Overview

Over the past five years, California has reconfigured its educational reform and assessment strategies to increase student achievement, improve accountability and comply with federal educational funding requirements. It has inaugurated several new programs designed to gauge the progress that the state's public school students are making toward acquiring critical knowledge and skills, including:

- Rigorous content standards for grades K-12. (Standards for mathematics were adopted in 1998.) These standards state explicitly the content (concepts and skills) that students need to acquire at each grade level.
- The Standardized Testing and Reporting (STAR) system, introduced in 1998, which administers the norm-referenced SAT-9 (the CAT-6 was recently adopted for use in 2003-05) and the criterion-referenced California Standards Test (CST), which is aligned with the standards.
- A California High School Exit Examination (CAHSEE), authorized by state law passed in 1999, which students in California public schools will be required to pass in order to receive a high school diploma, beginning with the graduating class of 2004.

(Additional information about these state tests is available online at www.cde.ca.gov/statetests/.)

Districts across the state have been struggling to modify their curriculum, pedagogy and assessment to respond to these changes. Orange County, California, a diverse region of nearly 800 square miles and a population of close to 3 million people, is no exception. While Orange County has the lowest high school dropout rate in Southern California and posted the highest verbal and mathematics scores in the region on the Scholastic Assessment Test, there are wide disparities in the socioeconomic status of its population—disparities that are reflected in the achievement of its students and its schools. Schools in more affluent communities tend to have higher-achieving students, while those in poorer communities tend to be lower-achieving. One of the biggest educational challenges the county currently faces is to close the gap by increasing the student achievement at low-performing schools.

A partnership to promote student learning

In order to address this achievement gap, a targeted partnership consisting of California State University, Fullerton (CSUF), the Orange County Department of Education (OCDE), four Orange County school districts, five low-performing high schools and their eight feeder middle schools has created Teachers Assisting Students to Excel in Learning Mathematics (TASEL-M). TASEL-M is a data-driven program designed to improve students' academic performance in mathematics at the participating schools by giving their teachers the knowledge and tools to accurately diagnose students' deficiencies, assess their progress, adjust the curriculum and pedagogy and transform the departmental culture to maximize student learning in mathematics. Mathematics was chosen as the focus for the project because mathematics knowledge and skills are cumulative, and unless student deficiencies are remediated, students won't be able to progress in their mathematical studies. It is also a field marked by a disproportionate number of underqualified teachers, and unless the gaps in their knowledge are filled, they won't be teach effectively.

TASEL-M is a partnership in the true sense of the term, with each of the partners bringing to the project a unique and complementary set of strengths, experiences and opportunities. As the official liaison between the school districts and the California Department of Education, OCDE facilitates access to the districts and individual schools and has access to data on them that can be used for baseline comparisons. It also provides a multitude of services to the county's K-12 school districts and houses a number of state, federal, county and private programs that can be leveraged to maximize the impact of the TASEL-M activities. Its staff members have expertise in major areas of instruction and assessment and offer such professional development programs as teaching strategies to reach the large number of ELL students in the county. TASEL-M will leverage their expertise to help participants with a number of the key skills and methodologies necessary to enhance teachers' effectiveness and ensure the project's success.

The participating schools and districts are the proving grounds for TASEL-M's unique combination of approaches, providing a student population desperately in need of assistance and mathematics faculty

members who are eager to help them improve and are enthusiastic about the opportunities that TASEL-M presents. The school sites will also provide unique opportunities for CSUF preservice teachers to learn about curriculum, content, pedagogy and assessment alongside the inservice teachers at these schools.

CSUF brings to the project a longstanding commitment to K-12 mathematics education reform and a history of leadership in reform in Orange County. It also is a source of extensive content knowledge and expertise in pedagogy to help the participating teachers improve their performance in the classrooms. In addition, it maintains many outreach programs designed to encourage and ease the transition from precollege to higher education, and will direct these programs to the target schools to help increase the number of students going on to higher education.

