THE CALIFORNIA STATE UNIVERSITY
MATHEMATICS AND SCIENCE
TEACHER INITIATIVE

2009-10 REPORT:

MATHEMATICS AND SCIENCE TEACHERS
CREDENTIALED BY CALIFORNIA STATE UNIVERSITY CAMPUSES

EXPENDITURE OF PROGRAM FUNDS

JOB PLACEMENTS OF NEW TEACHERS

EFFECTIVE COMPONENTS AND BEST PRACTICES

CALIFORNIA STATE UNIVERSITY

CHANCELLOR’S OFFICE

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Background

The projected need for new mathematics and science teachers in California in the next ten years exceeds 33,000. The demand for mathematics and science teachers is far greater than the pool of teachers credentialed in these fields, and many students in the state continue to be taught by teachers who are under-prepared in these subjects. Students who do not have qualified mathematics and science teachers demonstrate lower achievement gains than those whose teachers are qualified in these fields.¹

The problem of an insufficient number of fully prepared teachers has continued in these two fields while dropping overall in California. The state’s institutions of higher education and school districts have worked hard to address the No Child Left Behind Act requirement that classroom teachers meet the state’s standards for highly qualified teachers. Still, in 2008-09, more than 10% of California’s high school mathematics, physical science and life science teachers were under-prepared in these subjects.² While the number of under-prepared teachers has declined across the state, these often struggling teachers continue to be disproportionately placed in the highest need schools. More than 200 schools in the state had 20% or more under-prepared teachers in 2008-09, mostly in urban areas, serving, on average, 87% students of color.³

The CSU Mathematics and Science Teacher Initiative

The California State University (CSU) is the largest producer of mathematics and science teachers in California, preparing close to one-half of the new 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. To address the significant need for additional mathematics and science teachers, Chancellor Charles B. Reed made a systemwide CSU commitment to double production of teachers in these fields from a baseline of approximately 750 in 2003 to a figure of 1,500 by 2010-11.

CSU began its Mathematics and Science Teacher Initiative in 2004-05 with a planning process involving all of its 23 campuses. Each campus designed expansion approaches based on its strengths along with the needs and opportunities in the region. A seven-part systemwide action plan was developed that was focused on meeting the goal of doubling annual preparation through diverse approaches building on campus and regional capacity. Each campus now develops an annual action plan with numerical goals for increased credential production and strategies for reaching these goals.

The campus approaches are integrated within the CSU systemwide initiative that includes the seven comprehensive strategies. The evidence from 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 must be addressed through a multi-faceted approach for sustained effectiveness.⁴

³ Ibid.
The CSU approach includes (1) recruitment of new students into the teaching field, (2) increasing production through new credential pathways, (3) financial support to attract outstanding candidates and to facilitate credential completion, (4) community college program alignment, (5) online resources and preparation, (6) partnerships with federal labs and industry, and (7) identification of the most successful approaches to replicate and scale up systemwide.

**CSU Mathematics and Science Teacher Initiative Reporting Requirements**

This report provides information on the CSU Mathematics and Science Teacher Initiative and its outcomes during 2008-09. It is in response to provisions of the 2009-10 Budget Act that continued an annual reporting requirement having four components:

1. annual number of mathematics and science teachers awarded credentials by each CSU campus beginning with the 2004-05 academic year (before the state first provided funding for the Initiative);

2. an expenditure plan on the use of the funds appropriated in this provision;

3. the effectiveness of the Initiative’s different components and activities, including an identification of best practices; and

4. the job placement of students who earn a mathematics or science teacher credential, including the location of the K-12 school of employment and whether it is in an urban, rural, or suburban setting.

**Number of Mathematics and Science Teachers Produced by CSU Campuses**

The increase in CSU production of mathematics and science teachers from the baseline year of 2003 to 2008-09 has been significant, an increase of 80%—from 768 to 1,367. The increase has been steady and sustained over the five year period since the initial planning and first funding for the CSU Mathematics and Science Teacher Initiative began in 2004-05. Systemwide data for 2008-09 and the previous five years for mathematics and science teacher credentials issued by CSU campuses are presented in Table 1 on page 10.

