MATHEMATICS AND SCIENCE
TEACHER INITIATIVE

PROGRESS REPORT

TO THE LEGISLATURE
AND GOVERNOR

CALIFORNIA STATE UNIVERSITY

CHANCELLOR’S OFFICE

APRIL 1, 2007
The California State University Mathematics and Science Teacher Initiative

Background

California's schools are experiencing a critical need for more fully qualified mathematics and science teachers. In turn, the state's industries face a significant need for a workforce prepared with science, mathematics, and technology skills essential to retain California's economic competitiveness. Creating a foundation for a scientifically and technologically literate workforce begins with developing highly qualified mathematics and science teachers.

The need for new math and science teachers in California in the next ten years is projected to exceed 33,000. Because the current demand for credentialed math and science teachers is far greater than the pool of teachers credentialed in these fields, many students in the state are taught by unqualified teachers. This is a significant problem, particularly because students who do not have qualified math and science teachers demonstrate lower achievement gains than those whose teachers are qualified in these fields.

Overall in California, at least 20% of mathematics teachers and one-third of physical science teachers are either assigned out-of-field or not credentialed in the field they are teaching. Students in high poverty schools in the State are far more likely to have a teacher who does not have a credential in mathematics or science than students in low poverty schools.

Intern teachers have been and continue to be distributed unevenly, with approximately 85% assigned to high poverty, high minority schools. The U.S. Department of Education has indicated that it is taking very seriously the requirement for states to meet highly qualified teacher requirements under No Child Left Behind. States are required to ensure that poor and minority children are not disproportionately taught by unqualified teachers.

The California State University (CSU) is the largest producer of mathematics and science teachers in California, preparing approximately one-half of the teachers in these fields. In 2004, the Governor called on the state's two public university systems to develop programs to prepare significantly more teachers in these critical areas. The CSU made a commitment to double its annual production of math and science teachers over a five-year period. This was a commitment to increase from a baseline of 750 to a figure of approximately 1,500 new teachers produced in these fields by 2009-2010.

CSU Mathematics and Science Teacher Initiative

CSU's Mathematics and Science Teacher Initiative began in 2004-05 with a planning process involving all of its 23 campuses. Each campus designed its approaches based on the strengths of that campus along with the needs and opportunities in the region. A seven-part action plan was developed that is focused on meeting "one goal through diverse pathways." Each campus has a specific action plan that includes a numerical goal for increased credential production and strategies for reaching the goal.

The campus approaches are integrated within a CSU systemwide program that includes the seven comprehensive strategies for implementing the initiative. The evidence from earlier efforts in math and science teacher preparation indicates that there is not one simple solution to increasing production. There are multiple obstacles to increasing recruitment and production and these need to be addressed through a multi-faceted approach.
The CSU approach includes recruitment of new students into the teaching field, financial support to assist in credential completion, increasing credential production through new approaches that expand credential pathways, community college program alignment, online preparation, and flexible programs for career changers. A primary goal is to identify the most successful approaches to replicate and scale up across the state.

**Component #1. Comprehensive Recruitment Aimed at Expanding and Diversifying the Pool of Candidates**

**Objective:** To significantly expand recruitment of new mathematics and science teacher candidates.

**Programs:** Comprehensive, sustained, and innovative recruitment and marketing initiatives.

The first component of CSU’s approach is directed toward substantially expanding and diversifying the pool of qualified candidates for math and science teaching. It is a broadly-based recruitment effort targeted to college students and recent graduates, community college and high school students, mid-career and pre-retirement professionals, recent retirees, and existing teachers with the potential to change teaching fields.

Campuses are using a wide range of print and electronic tools for comprehensive and innovative marketing and recruitment approaches employing a variety of media. The CSU Teacher Recruitment Projects are offering outreach, workshops, advising, test preparation, and textbook stipends to assist students.

**Component #2. Creation of New Credential Pathways**

**Objective:** To establish multiple new pathways to mathematics and science teaching credentials.

**Programs:** A broad range of new programs beginning at the freshman level and continuing through fast-track post-baccalaureate options.

A central part of the CSU strategy to expand math and science teacher production is the creation of new credential pathways. The purpose is to establish multiple points of entry into these fields for individuals at different educational and career stages.

