due to cost savings that we realized over the five year period, we discovered midway in Year Five that we could fund one more course development effort. During the previous year, the State of California had released new standards for the content education of future elementary school teachers. The coverage of the geosciences, in particular, was expanded, plus courses needed to incorporate more of an “integrated” science approach.. To comply with these new science standards required the revision of some existing courses plus the development of a few new courses on selected campuses. The new courses contained more of the “integrated science” focus. This course development effort was planned in Spring, 2001, and began in early Summer, 2001. However, most of the faculty to be involved could not complete their efforts until Academic Year 2001-02 because of previous commitments. The NSF granted us an extension of our award until December, 2002, in order to complete these last course revisions/developments. The courses impacted were:

At San Francisco State University: Geol/Metr 309 (Investigating Land, Air and Sea Interactions); plus Biol 310 (Biology for Today’s World).

At the College of San Mateo: Biol 110 (General Principles of Biology).

At San Jose State University: Biol 21 (Human Biology); Chem/Phys 35 (Introduction to Physical Science), and Sci 110 (Global Themes of Science).