The increases have been large in all areas of mathematics and science. In mathematics, the increase was from 349 in the 2003 baseline year to 773 in 2008-09, an increase of 121%. This is attributable in part to the introduction of the Foundational Level Mathematics credential in 2004. This credential is designed to address the need for credentialled middle school mathematics teachers. CSU prepared 452 teachers with regular mathematics credentials in 2008-09 and 321 teachers with the Foundational Level Mathematics credential. Its preparation of mathematics teachers with regular credentials, who typically teach at the high school level, increased from 349 in 2003 to 452 in 2008-09.

The increase in production of science teachers from 2003 to 2008-09 was from 419 to 594, an increase of 42%. Within the sciences, the largest gains have been in the highest shortage fields. These include increases in chemistry of 130%, geosciences of 97%, and physics of 40%. Gains in biology, which is not a severe shortage area, have been 16%. CSU made a deliberate attempt to increase science teachers in the highest shortage areas through its Science Teacher and Researcher (STAR) program, described later in this report. A new Foundational Level General Science credential was established in California in 2009 for middle school science teachers; a substantial increase in science teacher credential production is expected as a result.
The credential production increases provide clear evidence of the impact of the state support for
the CSU Mathematics and Science Teacher Initiative. Campus data in Table 2 (page 11) for
2002-03 through 2008-09 show that 18 of the 22 CSU campuses that prepare math and science
teachers demonstrated substantial increases during the period. Those that did not are in regions
declining enrollments where even the demand for teachers, even in these fields, is not large.

Nine CSU campuses more than doubled their production of math and science teachers between
2003 and 2008-09; 11 campuses increased their yearly production in these fields by 25 or more
teachers. Examples of large increases include CSU Bakersfield, which grew from production of
29 to 88 between 2003 and 2007-08, CSU Dominguez Hills, which grew from 75 to 157, CSU
Long Beach, which grew from 42 to 135, and CSU Stanislaus, which grew from 13 to 72.

These increases are directly related to the state support provided for the CSU Mathematics and
Science Teacher Initiative and to the strategies implemented with these resources. In the case
of CSU Bakersfield, for example, funding has gone in large part to scholarships and has
included matching private sector support from the Chevron Corporation. In the case of CSU
Dominguez Hills, it has been used primarily to create new credential pathways and provide
financial support, including use of the funds as a match to obtain federal scholarships.

In the case of CSU Long Beach, the funding has been used for a comprehensive strategy that
focuses on recruitment from traditional and new pools of candidates. It includes a partnership
implemented with Cerritos College that focuses on recruitment and preparation of community
college transfers. In the case of CSU Stanislaus, funding has been used for innovative
recruitment approaches, including access to credential program for students from UC Merced,
and development of online credential courses and resources. Across the CSU system, new
strategies have been implemented that could not be initiated or continued without state support,
and they have resulted in major increases in mathematics and science teacher production.

The significance of these increases is underscored by the overall declines found statewide in
preparation of new teachers. In California, the total number of credentials awarded declined
42% between 2003-04 and 2007-08, from 27,150 to 19,084 teachers. The production of single
subject candidates declined by 22%, from 8,053 to 6,609 teachers. CSU experienced overall
declines, as did the other institutions of higher education. The continued growth in math and
science teacher production is directly attributable both to the continued demand for teachers in
these fields and to the financial support provided for the program in the Budget Act.

Expenditure of Funds Appropriated to Mathematics and Science Teacher Initiative

The 2009-10 State Budget appropriated $2.713 million for the CSU Mathematics and Science
Teacher Initiative. The expenditure plan adopted for these funds consisted of two primary
components, as described below.