New pathways include options that provide added opportunities for becoming credentialed in these fields. They include, for example, (1) the new Foundational Level math credential for middle school teachers and (2) blended programs for undergraduates in which an academic major and teacher preparation are integrated in an articulated program of study.

Several campuses are planning new pathways that will enable professionals in math and science-based fields to transition to careers in math and science teaching—including efficient, fast-track paths to the state’s recently established specialized science credentials. Other approaches are focused on assisting credential candidates initially enrolled in different teaching fields and current teachers in other fields to obtain a teaching authorization in math or science.
Component #3. Internet-Supported Delivery of Instruction

Objective: To create systemwide, Internet-supported math and science credential preparation resources.

Program: A new online-delivered teacher preparation program in mathematics and science.

To accommodate the needs of diversified pools of candidates, flexible preparation options are needed. Anytime, anyplace instruction is particularly advantageous for candidates who are career changers and currently fully employed. Learning from the infrastructure created for CalStateTEACH (the CSU statewide site-based and online credentialing program), CSU’s initiative includes development of Internet-supported instruction to be available to candidates and programs statewide. Cal Poly San Luis Obispo is leading the development of this effort.

Component #4. Collaboration With Community Colleges

Objective: To implement integrated 2-year/4-year math and science credential preparation programs with California’s community colleges.

Programs: Partnerships with community colleges that align lower division and upper division math and science teacher preparation and institutionalize early recruitment and academic advising in these fields.

California’s community colleges represent one of the largest potential recruitment pools of future math and science teachers in the state. A central component of campus plans is collaboration with community colleges in integrated 2-year to 4-year programs that provide a continuous and seamless sequence of preparation for math and science teaching. CSU campuses are working with their regional feeder community colleges to establish fully aligned programs. The Chancellor’s Offices of the CSU and of the California Community College have entered into a Memorandum of Understanding that identifies the system-level strategies to be implemented in support of 2-year to 4-year aligned pathways.

Component #5. Financial Support and Incentives

Objective: To provide financial support for new math and science teachers through the full array of available fiscal mechanisms.

Programs: Scholarships, loan assumption programs, paid tutoring, salaried school district internships.

An important component of CSU's strategies—one essential for its success—is having sufficient support for candidates through scholarships and loan assumption/cancellation programs, paid tutoring, and salaried internship opportunities that will make teacher preparation financially attainable and attractive for college students of all backgrounds. This is particularly important because students from underrepresented groups, those most often in need of financial assistance, must increasingly be a substantial part of the math and science teacher work force. Expanding their participation within these teaching fields is a central component of CSU’s current and long-term strategy.
A major effort has been undertaken by CSU to foster maximum utilization of California’s Assumption Program of Loans for Education (APLE). Research indicates that loan debt deters students—even those having a keen desire to teach—from choosing teaching as a career due to the students’ concerns about being able to pay back loans on the moderate salary of a beginning teacher.

Significant outreach efforts have been undertaken and a dedicated CSU APLE site on the World Wide Web has been established to ensure that all CSU students know of APLE and can easily access it. This state program for future teachers provides up to $19,000 of loan forgiveness for new math and science teachers. As a result of this broadly-based outreach effort, CSU campuses have allocated more than $50 million in loan cancellation awards in the past year, enabling more than 4,000 students to enter the teaching profession in math, science, and other fields with greatly reduced student debt.

On a number of CSU campuses, paid tutoring is being integrated with math and science teacher recruitment. Research shows that the desire to assist others is a primary factor in recruitment into math and science teaching. The opportunity for undergraduates to work with K-12 students as tutors in math and science not only assists them financially; it also enhances the quality of their preparation as new teachers in these fields.

An additional approach for providing financial support to candidates is through paid internships in lieu of student teaching. These internships are typically followed by full-time teaching positions in the same school or school district. Immediately serving as a full-time teacher is by no means optimal preparation. Nevertheless, CSU campuses meet the pressing needs of school districts by enabling math and science candidates to serve as paid interns. The campuses provide significant support for teacher candidates in intern positions in order to ensure that they have the kind of guidance and assistance they need to be successful.

**Component #6. Partnerships with Business, Industry, and Federal Laboratories**

**Objective:** To develop and institutionalize partnerships that enhance the attractiveness of teaching careers in math and science.