The preK-12 environment: Room for improvement

The challenge at the schools participating in TASEL-M is clear. On average, only 39.7% of their students in grades 9-11 scored at or above the 50th percentile on the Stanford 9 standardized test in mathematics, and that showing is significantly lower than both the county and state averages (57.6% and 47.3%, respectively). Collectively, these high schools and junior high and middle schools enroll 16,137 students and have a high percentage of minority students. On average they are 63.16% Hispanic, 13.62% Asian, 17.46% white, 2.52% African American, 1.8% Filipino, .98% Pacific Islander, and .36% Native American, (based on high school enrollments). More than half—50.74%—are economically disadvantaged (based on high school enrollments). Many of these schools struggle with high transience rates among their student body, and all have high percentages of students who are English language learners. All are Title I schools, receiving federal support for programs due to the low socioeconomic status of their students.

In addition to economically and educationally disadvantaged students, these schools grapple with a disproportionate number of mathematics teachers who are ill-prepared to teach their subject. Out of the 104 mathematics teachers targeted by the project, nearly a third—31%—have emergency or supplemental credentials and neither majored nor minored in math. As Lee S. Shulman, president of the Carnegie Foundation for the Advancement of Teaching, has shown, teachers can't teach what they don't know.

A number of programs already exist to help these schools, including Beginning Teacher Support Assistance (BTSA), a state program that aids novice teachers, who tend to be more numerous at low-performing schools; Advancement by Individual Determination (AVID), a national private program designed to help and motivate underachieving students to go on to college; Immediate Intervention for Underperforming Schools Program (IIUSP), which provides assistance to schools with low standardized test scores; and ELL programs for students who lack proficiency in English. While these programs provide valuable help, none address emergency credentialed teachers; specifically target mathematics; address the in-depth content needs of beginning teachers; or consider the cultural changes that must take place at schools if student achievement in mathematics is to become a priority.

The higher education environment: Learning from experience

California State University, Fullerton (CSUF) has a long history of commitment to mathematics reform and to innovative collaborations with Orange County's K-12 schools. One of three universities in Orange County, it has the largest teacher education program in the county, graduating more than 1,000 K-12 credentialed teachers a year, 15-20 of whom are credentialed to teach high school mathematics. CSUF is also home to the Center for Excellence in Science and Mathematics Education (CESME), an entity created in 1992 to meet the inservice needs of area science and mathematics teachers and to coordinate the university's efforts in science and mathematics education partnerships.

CSUF's mathematics faculty have been actively engaged in partnership programs with K-12 schools since the early 1970s, delivering services directly to students, professional development programs to teachers and broader programs to schools and districts, primarily serving lower socioeconomic groups in the county. Since the late 1980s, the university's mathematics education faculty have been involved in outreach programs emphasizing equity issues, mathematics education reform and implementation of the National Council of Teachers of Mathematics (NCTM) standards. Its Mathematics Intensive Summer

Session (MISS), for example, launched in 1990, brings underrepresented minority female high school students to campus each summer for a one-month program focusing on Algebra II. MISS has received national recognition, appearing in the Mathematical Association of America's 1996 Directory of Mathematics-Based Intervention Projects for Strengthening Underrepresented Minority Mathematics Achievement. CSUF's NSF-funded C^3 (Content, Confidence, Collaboration) project, a collaboration with OCDE that began in 1994, centered around teacher enhancement by preparing teachers to adopt new pedagogy and new materials conforming to the NCTM *Curriculum and Evaluation Standards for School Mathematics* (1989). In a safe laboratory setting with small classes and no pressure to "get through the curriculum," this summer program enabled teachers to collaboratively explore and experiment with new materials and to try out pedagogical ideas they might have been reluctant to try in their own classroom without prior experience. Most recently, CSUF has implemented Students Using Mathematics Successfully (SUMS), a successful Local Systemic Change program in partnership with the Santa Ana Unified School District (SAUSD) (see "Results from Prior NSF Funding," below). Santa Ana, the county seat, is the largest city in Orange County, and SAUSD ranks as the eighth-largest district in the state. It is an urban district that is also the lowest-performing in the county. It serves 61,909 students (47,929 in K-8), over 97% of whom are Hispanic. More than 70% of its elementary students are enrolled in the Free/Reduced Lunch Program and 65.9% are English language learners. SUMS targeted teachers in grades K-9 for professional development in mathematics, calling on parents, teachers, support staff, administrators and community advocates to improve mathematics instruction. The project reflected CSUF's commitment to and experience in working with inner-city schools.