• **Support provided for each of the 22 campuses preparing math and science teachers** to
  implement: (a) comprehensive recruitment efforts, (b) a range of credential pathways to
  increase math and science credential production—including innovative programs preparing
  candidates for the newly established Foundational Level General Science Credential, (c)
  financial support to candidates, and (d) programs aligned with community colleges: **$2,520,105.**

• **Statewide management and administration**, including activities aimed at: (a) acquiring
  external resources through matching federal funds to augment state funding, (b) developing
partnerships with federal science agencies, (c) monitoring program implementation and effectiveness, and (d) disseminating and scaling-up effective practices: $192,895.

In addition, funds were utilized for continued support of the CSU systemwide web-based MSTI Recruitment Toolkit (http://msti.fullerton.edu). This Toolkit contains a range of recruitment resources found to be effective by individual campuses and makes them accessible to all campuses. Continued work was also done planning online mathematics and science credential programs, which are expected to be ready to enroll students by 2010-11.

**Campus support funding** was, as in previous years, performance-based and reflected the increased production of math and science teachers by each campus. This approach has been used during the past three years in order to target resources on approaches and to campuses that show significant success in achieving the goal of doubling credential production.

Allocations to campuses ranged from $65,000 to $165,000, and individual campus amounts were based on (a) production increases the previous year, (b) increases achieved during the entire period of the systemwide initiative, and (c) total production during the previous year. In order to receive an allocation, each campus was required to submit a plan that included:

- credential production targets for the next two years
- action steps for increasing production of both mathematics and science teachers
- a detailed budget and budget justification for the allocation
- a progress report, including the identification of effective strategies and best practices.

Purposes for which the campus allocations are being used follow systemwide guidelines. There are strict limitations on uses for administration, faculty salaries, consultants, and travel in order to ensure that resources are targeted primarily to assisting students enter and complete credential preparation. Only activities that are directly related to math and science teacher recruitment and preparation can be supported, and the funds cannot be used to offset costs of instruction or student support that are part of ordinary campus academic programs. All budgets are reviewed thoroughly to ensure conformity with these requirements.

Primary budget items for which campuses use funds continued to include:

- scholarships to students to assist them in completing math or science credential pathways
- stipends to students who served as mathematics or science tutors in K-12 schools
- a dedicated project coordinator responsible for planning, coordination, and reporting
- recruitment efforts such as workshops, events, advising, and outreach materials
- faculty release time to plan and develop programs for new credential pathways
- support staff to advise and assist students about credential pathways and resources
- outreach, publicity, and assistance to students in applying for scholarships and other support
- coordination with community colleges and advising for community college students
- creation of online program resources and tools
- development and maintenance of project web sites
- assisting students with preparing for the California Subject Examination for Teachers (CSET).

Systemwide guidance regarding the use of Mathematics and Science Teacher Initiative funds is provided to ensure activities are undertaken that have significant promise for recruiting and preparing new math and science teachers. In addition, a primary feature of systemwide coordination is the strategic use of program funds to leverage federal and philanthropic funding.
An example of the leveraging strategy was the use of funds from the program to maximize the federal American Recovery and Reinvestment Act (ARRA) to California for mathematics and science teacher preparation. The ARRA included a $60 million appropriation to the National Science Foundation (NSF) for the Robert Noyce Scholarship program. The ARRA required a large campus match a significant new Noyce program providing fellowship support for combined credential-Master’s programs in math and science. Math and Science Teacher Initiative funds have been exceptionally important in leveraging these federal funds. This new Noyce fellowship program required a 50% match for NSF grants, and program funds, along with state marginal cost funds, are being utilized to meet the matching requirement, which campuses could not meet otherwise.

In part due to the use of Math and Science Teacher Initiative funds to meet required matches, a total of 19 NSF Robert Noyce awards were made to CSU campuses in 2008-09. Funding to CSU from this federal program, expanded under ARRA, was more than $16 million last year. The first year of Noyce scholarships have now been awarded to outstanding math and science majors having a GPA of 3.0 or above, who are planning a teaching career. Math and Science Teacher Initiative recruitment and NSF Noyce scholar recruitment are closely coordinated.

