THE CALIFORNIA STATE UNIVERSITY
MATHEMATICS AND SCIENCE
TEACHER INITIATIVE

2012-13 REPORT

CALIFORNIA STATE UNIVERSITY
OFFICE OF THE CHANCELLOR

JUNE 2013
Overview

Through the implementation of its system-wide Math and Science Teacher Initiative (MSTI), the California State University (CSU) has achieved and sustained its goal of doubling the production of math and science teachers. CSU campuses increased the annual number of math and science teachers produced from 750 per year in 2002-03 to 1,504 in 2011-12. Of the 1,504 teachers prepared by CSU this past year, 807 were math teachers and 697 were science teachers. In the severe shortage areas of physics and chemistry, CSU has increased the number of teachers it prepares by 107%. Ten CSU campuses more than doubled their production of math and science teachers between 2003 and 2011.

Utilizing MSTI resources in strategically planned efforts, CSU campuses have not only been effective in increasing production of math and science teachers, the campuses have also been successful in acquiring federal grants to supplement the initiative. This includes prestigious Robert Noyce scholarship awards to all campuses from the National Science Foundation. The CSU has also developed strong partnerships with the U.S. Department of Energy, the National Aeronautics and Space Administration (NASA), and the National Oceanographic and Atmospheric Administration (NOAA). These agencies have provided research internships in leading federal labs for 290 CSU future science teachers.

CSU’s success in math and science teacher preparation includes its being a leading partner in the prestigious 100Kin10 national initiative. Led by the Carnegie Corporation of New York, this is a group of national foundations, education institutions, and businesses that have joined together to prepare 100,000 excellent STEM teachers over the next decade. As part of the initiative, CSU has committed to sustain its current preparation of 1,500 new math and science teachers annually. CSU priorities include: producing increased teachers in severe shortage fields; placing new math and science teachers in high need schools; and preparing candidates credentialed in more than one STEM discipline to assist hard-to-staff schools.

Background

The projected need for new mathematics and science teachers in California in the next ten years continues to exceed 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. Numerous studies show that 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 been persistent in these two fields. 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, more than 10% of California’s middle and high

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school mathematics and physical science teachers continue to be under-prepared in these subjects or are teaching out-of-field.²

Under-prepared teachers are disproportionately placed in the highest need schools. More than 200 schools in the state have 20% or more under-prepared teachers; these are mostly in urban areas, serving, on average, 87% students of color. The majority of the under-prepared teachers are in math and science classrooms.³

**CSU Math and Science Teacher Initiative**

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 substantially more teachers in these critical areas. To address the significant need for additional math and science teachers, Chancellor Charles B. Reed made a CSU systemwide commitment to double production of teachers in these fields from a baseline of approximately 750 in 2003 to 1,500 by 2011.

CSU began MSTI 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 those 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

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 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 on other campuses.

**MSTI Annual Reporting Requirements**

This report provides information on MSTI and its outcomes during 2012-13. It addresses Budget Act requirements for an annual report in four areas that were designated at the time MSTI was included in the state budget:

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³ Ibid.

1. Annual number of math 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 report 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

4. The job placement of candidates who earn a math 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 Math and Science Teachers Produced**

The increase in CSU production of math and science teachers from the baseline year of 2003 to 2012-13 has been highly significant, a doubling from 750 to 1,504. The increase has been steady and sustained over the six-year period since the initial planning and first funding for MSTI began in 2005. Systemwide data for 2011-12 and previous years for mathematics and science teacher credentials issued by CSU campuses are presented in Tables 1 and 2 at the end of this report.

The increases in production have been large in all areas of math and science. In math, the increase was from 349 in the 2002-03 baseline year to 807 in 2011-12, an increase of 131%. This is attributable in part to the introduction of the Foundational Level Math credential in 2004. This credential is designed to address the need for credentialed middle school math teachers. CSU prepared 356 teachers with the Foundational Level Math credential in 2011-12. This new credential, authorized by the California Commission on Teacher Credentialing (CTC) six years ago, prepares candidates for teaching middle school math, including algebra, addressing the large need for teachers skilled in teaching this subject to meet state requirements regarding the teaching of algebra in the state’s middle schools.

The increase in production of science teachers from 2003 to 2011-12 was from 419 to 697, an increase of 66%. Within the sciences, the largest gains have been in the highest shortage fields. These include increases in chemistry of 102%, geosciences of 65%, and physics of 117%. CSU has 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. The CTC in 2009 introduced a new Foundational Level General Science credential for middle school science teachers; an increase in middle grade science teacher credential production has occurred on CSU campuses as a result.

The credential production increases provide clear evidence of the impact of the support for MSTI. Campus data in Table 2 from 2002-03 through 2011-12 show that virtually all CSU campuses demonstrated substantial increases in math and science teacher production during the period as a result of the support provided for the Initiative.