**Programs:** Partnerships with business, industry, and federal laboratories enriching math and science teachers’ career opportunities.

Long-term success in increasing production and retention of math and science teachers can best be achieved through a strategy that includes the active participation of corporate leaders and partnerships with federal laboratories. Corporate leaders can assist in bringing about fundamental changes in the societal value accorded math and science teaching, and federal laboratories can help to increase the attractiveness of careers in these fields.

Business and industry involvement often includes scholarships for future math and science teachers. The CSU system has a longstanding partnership with the Boeing Foundation, for example, through which scholarships have been provided to future math and science teachers. Federal Department of Energy Labs in California have for several years provided opportunities for paid summer laboratory experiences for CSU teacher candidates and graduates, and plans are under development to expand these opportunities. In collaboration with education programs at the Jet Propulsion Laboratory (JPL), CSU established the CSU-NASA partnership several years ago. It enables CSU campuses to connect with the nation’s most advanced applications of technology as they prepare future math and science teachers.
Component #7. Supporting and Evaluating Promising Approaches Having Scale-Up Potential

Objective: To identify successful recruitment and preparation approaches with potential for expansion at other campuses.

Programs: Implementation and examination of a range of different expansion approaches.

The CSU strategy is a carefully planned effort aimed at identifying and scaling up especially promising approaches for preparing well-qualified math and science teachers. Priority is being placed on identifying and examining effective strategies for increasing credential production having clear potential for replication at multiple campuses. Data on the quality and effectiveness of different approaches is being collected as a central part of the initiative.

An example is seen in the approach being taken as campuses implement the new Foundational Level math credential, which requires less disciplinary preparation in math than is required for the regular math credential. It is designed particularly for middle school math instruction, a field in which a very large shortage of qualified teachers exists in California and nationally.

There is a need for middle school teachers with the new math credential in all regions of the state, and CSU campuses are testing a range of promising approaches preparing individuals to earn it. Data on the quality of preparation of the new math teachers are being collected that will allow for an assessment of the various approaches that are being implemented.


Math and Science Teacher Production Growth

Results to date indicate that CSU's initiative is on course for achieving intended outcomes. Since launching of the initiative two-and-a-half years ago, credential production has increased 37.8%, from 767 to 1,057. It increased 63.9% in mathematics and 15.8% in the sciences, and it is projected that increases will continue at the level needed to double credential production.

Tables 1, 2A, and 2B on the next page demonstrate the increase in production that has been achieved by CSU to date. Table 1 demonstrates the overall increase between 2002-03 and 2005-06. The largest increase is attributable to growth from 349 to 572 in production of math credentials, although science credential production has also increased, from 419 to 485. In the sciences, increases have occurred in the severest shortage fields, with a gain of 42% in the physical sciences (physics and chemistry), fields particularly in need of increased production.

Table 2A shows the increase in math in the regular credential and in the new Foundational Level Credential. Over three-quarters of the increase is attributable to growth in the Foundational Level credential. It allows an individual to teach in middle school and can be earned in a number of ways. One option is for an individual with another credential to pass specific subject matter examinations. CSU campuses have encouraged a range of individuals who have strong math backgrounds to consider earning the Foundational Level math credential. In the sciences, more than one-quarter of the increase has been in the newly authorized specialized credentials, which enable professionals to demonstrate subject matter expertise by passing specific examinations and achieve a credential through an efficient path. These patterns demonstrate the importance of taking advantage of new credential pathways.
Table 1
Total Mathematics and Science Teachers Awarded Credentials by CSU Campuses

<table>
<thead>
<tr>
<th>Mathematics and Science Credentials</th>
<th>2002-03</th>
<th>MSTI Began in 2003-04</th>
<th>2005-06</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>349</td>
<td>First Campus Projects</td>
<td>572</td>
<td>+37.6%</td>
</tr>
<tr>
<td>Science</td>
<td>419</td>
<td>Were Begun In 2005</td>
<td>485</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>768</td>
<td></td>
<td>1057</td>
<td></td>
</tr>
</tbody>
</table>