One component of NSF funding to campuses is support for undergraduate/credential scholarships. This program provides scholarships of up to $10,000 per year to future teachers during upper division and credential study. Total funding for this program was nearly $6,000,000 in 2008-09. Every CSU campus preparing teachers now has one of these highly prestigious NSF Robert Noyce math and science teacher scholarship programs.

Seven CSU campuses have also received NSF awards for new credential/Master’s degree fellowships for mathematics and science teachers. These programs provide a fellowship of $10,000 for a year for credential/Master’s degree study and a stipend of $10,000, accompanied by mentoring by an expert experienced teacher, during each of the first four years of teaching. Four additional campuses received planning grants for these credential/Master’s degree programs. Total funding for both was approximately $9,300,000. These programs require a continued match, and Mathematics and Science Teacher Initiative funds are the state support being used for meeting this CSU campus obligation during the three year period of the grants.

Two additional NSF awards were made to CSU campuses for the NSF Noyce programs. One was for an annual Western Regional Noyce Conference during each of the next three years that will bring the Noyce fellows on the campuses together. This is part of CSU’s strategy to create a community of outstanding new math and science teachers, to facilitate connections among these new teachers, and to foster their persistence in the teaching profession.

An additional NSF award was for the CSU Science Teacher and Researcher (STAR) Program. This program creates a distinguished dual teacher/researcher career pathway for science and math teachers. It is an innovative partnership between CSU and federal science agencies. It provides cutting edge research experiences for prospective and new teachers and encourages them to develop applications of these research experiences for their own classrooms. The program was begun in the summer of 2007 with 16 future CSU science teachers having summer research placements at the Lawrence Livermore National Laboratory in the San Francisco Bay Area and with support from the S.D. Bechtel, Jr. Foundation.

The STAR program includes a deliberate focus on connecting laboratory research with classroom teaching, and 77% of participants indicate that it increases their interest in becoming a science teacher. STAR was expanded in both 2008 and 2009 to include more students at
additional federal Department of Energy research laboratories and at NASA research centers, with support from the Bechtel and Fluor Foundations. In 2009, NSF awarded a $737,000 grant to California Polytechnic State University, San Luis Obispo, the campus that leads the STAR program, for expansion in California and for facilitating small pilot programs in five other states.

The STAR program now involves the U.S. Department of Energy (DOE) Lawrence Livermore and Berkeley national laboratories as well as the DOE Sandia laboratory in Livermore and the Stanford Linear Accelerator Center. In addition, the three NASA research centers in California—NASA Ames, Dryden, and the Jet Propulsion Laboratory—are now all participating and will work with more than 25 future CSU science teachers in summer 2010. This year, the external funds raised will enable a total 65 CSU students to participate. The design CSU has created for the program enables future science and math candidates to be in the program initially in the summer before their senior year and then to continue for five years. It is a long-term CSU strategies aimed at both recruiting and retaining outstanding science and math teachers.

The STAR program was recognized at a recent Presidential Council of Advisors on Science and Technology (PCAST) meeting as a national model for addressing K-12 science and mathematics teacher workforce needs. Added benefits of the model that were cited included contributions to improving student achievement and fostering development of a long-term pipeline in science, technology, engineering and mathematics (STEM). In 2009-10, the program will begin industry internships at Life Technologies, a leading California biotechnology firm. The company has world-class research facilities in the San Francisco and San Diego regions at which future science teachers will work. This experience attracts outstanding science undergraduates into a teaching career in which they also work at the forefronts of science.

**Effectiveness of CSU Mathematics and Science Teacher Initiative Components and Identification of Best Practices**

The components of the CSU Mathematics and Science Teacher Initiative are integrated into a comprehensive systemwide strategy that is recognized as being one of the most significant approaches for increasing math and science teacher preparation that has been undertaken nationally. The distinctive features of the Initiative are: (a) institutional commitment that is articulated and reinforced at multiple levels, (b) comprehensive recruitment and financial support, (c) approaches that connect future teachers with communities of practice that include scientists and mathematicians as well as other dedicated teachers in their disciplines, (d) broad-ranging collaboration and partnerships with other educational agencies and with federal science agencies, and (e) rigorous data systems and evaluation procedures for monitoring outcomes.