Other representative programs include the Orange County Mathematics Project at Fullerton (OCMPF), which trains 20-25 middle school teacher leaders in pre-algebra and algebra content and pedagogy each summer in order to coach and assist colleagues in their respective districts; the Collaborative Academic Preparation Initiative (CAPI), in collaboration with OCDE, which was funded by the CSU Office of the Chancellor to provide faculty-to-faculty help in mathematics at the high school level in order to increase the pass rate of students taking the Entry Level Mathematics (ELM) exam when they enroll in CSUF; and the Mathematics Readiness Project, funded by the Eisenhower State Grant Program in Mathematics and Science, which analyzed data from the statewide Mathematics Diagnostic Testing Project (MDTP) to develop instructional modules addressing the algebra concepts in which high school students most often were deficient. CSUF also offers state-funded professional development institutes in algebra and geometry for middle schools and recently received support for a collaboration with OCDE to establish a professional development institute in mathematics for elementary schools.

Planning History

Building on research

TASEL-M reflects a synthesis of ideas from several recent research projects addressing different aspects of teacher preparation, assessment and student learning.

Foremost among these is Nancy Love's work, detailed in *Using Data/Getting Results: A Practical Guide for School Improvement in Mathematics and Science* (2002), which explores the impact of equipping teachers with student achievement data and the tools to analyze it in order to tailor their curriculum and pedagogy to students' needs. Love has found that data can uncover problems that might otherwise remain invisible; convince people of the need for change; confirm or discredit assumptions about students and school practices; get to the root cause of problems, pinpoint areas where change is most needed and guide resource allocation; help schools evaluate program effectiveness and keep the focus on student learning results; provide the feedback teachers and administrators need to keep going and stay on course; prevent overreliance on standardized test scores; prevent one-size-fits-all and quick-fix solutions; give schools the ability to respond to accountability questions; and help build a culture of inquiry and continuous improvement.

In addition, Richard Stiggins has shown that quality classroom assessment drives student improvement. Writing in the November 1999 *Phi Delta Kappan*, he challenges the notion that "intimidation by assessment" will lead to more effective schools and offers an alternative vision in which assessment is used to build teacher and student confidence in the service of school improvement.

"[I]f assessment is not working effectively in our classrooms every day, then assessment at all other levels (district, state, national, or international) represents a complete waste of time and money," he says. "[N]o once-a-year standardized assessment can overcome the dire consequences for students that are caused by the ongoing mismeasurement of their achievement….We will begin to reform our assessment systems productively when we realize that we must blend high-quality standardized testing programs with high-quality classroom assessment in balanced assessment systems. We have been grossly out of balance in this regard for decades, and this must change if students are to meet high standards."

Stiggins goes on to cite an analysis conducted by Paul Black and Dylan Wiliam in England (reported in *Phi Delta Kappan* in October 1998), which documented the effects of more than 40 controlled studies of the impact of improved classroom assessment on subsequent student success, as reflected in summative assessments. Black and Wiliam reported consistent and sizable gains in standardized test scores that were directly attributable to prior differences in teachers' classroom assessment practices. The effects of enhanced classroom assessment were of a magnitude that would raise student performance on summative assessments by 0.4 to 0.7 of a standard deviation. Effects of this size, if realized in familiar contexts, would translate into improved performance in grade-equivalent scores of as much as three or four grade levels; improvement of 15 percentile points; or an increase in England's ranking among the 41 nations that participated in TIMSS (Third International Mathematics and Science Study) from the middle of the pack to the top five. Furthermore, many of the studies showed that improved formative assessment helped low achievers more than the rest, and so reduced the spread of attainment while also raising it overall.

Designing Professional Development for Teachers of Science and Mathematics, by Susan Loucks-Horsley, Peter W. Hewson, Nancy Love and Katherine E. Stiles (1998), details the benefits of coaching and mentoring. Citing the Atlanta Math Project at Georgia State University, which uses coaching and mentoring as a key component in helping mathematics teachers implement the NCTM standards, the authors note, "Through assessment of the program, it has been found that the use of a peer partner to facilitate planning, teaching experiences, and debriefing sessions helps teachers construct pedagogical content knowledge and mathematics content knowledge as well as creates a support structure that facilitates risk taking in the classroom."

Finally, in her unpublished 2000 doctoral dissertation, *A Professional Development Project for Elementary and Middle School Teachers to Begin Implementation of the California Mathematics Content Standards: An Evaluative Study*, Dianne DeMille, one of TASEL-M's co-PI's, reported on a study of professional development for teachers in grades 4-7. The study showed that boosting teacher knowledge of mathematics content and increasing their confidence about mathematics translated into a tremendous increase in student achievement.