Table 2A
Total Mathematics Teachers Awarded Credentials by CSU Campuses

<table>
<thead>
<tr>
<th>Mathematics: Regular and Foundational Level Credentials</th>
<th>2002-03</th>
<th>MSTI Began in 2003-04</th>
<th>2005-06</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>349</td>
<td>Foundational Level Math Credential Awarded Beginning in 2003-04</td>
<td>402</td>
<td>+63.9%</td>
</tr>
<tr>
<td>Foundational Level</td>
<td>0</td>
<td></td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>349</td>
<td></td>
<td>572</td>
<td></td>
</tr>
</tbody>
</table>

Table 2B
Total Science Teachers Awarded Credentials by CSU Campuses

<table>
<thead>
<tr>
<th>Science: Credentials by Discipline</th>
<th>2002-03</th>
<th>MSTI Began in 2003-04</th>
<th>2005-06</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological</td>
<td>296</td>
<td></td>
<td>310</td>
<td>+15.8%</td>
</tr>
<tr>
<td>Chemistry</td>
<td>56</td>
<td></td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>Geosciences</td>
<td>37</td>
<td></td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Physics</td>
<td>30</td>
<td></td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>419</td>
<td></td>
<td>485</td>
<td></td>
</tr>
</tbody>
</table>
**CSU Teacher Recruitment Projects**

To sustain long-term growth, recruitment efforts are needed that significantly increase pools of credential candidates from all backgrounds. The CSU Teacher Recruitment Projects (TRPs) have been in existence since 1987 and seek to make California’s teaching workforce more inclusive.

The Chancellor’s Office provides support for each campus for its TRP. Normally, the TRPs play an important role enhancing recruitment in all credential programs. In order to support the Math and Science Teacher Initiative, TRPs were asked to focus their efforts beginning in 2005-06 on recruitment in these two fields.

TRP activities include workshops and information sessions, faculty advising, test preparation, early field experiences through service learning and tutoring, and stipends for textbooks and other educational expenses. More than 30% of the participants have been from low-income backgrounds and underrepresented groups. The TRP programs are helping to increase the participation of students from diverse backgrounds in the math and science teaching force, supporting the commitment of the CSU to this goal.

Attention is also being given by TRPs to recruitment of students from community colleges and on advising to ensure that these students experience aligned programs of 2-year/4-year study. While most individual served by TRPs are students, there is also an effort to include populations of current teachers, including substitutes, aides, and existing teachers who are interested in earning a second credential in math or science.

**Related Initiatives Addressing Teacher Supply**

CSU campuses have made significant efforts to raise scholarship funds to assist in recruitment. Last year, four CSU campuses were awarded the prestigious National Science Foundation (NSF) Robert Noyce Scholarship grant for mathematics and science teachers. This program has been a priority for CSU campuses, and a total of twelve campuses have now been awarded these NSF grants, with total funding of more than $5.25 million for campus multi-year scholarship programs. The Noyce scholarships provide $10,000 for each of two years to math, science, and engineering majors entering a credential program, and stipends of $10,000 to career changers from math and science professions.

Campuses have also sought federal funding for math and science teacher recruitment, preparation, and retention through the U.S. Department of Education Transition to Teaching program. Three CSU campuses were awarded large grants through this program in 2006, with total funding of more than $5.1 million for a five-year period. These projects target undergraduates majoring in math and science, career changers, and individuals who planned teaching careers in other fields but have backgrounds sufficient to enable them to qualify for a math or science credential.

Math and science teacher retention is one of the primary areas of concern in these federal programs and in the CSU initiative. Approximately 90% of CSU math and science credential graduates are found in the teaching force one year after earning their credential. Several CSU campuses host summer institutes for math and science teachers, and most will be including their new math and science graduates in these programs. The programs typically are accompanied by ongoing professional development during the school year and seek to enhance teacher retention through creating discipline-based communities of math and science teachers.
**Math and Science Teacher Quality: CSU Systemwide Annual Evaluation of Teacher Preparation**

The CSU annually conducts the largest and most extensive evaluation of the outcomes of its teacher education programs in the nation. The annual *CSU Systemwide Evaluation of Teacher Preparation* has been in place since 2001. It consists of a comprehensive outcome evaluation of interrelated components of teacher preparation that, taken together, provide a rich and detailed picture of program quality. It includes:

- Evaluations by the school site supervisors of CSU credential program graduates regarding their performance during their first year of teaching

- Ratings by CSU credential program graduates concerning their preparation in central areas of teaching at the end of their first year as a classroom teacher

As part of the evaluation, CSU invites the school-site supervisors (most of whom are principals) of its teaching graduates to answer a battery of evaluation questions. The CSU Center for Teacher Quality provides each supervisor with the name of the first-year teacher whose preparation is to be assessed by the supervisor. Supervisors can report the first-year teacher to be “well prepared”, “adequately prepared”, “somewhat prepared” or “not at all prepared” in each of many specific domains of teaching. A core set of questions has been included on the school site supervisor survey for six years, enabling CSU to see trends over time. To date, close to 10,000 school administrators have participated in this survey.