A first factor that has supported program effectiveness is **institutional commitment at all levels**. Support of campus academic leaders and staff, engagement of faculty in Colleges of science, mathematics and education, and cooperative efforts to attract, recruit, and prepare outstanding candidates are characteristic of the CSU systemwide Math and Science Teacher Initiative. The program on most campuses has mutually supportive leadership

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7 Ibid.
among the top academic leaders. The commitment of leaders at each level is reinforced by and reinforces the work of leaders at the other levels and is encouraged by the Chancellor.

A second factor that has been instrumental in supporting program effectiveness is the integration of comprehensive recruitment strategies and financial support. Approaches for recruiting candidates from diverse populations are directly aligned with scholarships and loan assumption programs to enable candidates from diverse backgrounds to complete a credential program without incurring significant student debt.

A third factor supporting effectiveness is preparation that connects future teachers with science and mathematics communities of practice. In programs like STAR, CSU science teacher candidates are directly involved in scientific practice and discourse, and the programs engage them as members of professional communities with leading scientists.

A fourth factor that has advanced effectiveness addresses collaborative strategies and partnerships that often extend beyond traditional boundaries. These include innovative partnerships between colleges of education and colleges of science and engineering that have resulted in recruitment of outstanding undergraduates. They also include systemic partnerships with the entire spectrum of K-20 educational institutions throughout regions. Another important partnership has been with the California Student Aid Commission. It has enabled CSU campuses to award more than $10 million in loan assumption funds to future science and mathematics teachers. A fourth set are with federal agencies, including NSF, the Department of Energy, and NASA. A fifth set have been with philanthropic Foundations having a commitment to advancing STEM education and teacher preparation in California.

An additional factor enhancing effectiveness pertains to robust data systems for continuously monitoring progress and outcomes. Thorough and refined accountability systems are critical to (a) determine the strategies and institutions that are most effective in increasing production of well qualified math and science teachers and (b) to examine them to identify their distinguishing features and impacts. The approach used by CSU to monitor performance builds on the robust data systems developed for the Annual Evaluation of CSU Teacher Preparation Programs conducted by the CSU Center for Teacher Quality.

Identification of Best Practices

Best practices have been identified for each factor associated with effectiveness by examining relationships between the factors and changes in credential production. There has been a consistent association between certain approaches and large increases in preparation of well-qualified teachers and this is the basis for judging them best practices.

In the case of institutional commitment, a common feature is seen both at campuses that began with little institutional engagement but that now have science and mathematics teacher preparation as a campus-wide priority, and those that have a long tradition of commitment to this area and where the institution has more than doubled its programs. The feature characteristic of the institutional commitment is sometimes referred to as nested leadership.⁹ There is a concerted, campus-wide effort that involves the President, Provost,

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Deans, Department Chairs, and faculty all working toward the same goal. The actions at each level support one another and yield a culture of campuswide support for a long-term commitment to attracting and preparing outstanding new math and science teachers.

In the case of **recruitment and financial support**, campus efforts to secure external scholarship funding for candidates is essential. In science and mathematics, fellowships often exist for students who are pursuing research careers. The use of Mathematics and Science Teacher Initiative funds as matching resources to secure federal funds and the commitment of these funds for the entire periods of federal grants allows for the type of scholarship that attracts outstanding math and science majors into teaching. The simultaneous branding of math and science teaching as prestigious is essential. One campus achieved this through engaging bookmarks, posters, and ads. Another created engaging videos that demonstrate that science and mathematics teaching are exceptionally attractive and rewarding careers. These are being shared with other campuses through the online MSTI Recruitment Toolkit.