Testing a pilot

Drawing on these sources, in 2001 CSUF and OCDE tested a pilot program as part of the Collaborative Academic Partnership Initiative (CAPI), which was created by The California State University Office of the Chancellor to reverse the large number of entering CSU students requiring remediation in mathematics. CAPI includes training in the ELM and the MDTP so teachers can use the results to determine where their students are deficient and how to improve instruction in their classrooms. CSUF has received CAPI funds since 1999, and its program has been highly effective at increasing the pass rate of entering freshmen; the most recent figures show that CAPI students passed the test at a rate of 51% compared with the general CSUF population of 29%.

During summer 2001, CSUF leveraged funds from its third CAPI grant to add the pilot component, which targeted the mathematics faculty at one high school and its feeder middle schools and focused on aligning curriculum with the California mathematics standards. CSUF and OCDE postulated that addressing the standards would help more students to pass the ELM exam, and they believed that a data-

driven approach was likely to be most effective because it would help teachers better understand the multiple tests associated with standards-based assessment and how to interpret the results.

Participating teachers from the high school and middle schools met four days during the summer and at six half-day follow-up sessions during the school year, working collaboratively to examine the standards and test data from their schools, and to explore such high-stakes tests as the CAHSEE and the CST, as well as the MDTP, to help them improve their instruction and assessment. CSUF mathematics professors and OCDE staff helped the teachers locate high-quality curriculum materials that matched the California standards, thereby helping them improve instruction and assessment. Teachers were asked to use their findings to develop practice items that addressed the standards. The collaborative work environment that resulted, with mathematics teachers jointly focused on student learning in conjunction with the subject matter, represented a cultural change for most participants.

At a conference in January 2002, jointly sponsored by CSUF and OCDE, the participants presented their results. One team actually went beyond the assignment and made specific changes in their curriculum to ensure that every class covered a content area in the standards, even if the subject wasn't in the textbook or course guidelines. The outcome was so promising that CSUF and the OCDE began to look for ways to build on it.

Expanding the model

In December 2001, five CSUF mathematics faculty members interested in K-12 reform, the department chair and staff from the Orange County Department of Education began meeting to explore the potential of an expanded version of the CAPI model for improving mathematics education in the region's low-performing middle schools and high schools.

The planning team looked at high schools with low mathematics achievement and narrowed its focus to eight. OCDE staff talked with district personnel, who then approached the principals of the eight schools. Five responded enthusiastically to the opportunity to participate in the program.

With the five schools on board, the planning team, now expanded to encompass district administrators, principals and assistant principals, met several more times over the next couple of months to collectively formulate and refine the project. CSUF, with its extensive experience in K-12 mathematics reform, its 30-year history of partnerships with K-12 organizations and its institutional resources for managing the grant, was selected as the lead organization in the partnership. Overtures were made to the feeder middle schools for each participating high school to solicit their participation, and they too responded enthusiastically.

Several important milestones in the planning process were achieved at this stage: getting commitments at the district and school levels to focus on mathematics reform and achievement and to make it a priority; getting all the teachers in these schools excited about participating; and getting them to agree to work together to improve the performance of their students. To establish baseline information about teacher preparation and their need for content and pedagogical support, a questionnaire was devised and administered by CSUF faculty, who used it as an opportunity to visit the schools and meet with the mathematics teachers. The teachers' responses, as well as school data and student data, including SAT-9 math scores, CST math scores and additional teacher data provided by the schools, helped shape the TASEL-M program. Among the things teachers identified that would be helpful were time for collaborative planning, help with ELL students and better methods for teaching difficult topics, especially in algebra. They also requested professional development in the mathematics assessed by the CAHSEE, algebra and pre-algebra and aligning instructional materials with state standards.

The planning process was facilitated by the long history of collaboration between the partners, especially CSUF and OCDE, which have been working together on different mathematics-related projects since 1973. Recent partnership projects have included NSF-funded Content, Confidence, Collaboration (C^3) and the series of professional development institutes (see "The higher education environment," above), as well as ongoing participation in such organizations as the Orange County Mathematics Council. CSUF has also collaborated with all the participating school districts on other projects. Through the Orange County Mathematics Project at Fullerton, CSUF works with the Garden Grove Unified School

District and through CAPI works with districts throughout its service area. (See "The higher education environment," above, for more information about these programs.) In addition, with the MDTP as the focus, CSUF works with teachers in all the districts, conducting workshops in how to use the test results and sponsoring an annual conference. CSUF also worked with the districts on Secondary SAFEMAP, an Eisenhower-funded program that focused on improving the preparation of secondary school mathematics teachers in Orange County districts, and through the MISS program with the Newport-Mesa School District and Estancia High School.