The second component of the evaluation captures the reflections and perceptions of CSU graduates on the quality and effectiveness of their preparation near the end of their first and third years of teaching. For the purpose of compiling reliable evidence about the effectiveness of all CSU credential programs, the CSU Center for Teacher Quality attempts to include all of the program graduates one and three years after they complete their preparation. Due to use of electronic databases to locate very large numbers of recent CSU graduates and high response rates, the findings of the evaluation are representative, accurately describe the preparation of each year’s “class” or “cohort” of newly prepared teachers, and can be used to study sub-sets, such as mathematics and science credential graduates.

More than 12,000 graduates of CSU programs have responded to the graduate survey since it was first administered in 2001. CSU graduates are asked to evaluate the quality, value, and effectiveness of their preparation. The survey for secondary teachers yields extensive evidence about preparation to teach the subject according to State Academic Content Standards, preparation to understand and teach adolescents, including at-risk students, preparation to foster problem-solving and student responsibility for learning, and several other critical dimensions of effective practice.

In order to undertake an analysis of quality issues in the preparation of math and science teachers, the data on these teachers available from the Systemwide Evaluation were analyzed. The results demonstrated that in most areas, the graduates of the CSU math and science teacher credential programs are rated as being well prepared by their supervisors. The graduates themselves report being well prepared for the central responsibilities of new teachers. Data continue to be collected and analyzed annually through the survey to assess quality of preparation, and this provides the opportunity to assess the Math and Science Teacher Initiative on an ongoing basis.
Table 3 on the following page presents quality indicators for central factors in single subject teaching for the new mathematics teachers prepared by CSU during the first six years of the survey. Because the evaluation data are collected one year after candidates graduate, it is too early to perform an evaluation solely on the new teachers prepared through the Math and Science Teacher Initiative. However, an analysis of the overall evaluation data for math and science teachers provides an indication of the quality of preparation of CSU credential graduates in these critical fields.

The data in Table 3 present the results of evaluations by the supervisors of the math and science credential graduates and by supervisors of CSU graduates in other credential fields. Supervisor evaluations of this nature have been shown to be sensitive to differences in new teacher effectiveness and are a valid indicator for use in this analysis of program quality.

On nine of the eleven central factors, the school site supervisors of the mathematics teacher credential graduates rate their performance to be very high. The findings include the following:

- 89% of supervisors rate the graduates as being well or adequately prepared to teach their primary subject according to State Academic Content Standards
- 88% rate the math graduates as being well or adequately prepared to use textbooks and other materials aligned with State Content Standards
- 83% rate the graduates as being well or adequately prepared to develop fair criteria for course grades and to explain these to student and parents
- 81% rate these new math teachers as being well or adequately prepared to establish expectations that are intellectually challenging for students
- 81% rate the CSU math teacher graduates as being well or adequately prepared to provide opportunities for students to develop advanced problem-solving skills
- 81% rate the graduates as being well or adequately prepared to help students realize the connections between math and life beyond school
- 81% rate the math graduates as being well or adequately prepared to communicate their course goals and requirements to students and their parents
- 78% rate the new math teachers as being well or adequately prepared to encourage and enable students to assume increasing responsibility for their learning.

The mathematics graduates of CSU credential programs are clearly considered by their supervisors to be well qualified to perform their responsibilities as new teachers. Many principals indicate that they are the best-prepared new mathematics teachers they hire.

The two areas in which the math teacher graduates are rated as being less prepared are in (a) contributing to students’ reading skills and (b) anticipating and addressing the needs of students who are at-risk of dropping out. In order to deal fully with these findings, both areas are being addressed by the CSU on a systemwide basis.