Most campuses doubled their yearly production in these fields and some tripled their production. Increases were directly related to strategies implemented with additional MSTI resources in combination with Teacher Recruitment Project (TRP) support. Funding was allocated in part to scholarships and student support and leveraged more than $80 million in matching private
sector and federal support from the National Science Foundation (NSF) and U.S. Department of Education.

MSTI funding has been used for comprehensive strategies that focus on recruitment from traditional and new pools of candidates. Included are partnerships with community colleges that focus on recruitment and preparation of transfer students in aligned pathways. Also included is recruitment of STEM professionals and current teachers interested in a second credential in math or science. Across the CSU system, new strategies have been implemented that could not be initiated or continued without state support, and these approaches have resulted in major increases in math and science teacher production and quality.

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 more than 40% between 2003-04 and 2011-12, and the production of single subject candidates declined by more than 20%. Due to reductions in school district hiring resulting from the state budget, CSU experienced overall declines, as did the other institutions of higher education. The stability in math and science teacher production is directly attributable to the continued demand for teachers in these fields, the financial support provided through MSTI, and the sustained commitment and effort of faculty and academic leaders on campuses across the CSU system.

Expenditure of MSTI Funds

CSU appropriated $2.713 million for MSTI in 2012-13. The expenditure plan adopted for these funds consisted of two primary components:

- **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: $2,491,000.

- **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: $222,000.

**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 in order to target resources on effective approaches and to campuses that show significant success in achieving the goal of sustaining CSU’s 1,500 annual credential production.

Allocations to campuses ranged from $56,000 to $180,000, and individual campus amounts were based on (a) increases in production 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 math 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 helping 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 math 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 MSTI 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.

**Effectiveness of MSTI Components and Identification of Best Practices**

The components of MSTI 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 MSTI. The program on most campuses has mutually supportive leadership among the top academic leaders. The commitment of...

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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 math 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 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) 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. This is the annual evaluation that is conducted on all of the CSU campuses that prepare teachers. It surveys teacher graduates and their Principals/Supervisors to assess their degree of preparation and is able to examine the added value of particular pre-service experiences.

A fifth factor advancing effectiveness is collaborative strategies and partnerships that often extend beyond traditional boundaries. These include innovative partnerships between colleges of education, science, and engineering that have resulted in recruitment of outstanding undergraduates. A variety of partnerships also exist with K-12 educational institutions. Included are partnerships with the California STEM Learning Network (CSLNet) statewide regional networks. CSLNet is one of more than a dozen state networks that are committed to advancing K-12 STEM teaching and learning. CSLNet includes an emphasis on expanding STEM learning through the state’s 4,000 publicly funded after-school programs. In collaboration with CSLNet, CSU campuses are providing inquiry-based STEM clinical experiences for future teachers in after-school programs around the state.

Significant partnerships have been established with federal agencies, including NSF, the Department of Education, the Department of Labor, the Department of Energy, NASA, and NOAA. These have led to federal funding of more than $75 million that has been possible through use of MSTI funds as matching resources.

Another important set of partnerships has been with philanthropic foundations having a commitment to advancing STEM education and teacher preparation. These partnerships include the S.D. Bechtel, Jr. Foundation, the Carnegie Corporation of New York, the James Irvine Foundation, and the David and Lucile Packard Foundation. Philanthropic matching support for activities that complement MSTI exceeded $5 million in the past three years.
CSU also has productive partnerships with Workforce Investment Boards (WIBs) across the state. These have led to the development of programs supported with Department of Labor funding that are enabling laid-off teachers who have strong backgrounds in math and science to earn second teaching credentials in these subjects and become employed in these high demand fields. WIBs have invested more than $2.5 million in these programs, addressing both teacher layoffs and the need for additional math and science teachers.

An ongoing partnership with Google has been focused on preparing math and science teachers in highly accessible, low cost technology applications that support 21st century learning. Forty CSU faculty members were supported as Google Faculty Fellows and explored advanced applications of digital technologies to secondary school STEM teaching and learning. Google has also provided support for the CSU Digital Ambassador program, enabling Google Fellows to provide training to other faculty in digital technologies.

A partnership launched with the S.D. Bechtel, Jr. Foundation in 2012-13 focused on significantly strengthening the preparation of future elementary teachers in science. The Foundation provided support for grants to campuses aimed at enhancing the content and pedagogical expertise of these teacher candidates and increasing their confidence and excitement about science. The project was aligned with the release of the Next Generation Science Standards (NGSS), enabling CSU to be a leader nationally in addressing the new standards. Through the project, campus courses, labs, and practicum and field experiences are being revised to address the NGSS focus on (a) scientific and engineering practices, (b) crosscutting concepts in science, and (c) the integration of engineering and science.

During the past six years, contributions to MSTI through federal and foundation partnerships have exceeded $80 million. This represents leveraging of MSTI funds in acquiring external funding at a level greater than 5 to 1. In virtually all cases, the availability of matching MSTI funds was a key factor in enabling CSU and its campuses to receive substantial external support.