To provide additional guidance and resources, TASEL-M will draw on exemplary programs such as Nancy Love's work at TERC-Alliance, the Northwest Regional Education Lab, the Stiggins Assessment Training Institute and the Southern Regional Education Board's High Schools that Work program.

Results from Prior NSF Funding

CSUF has had numerous NSF grants, all but the following more than five years ago.

Students Using Mathematics Successfully (SUMS) (ESI-9552868: 1996-2001)
SUMS used the current California Mathematics Framework (1992, 1999) and National Council of Mathematics (NCTM) Standards (1989, 1991, 1995, 2000), as models for professional development of the 1620 teachers and 480 instructional assistants and administrators (grades preK-9) in the Santa Ana Unified School District. The project galvanized parents, teachers, support staff, administrators, and community advocates who expect quality education for students. The project changed classroom behavior of teachers as outlined by the NCTM standards, teachers' attitudes and self-confidence in math, increased parent and community involvement, focused on students' using materials addressing the NCTM standards, raised teachers' expectations of English language learners (ELL), and increased teachers' awareness of gender equity in the classroom. Over the past three years, students in Santa Ana have made gains in math achievement, and many administrators are convinced that it is because of the SUMS Project. Overall, the evaluations written by the participants were extremely positive.

SUMS initiated community/business partnerships with 1) AmeriCorps involving homework centers in schools and community centers; 2) the Santa Ana Public Library to place children's literature books that integrate math in SUMS professional development libraries (the books are used in the SUMS professional development curriculum); 3) Allergan Corporation, which has helped fund the district Math Field Day; and 4) Santa Ana Networks, a consortium of CSUF, the University of California, Irvine, Santa Ana College and Santa Ana Unified School District that helped support Math Clubs and Family Math. SUMS also developed a relationship with the office of the mayor, who presents the annual Santa Ana/CSU Fullerton Mathematics Scholarship each fall.

SUMS produced documents for in-district use, including substitute teacher kits, math club coach handbooks, April is Math Month activities for home, and Professional Development Curriculum units. A document called "An Educator's Guide to Answering Parents' Questions on Mathematics" was also developed, published in the NCTM journal, *Teaching Children Mathematics*, in September 2000, and shared with all school districts in Orange County, CA. Three presentations of SUMS work have been made at NCTM annual meetings—in 2000 and 2001 and at an NCTM research pre-session in 2002.

Teachers' knowledge and practice were positively impacted as SUMS improved their attitudes toward teaching mathematics; broadened their pedagogical strategies; increased their mathematics content knowledge; made them more confident teaching mathematics; and augmented their ability to help others teach mathematics. (2000-2001 SUMS Report to NSF by Dr. Ruth VonBlum).

Goals, Objectives and Benchmarks

Goals

- To improve mathematics achievement in the targeted schools by implementing a program based on deep analysis of data collected from each school.

- To increase the mathematics achievement of students as measured by the SAT-9 and newly adopted CAT-6, California Standards Test, Golden State Exam (GSE), CAHSEE and ELM in five low-performing high schools and their feeder middle/junior high schools in Orange County, California.
- To improve teachers' mathematics knowledge and skills in order to deepen student understanding and retention of the mathematics taught.
- To engage teachers to work collaboratively in identifying the essential concepts and prerequisite understanding and skills in the California mathematics standards.
- To bring about a cultural change in the mathematics teaching environment at the participating schools, encouraging teachers to focus on student learning.
- To establish an ongoing mathematics education partnership between CSUF, OCDE and the five clusters.

Objectives

- At the end of five years, STAR mathematics scores in the participating schools will close the gap to the state average.
- At the end of five years, the number of students taking math analysis (pre-calculus) in the participating schools will increase by 50%.
- At the end of five years, teachers in the participating schools will collaborate on a regular basis to use data to make program and instructional decisions.
- At the end of five years, teachers' instruction in the participating schools will reflect increased pedagogical content knowledge.

