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California's Approach to Math Instruction Doesn't Add Up

Rising Enrollment + Impending Retirements + Chronic Math Teacher Shortages = Deepening Concerns for California's Middle and High Schools

The Center for the Future of Teaching and Learning Calls for Summer Institutes for 8th Grade Algebra I Teachers to Strengthen Knowledge and Skills

Poor Performance on High Stakes Math Tests

California's students are failing to make the grade in mathematics. A recent study released by the RAND Corporation found that California's eighth grade students ranked 43rd on the National Assessment of Educational Progress (NAEP) mathematics tests. A study conducted by the California State University system found that only 55% of high school juniors are prepared to enroll in college-level mathematics courses. In 2004, 82% of students scored below proficiency on the California Standardized Test in Algebra I (tested in grades 8-11). And in 2003-2004, more than a quarter of all students taking the California High School Exit Exam (CAHSEE) failed to pass the mathematics section of the test.

CST Algebra I	8th Grade	9th Grade	10th Grade	11th Grade
% Advanced	8%	1%	0%	0%
% Proficient	27%	14%	6%	4%
% Basic	27%	29%	23%	18%
% Below Basic	30%	43%	52%	55%
% Far Below Basic	8%	13%	19%	23%

Source: CDE

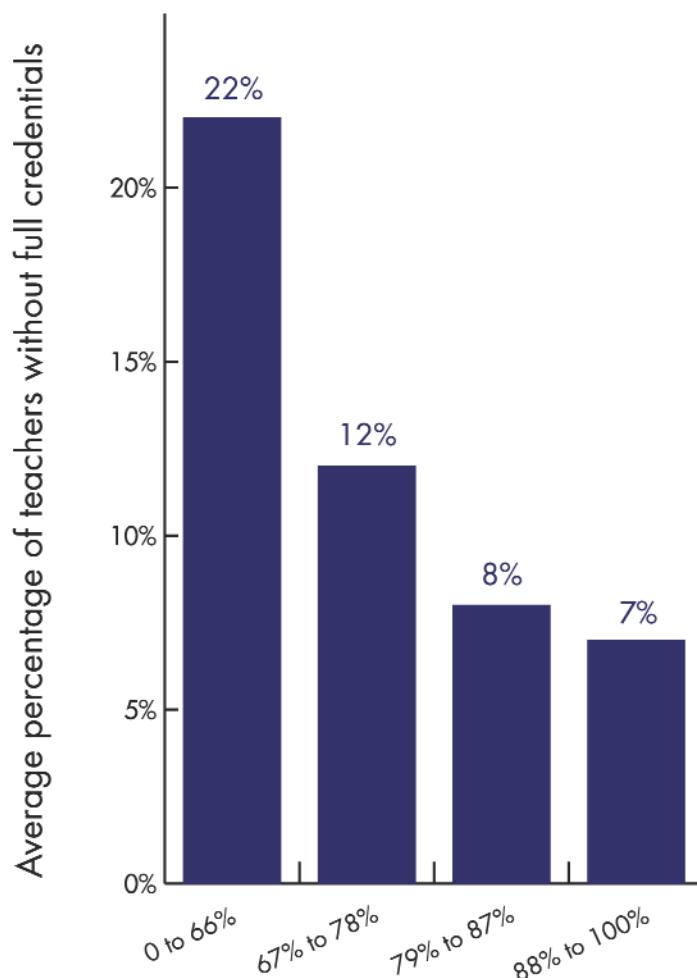
Recent research commissioned by the Center and conducted by SRI International found that, on average, schools with the lowest passing rates on the exit exam have far more underprepared teachers than schools with higher pass rates. Students in schools with lower pass rates are three times more likely to be taught by underprepared teachers than students attending schools with the highest passing rates. On average, more than 20% of teachers were underprepared in schools where fewer than two-thirds of the students passed the mathematics portion of the CAHSEE.

The Teaching Crisis in Algebra

Algebra I is viewed as the gatekeeper to a sequence of higher mathematics courses as well as the key to future academic success beyond high school. To highlight the importance of Algebra I, students are now encouraged to pass the course in the eighth grade. Yet 73,000 middle school students, almost double the total number of Oregon's 8th grade students, are enrolled in Algebra I classes in which the teacher is either underprepared or assigned "out-of-field." In California, 950 middle school teachers, or about 40% of the workforce assigned to teach Algebra I in middle school, do not have a subject matter credential in mathematics and may lack the background and preparation necessary to effectively teach the subject.