**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 math teacher preparation as a campuswide 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*. There is a concerted, campuswide effort that involves the President, Provost, Deans, Department Chairs, and faculty all working toward the same goal. The actions at

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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 are essential. In science and math, fellowships often exist for students who are pursuing research careers. The use of MSTI 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. CSU campuses have the largest number of National Science Foundation Robert Noyce scholarships in the nation. The 23 campuses have more than 50 different NSF-funded scholarship and fellowship programs, and more than 20% of CSU math and science candidates have Noyce annual awards of $10,000, the majority lasting for from three to five years during their teacher preparation pathway.

The concurrent branding of math and science teaching as a prestigious career choice has been highly effective. One campus achieved this through engaging messages on bookmarks, posters, and ads. Another created exciting videos that demonstrate that math and science teaching careers are attractive and highly rewarding. These are being shared with other campuses through the online MSTI Recruitment Toolkit.

The STAR program is an example of best practices enabling future science and math teachers to participate actively in scientific communities of practice. Through it, outstanding science teacher candidates work with some of the nation’s most outstanding researchers. More than 290 future science teachers have now participated in some of the nation’s finest research laboratories through STAR. The STAR program was cited by the President’s Council of Advisors on Science and Technology (PCAST) as a model for the nation for recruiting outstanding science, technology, engineering, and mathematics (STEM) majors into teaching and enabling them to continue participating in scientific communities of practice.

An additional partnership between CSU and NASA has had similar outcomes in motivating outstanding STEM majors to consider teaching as a career. From 2006-07 to 2012-13, *Spaceward Bound* included more than 180 CSU students 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 participate in a field research expedition with NASA scientists in the Mojave National Preserve, with subsequent follow-up involving teams of researchers and high school teachers.

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. During the past four years, CSU campuses received $2.5 million in grants from NASA headquarters in Washington, D.C. and its three California research centers to enable them to establish model programs preparing both current and future teachers in using NASA research in middle and high school classrooms.

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The data systems used by CSU to continuously monitor progress and assess outcomes are another example of best practices. They 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 the Principals at their schools.

In addition, data provided by the CTC are subject to refined analyses by the CSU Office of Analytic Studies to determine the exact numbers of credentials recommended by each CSU campus. The Office of Analytic Studies has also performed analyses of community college transfers to CSU with declared STEM majors. These data identify the California Community Colleges from which CSU STEM transfers have averaged more than 100 annually. They facilitate planning of transfer patterns that are common across campuses, part of CSU’s commitment to facilitating efficient transfer under SB 1440.

**Job Placement of Math and Science Teacher Graduates**

A comprehensive analysis was conducted on the job placement of CSU math and science teachers whose first year of teaching was 2012. The findings were striking, demonstrating that large numbers teach in high need schools. Of CSU math and science teacher graduates:

- Approximately 56% taught in city schools and 10% taught in rural schools
- Approximately one-third taught in schools that did not meet their annual Academic Performance Index (API) in 2010-11
- 80% taught in schools with more than half of the students in poverty and close to 90% in schools where one-fourth or more of the students were from families in poverty
- 70% 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 teacher graduates—which show a striking pattern in which 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 math and science teachers.

**Conclusions**

CSU campuses demonstrated a pattern of sustained production of math and science teacher production in 2011-12, with the doubling to 1,500 since 2003 continuing. 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 math and science teachers that have been found in the state and that have been a significant factor in causing achievement gaps in these fields throughout the past three decades. The system and its campuses are among the nation’s leaders in reforms addressing the significant new Next Generation Science Standards in both elementary and secondary teacher preparation.
### Data Tables

#### Table 1. CSU Mathematics and Science Teacher Credential Production by Subject: 2002-03 to 2011-12\(^{a,b}\)

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\(^{a}\)Data on new credentials are provided by the California Commission on Teacher Credentialing (CTC).

\(^{b}\)Data include total CSU mathematics and science teacher credentials and authorizations from 2002-03 through 2011-12.

This table presents California Commission on Teacher Credentialing data from 2002-03 through 2011-12 for mathematics and science credentials recommended by California State University campuses. The numbers are based on the count of math and science credential authorizations that have been recommended for (a) regular credential candidates and (b) intern credential candidates, since both are compliant with federal No Child Left Behind (NCLB) requirements.
Table 2. CSU Mathematics and Science Teacher Credential Production by Campus: 2002-03 to 2011-12a,b

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Data on new credentials are provided annually by the California Commission on Teacher Credentialing. The data represent secondary mathematics and science credentials among new teachers each year. The data demonstrate that large increases in mathematics and science teachers produced annually have occurred on virtually all CSU campuses. Fourteen CSU campuses more than doubled their production of these teachers during the period, and nine campuses increased their yearly production of mathematics and science teachers nearly three-fold.