Benchmarks

- STAR scores will increase annually at each grade level in the participating schools.
- The number of students taking high school mathematics courses will increase annually.
- Teachers' math content knowledge, as measured by the MDTP, will increase each year.

Program Design

TASEL-M is a multifaceted program that will target 104 mathematics teachers at five Orange County school "clusters," which include the five low-performing high schools that opted to participate and their eight feeder middle and junior high schools. Through them, the program will reach 8,927 high school students and 7,210 middle and junior high school students. In addition, most professional development components of the program will be open to teachers at continuation high schools in the participating districts.

TASEL-M is primarily a professional development program, but one that uses collaborative professional development as a means to a specific end—namely, improving students' achievement in mathematics. Instead of addressing teachers as passive "sponges" to absorb new information, then sending them away to process it independently, TASEL-M demands that teachers take an active role in their professional development and work collaboratively, empowering them with information, knowledge and teamwork. It will teach them how to analyze assessment data in depth, share their classroom experiences and develop new, standards-based approaches to curriculum and pedagogy. It will help them become student-focused rather than subject-focused, with an eye toward increasing student successes in mathematics. The nature and form of the professional development are expected to change administrative practice in the school and the classroom, effecting a cultural change that creates a self-perpetuating climate of improvement and achievement.

TASEL-M centers around four specific strategies: using data to get results, improving classroom assessment, coaching and mentoring, and increasing pedagogical content knowledge.

Using data to get results

Consistent with Nancy Love's model, mathematics teachers, in collaboration with principals and counselors at the participating schools, as well as five peer coaches and five CSUF mathematics faculty partners (see "Coaching and Mentoring," below), will learn how to collect and analyze student data and apply their findings to make instructional and assessment decisions that address student needs. At a series of summer institutes, through peer coaching during the school year and in consultation with CSUF faculty partners and OCDE staff, they will examine such data as standardized tests; other state assessments; classroom assessment results; examples of student work; teacher surveys on classroom practice; teacher surveys on concerns and needs; surveys on student aspirations; master schedules showing mathematics course offerings; demographic breakouts of students taking algebra and geometry; interviews with teachers, administrators, students and parents; demographic breakouts of students participating in mathematics clubs; and classroom observations. Foremost among their tasks will be to consider the ways they can change instruction as a result of the data analysis.

Participants will also learn how to disaggregate the data and factor it into their instructional decisions. They will identify the math concepts and lessons reflected in the state standards and assessments and how to help their students master them. They will learn how to involve their students in the assessment process, bringing them in as partners to help define the criteria by which their work will be judged so they too have a stake in their own learning—a model outlined by Stiggins (*Phi Delta Kappan*, November 1999).

During the summer institute, the teachers themselves will take the Mathematics Diagnostic Testing Project exams, to give them a sense of what their students will be facing. The test results will also highlight where their own weaknesses lie so these can be addressed during the school year via mini-courses.

Improving classroom assessment

Building on Stiggins's and Black and Wiliams's findings that ongoing classroom assessment is the key to student motivation and achievement, the coaches and CSUF faculty partners will be trained in student-involved assessment techniques that help students seize control of their own academic futures. They, in turn will teach the teachers how to work in teams to improve their own assessment literacy and implement student-involved assessment in their own classrooms, essentially using the same techniques to teach them that they will be using with their students.

The process will center around three approaches: student-involved classroom assessment, which brings the students in as partners in the assessment process and invites them to define the criteria by which their work will be judged; student-involved record keeping, which brings students into the process of monitoring improvements in their performance through repeated self-assessment over time through, for example, building portfolios of evidence of their success; and student-involved communication, which brings students into the process of sharing information with others about their success, through, for instance, student-led parent conferences. These approaches help students see, understand and appreciate their own progress toward achievement, allowing them to feel in charge of the assessment process and enabling them to build the self-confidence they need to continue embracing new learning experiences.

Participants will learn to gather dependable information about student achievement and use the assessment process and its results to benefit students. They will learn to communicate effectively about student achievement and to involve students in the assessment, record keeping and communication process in order to maximize motivation and learning. They will gain understanding about the power of learning teams or study groups as a professional development strategy for assessment literacy.

By learning the student-centered assessment practices, the five CSUF faculty partners will be able to incorporate them more fully into CSUF's methods course for preservice mathematics teachers and thereby increase the assessment capabilities of future teachers and institutionalize improved assessment techniques into CSUF's teacher education curriculum (see "Training preservice teachers," below).