The STAR program is an example of making it possible for future science and math teachers to participate actively in scientific **communities of practice**. Through it, these teachers work with some of the nation’s most outstanding researchers. An additional partnership between CSU and NASA is another example of best practices that has similar outcomes. In 2008-09, **Spaceward Bound** included 40 CSU students who participated in field research with NASA scientists in extreme environments that have similarities with remote planetary conditions. Each spring, future science teachers from several CSU campuses now go on a field research expedition with NASA scientists in the Mojave National Preserve, with subsequent follow-up with the teams of researchers.

Spaceward Bound is now part of a broader effort funded by NASA to enhance the integration of NASA Mission research into the classroom at the secondary level. The focus is to introduce NASA-related field research to pre-service and in-service teachers. In 2009, CSU campuses received one of seven grants made nationally by NASA to prepare both current and future teachers in using NASA research in high school classrooms.

The data systems used by CSU to **continuously monitor progress and assess outcomes** build on data from the annual CSU Evaluation of Teacher Preparation Programs. The reporting systems developed by the CSU Center for Teacher Quality enable CSU to track its teacher graduates, identify the attributes of the schools in which they teach, and analyze the degree of preparation as reported by candidates and their Supervisors.

In addition, data provided by the California Commission on Teacher Credentialing are subject to refined analyses by the CSU Office of Analytic studies to determine exact numbers of credentials recommended by each CSU campus. This spring, the Office of Analytic studies also performed an in-depth analysis of community college transfers to CSU with declared STEM majors. These data identified the 23 California Community colleges from which CSU STEM transfers have averaged over 100 during the past three years.

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11 Ibid.
These data will be used to target transfer strategies during 2010-11, reflecting the overall strategy of data based management building on CSU analytic and evaluation systems.

**Job Placement of CSU Students Who Earn a Mathematics or Science Teaching Credential**

A comprehensive analysis was conducted on the job placement of CSU mathematics and science teachers whose first year of teaching was 2008. The findings were striking, demonstrating that large numbers teach in high need schools. Of CSU math and science teacher graduates:

- 42% taught in city schools, approximately 10% in rural schools, and the remainder in suburban schools;
- 34% taught in schools that did not meet their annual Academic Performance Index (API) in 2007-08; the remainder taught in schools that did;
- 49% taught in schools with more than half of the students in poverty and more than 70% where 25% or more of the students were from families in poverty;
- 84% taught in schools with less than 100% fully credentialed teachers.

Data on the California teacher workforce underscore the importance of these job placements among CSU math and science teachers—which show a striking pattern where the majority teach in high need schools. Challenges of finding qualified math and science teachers are acute among the state’s highest need schools. The new math and science teachers prepared by CSU are teaching in the state’s neediest schools and contributing substantially to overcoming inequities in the distribution of well-qualified mathematics and science teachers.

**Conclusions**

CSU campuses continued on a trajectory of significant growth in mathematics and science teacher production in 2008-09, with the increase totaling 80% since 2003. The new teachers produced by CSU campuses are taking job positions in high need schools across the state. They are contributing markedly to reducing the disparities in access to qualified mathematics and science teachers that have been found in the state throughout the past decades.
This table presents California Commission on Teacher Credentialing data from 2002-03 through 2008-09 for mathematics and science credentials recommended by California State University campuses. The calculation is based on a count of math and science credential authorizations that have been recommended for (a) regular credential candidates and (b) intern credential candidates.

The data show an increase from 768 to 1,367 in mathematics and science credentials—an increase of 80%—since the year prior to the start of the CSU Mathematics and Science Teacher Initiative.
Table 2. CSU Mathematics and Science Teacher Credential Production by Campus: 2002-03 to 2008-09\(^a\)

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\(^a\) The data are based on figures provided by the California Commission on Teacher Credentialing (CCTC).

\(^b\) Data represent total CSU mathematics and science credentials recommended in 2008-09.

These data demonstrate that increases in mathematics and science teachers produced annually have occurred on 18 of the CSU campuses, with the magnitude of gains large on most campuses. Nine CSU campuses more than doubled their production of these teachers during the period, and 11 campuses increased their yearly production of teachers in these fields by 25 or more.