At the high school level, knowledge of algebraic concepts is required to pass sections of the state's high school exit exam and STAR tests. And because Algebra I serves as a gatekeeper course for the more advanced math required for admittance to California's institutions of higher education, such as Geometry and Algebra II, as well as the recommended additional courses of Trigonometry and Calculus, Algebra I is critical. Yet nearly 2000 teachers, or *one out of five* high school teachers assigned to teach mathematics, are teaching out of their field of expertise or have not yet completed requirements for a teaching credential.

Average Percentage of Underprepared Teachers by School-Level Percentage of Students Passing the Math Portion of the High School Exit Exam, 2003-04



High schools by percentage of students passing the math portion of the exit exam

Sources: CDE, SRI Analysis

Bulging Enrollment in Middle and High Schools + Existing Teacher Shortages + Accelerating Student Academic Standards = Increasing Demand for Skilled and Knowledgeable Math Teachers

To improve achievement in mathematics and provide students the opportunity to meet the high academic standards the state has set, California needs to ensure that every student has access to a truly qualified and effective mathematics teacher. But existing conditions and developing trends are straining the supply and increasing the demand for skilled and knowledgeable math teachers:

- Student enrollment is bulging at the middle and high school levels, accelerating the need for fully qualified teachers of mathematics. Enrollment at the high school level is expected to increase by 17% from 2001 before peaking in 2009.
- There are existing and persistent shortages of fully qualified teachers in math. Twenty percent of high school math teachers are unprepared or teaching out-of-field.
- Teachers are projected to retire by tens of thousands over the next decade. One in five teachers is projected to retire within three to five years, and more than 100,000 teachers, or about one-third of the workforce, are expected to retire by 2014.

Considerations for Policy-Makers

Current demand for fully qualified mathematics teachers is great and will increase further as the student enrollment bubble hits middle and high school, thereby making it unlikely for California to "grow" its way out of this problem. To ensure students meet state standards in mathematics, their teachers must get the training necessary to develop the knowledge and skills to effectively teach Algebra I. Unfortunately, recent budget decisions have resulted in dramatic cuts (from \$222 million in 2000-2001 to \$63 million in 2004-2005) in teacher professional development. Moreover, nearly half of the existing funds are targeted toward reading and math professional development for grades K-3. In short, not only are middle and high school students in desperate need of high quality mathematics teachers, the state's existing professional development programs that might serve to boost teachers' knowledge and skill in this area are not targeted or designed to do so.

The Center View: Establish Summer Mathematics Institutes; Begin by Serving 8th Grade Algebra I Teachers

In 2000, the California Professional Development Institutes (CPDI) were established to provide intensive professional development programs for up to 70,000 teachers statewide. As part of that effort, the state budget set aside \$2.5 million to establish Algebra Summer Institutes. These institutes were provided through the collaborative efforts of the University of California, the California State University, independent colleges and universities, and the K-12 community. Unfortunately, funding for the CPDI was eliminated. With their intensive two-week summer program followed by additional assistance throughout the school year to total 160 hours of training, the CPDI was generally considered an effective model for teacher pro-

fessional development. Their termination was unfortunate given the state's expectations for student achievement in mathematics, the press for students to take Algebra I in the 8th grade, and the large number of underprepared math teachers.

The Center strongly urges California's governor and Legislature to establish summer institutes for 8th grade Algebra I teachers. We propose that these institutes be conducted on college campuses located in urban centers where the shortage of fully-prepared teachers is the greatest. These institutes should provide teachers with 80 hours of intensive professional development plus an additional 80 hours of follow-up aimed at improving their content and pedagogical knowledge in algebra. Providing \$2000 stipends will encourage participation and reward efforts for self-improvement. California policy-makers are working within a constrained budget; however, the cost of providing these institutes and stipends for the 950 middle school teachers currently teaching Algebra I without the necessary background is quite low: \$3.3 million. Given the high stakes for students' success in high school and beyond, and the complex subject matter content that teachers are expected to deliver, that's a small price to pay for such a large return on investment.

**Notes: 160 hrs=Two week institute (80 hrs) + 40 hrs face-to-face follow-up + 40 hrs teacher work at site.
Estimated cost derived from: \$3500 X 950= \$3,325,000*