Coaching and mentoring

According to Gene Bottoms, in *Raising the Achievement of Low-Performing Students: What High Schools Can Do*, a 2002 report of the Southern Regional Education Board on the High Schools that Work program, low-performing schools need outside technical assistance to improve, and many high schools that are not considered low performing need help to improve the performance of their low-performing students. Furthermore, he notes, current funding available from federal sources is usually not adequate to obtain the level of on-site technical assistance, coaching and professional development needed to achieve rapid improvement in student achievement. At least two states, he reports—Kentucky and North Carolina—have experienced success with low-performing high schools with the selection, development and assignment of a highly experienced educator or team of highly experienced educators to work with low-performing schools over an extended period of time. In both states, the schools that have received such support have been able to improve student performance.

Consistent with Bottoms's findings, a central component of TASEL-M will be ongoing onsite coaching and mentoring at each participating school, to support and extend what teachers learn at the summer institutes. Five coaches, who may be retired master teachers or outstanding inservice teachers on loan from their districts, will receive special training to assist the teachers at the school sites. Each one will be assigned to a cluster, where he or she will have multiple responsibilities, such as guiding teachers in examination of student work and in student-involved classroom assessment; assisting teachers in diagnosing student difficulties with mathematics and planning appropriate intervention and accommodation strategies for all students; assisting with curriculum and pacing of programs to ensure that the depth of mathematics is presented for greatest student understanding, using adopted and supplemental materials, as appropriate; conducting focused observations and providing peer review support to mathematics teachers; providing formal and informal feedback and professional development for mathematics teachers on instructional strategies and classroom practices aligned to research and standards-based instruction; and planning, facilitating and attending mathematics department meetings/study groups to assist teachers in maintaining pacing of instruction, utilizing data to determine the next instructional strategies for improving student achievement in mathematics and collecting data for the project.

Although each cluster will work out its own schedule, it is envisioned that the coach will spend one day a week at each middle or junior high school and a minimum of three days a week at the high school. Each coach will likely teach a class section at the high school in order to reduce the class size and lighten the teaching load for the rest of the teachers. His or her classroom will also provide a venue for modeling exemplary teaching that is steeped in research and that can be shared with colleagues. Because much of the mathematics content on the CAHSEE is based on the seventh- and eighth-grade standards, at the middle schools, the coaches will pay special attention to making sure that the middle and junior high school participants develop a sound standards-based curriculum.

Each of the five participating mathematics professors at CSUF will provide backup for the coaches and serve as a personal faculty advisor to the participants, especially on content and pedagogy. They will meet with faculty regularly onsite and be available to answer questions online or by phone.

Pedagogical content knowledge

Because many of the participating mathematics teachers are on emergency or supplemental credentials (allowing them to teach only the lower-level courses) and lack either a major or minor in mathematics, increasing teachers' knowledge of mathematics and how to teach different concepts will be a top priority of TASEL-M.

Using data supplied by the teacher background questionnaires administered by OCDE staff during the project's planning phase, scores on the MDTP during the summer institutes, and teacher requests, CSUF faculty partners will develop a series of mini-courses designed to fill in any gaps in teachers' knowledge of mathematics content and pedagogy. If teachers need the content that is available through the existing professional development institutes offered at CSUF, they may enroll in one of those. In addition, the

mini-courses, workshops held during the summer institutes and school year, and the coaches themselves will model appropriate pedagogy for the content being presented.

Also providing guidance for this component will be the teachers' own individual professional development plans, which they will formulate during the summer institutes. Working with staff from OCDE, and the coaches and CSUF faculty partners for their clusters, they will identify what they as individuals need in order to do the best job possible in the classroom. It will then be up to the coaches, CSUF faculty partners and OCDE staff to support them in pursuit of the knowledge, skills and understanding they require. Every summer during the institute, teachers will review, modify and adjust their plans; teachers new to the project due to staff turnover will formulate their own professional development plans.

In addition, TASEL-M will help teachers identify materials with lessons relevant to the standards, which may not exist in the current texts. Using AAAS Project 2061's evaluation criteria of middle school mathematics and algebra textbooks as a starting point, project staff will guide teachers toward selecting supplemental materials that have depth of content (conceptual and skills development); identify a sense of purpose for mathematics; build on student ideas about mathematics; engage students in mathematics; develop mathematical ideas; promote student thinking about mathematics; assess student progress; and enhance the mathematics learning environment.

Additional components

Training preservice teachers. Beyond working with inservice teachers, TASEL-M will provide an opportunity to train preservice teachers to work effectively within the collaborative, standards-based environments being created at the participating schools. The CSUF mathematics department conducts a methods course for preservice teachers, which they take before student teaching. The course is part of an extern semester, during which students visit and observe classrooms. Once TASEL-M is in place, the preservice teachers will visit the participating schools, where they will gain a new understanding of student learning and school cultures.

Furthermore, TASEL-M will also enable CSUF to prepare student teachers more effectively by applying the lessons learned and refined during the project, in terms of content, pedagogy, assessment and working as team members in mathematics departments. For student teaching, the preservice teachers will be placed in the participating high schools and middle schools, and during the summers, they can take part in the TASEL-M summer institutes.

Parent support. Because parental support is essential for student achievement, TASEL-M will incorporate a parent component, to be designed by the mathematics teachers at each school. Ideally, this component will bring parents to campus twice a year, where presentations or activities will reinforce the value of a college education for their students and the central role that mathematics plays as a gatekeeper to higher education. It will likely address the importance of mathematics in the workplace and the fact that to a great extent, the math skills a person has determine how high he or she rises professionally.

As part of this parent component, the fall Back to School Night at each school will focus on the CAHSEE, with a special emphasis on mathematics, and advise parents on what to do if their children are failing. Tutoring options, after school and online programs will also be outlined.

In addition, CSUF's campus outreach staff will offer seminars to help parents learn what it takes for their students to prepare for college, as well as financial aid information. TASEL-M will work with the community liaisons at each school to help organize the parents and bring them out for the various activities.

Program Management, Staffing and Operation

CSUF will be the lead organization for TASEL-M. No other organization in Orange County is as experienced in K-12–higher education partnerships and at working with K-12 faculty and staff, nor as well-positioned to coordinate and interface with the different schools, agencies or staff members involved

in the project. As a major university with a long history of successful NSF and federal government grants, CSUF also has the resources, personnel, experience and accountability to serve as fiscal agent. (See "The higher education environment," under Overview, above.)

Implementation

TASEL-M will be implemented over five years, with a strong initial focus on algebra and pre-algebra in order to ensure that the teaching and curriculum are especially solid in the early courses at the high schools. In successive years, the emphasis will shift to increasingly advanced mathematics courses, as appropriate at each school.

TASEL-M will begin in spring 2003, with the recruitment of the five coaches. CSUF will spearhead the recruitment effort, drawing on recipients of more than 160 master's degrees in mathematics education it has awarded over the past two decades and its many connections in K-12 education, and working with the participating high schools to identify and attract appropriate candidates. These may include retired teachers; inservice teachers on loan to the project, who are interested in gaining additional mentoring experience; or out-of-state teachers. Because of the shortage of top mathematics teachers, arrangements with the coaches may have to be flexible, depending on the availability of the leading candidates. Some, like the retired teachers, may prefer to work half-time, which will necessitate hiring two half-time people to fill a single coaching slot. While it would be ideal to retain the coaches for the full five years of the program, it may be necessary to return inservice teachers to their home districts, or to renew their contracts on a year-by-year basis.

During summer 2003, the coaches and CSUF faculty partners will undergo at least five days of training in coaching and mentoring, facilitated by an expert in the field. The Orange County Department of Education will take the lead in training the coaches, drawing on staff who are trained in peer coaching and facilitation skills, or hiring qualified trainers they have worked with before. OCDE, which has a major initiative under way to introduce the county's teachers to Stiggins's model, will also spearhead training for the student-involved assessment, led by co-PI Dianne DeMille, Ph.D. (See "Staffing," below). She, along with other qualified OCDE staff, will serve as trainers of trainers for that component.

This training will be followed by a two-day retreat, which will bring the coaches, five CSUF faculty partners and participating teachers, principals and OCDE staff together in a friendly, social environment to get acquainted, learn about the program and take part in team-building and goal-setting activities to start them working together and considering the roles they can play in pursuing their goals.

A five-day summer institute after the retreat will begin the main work of TASEL-M. At the institute, the five coaches and five participating CSUF faculty partners will be assigned to their clusters, and teachers, guided by the coaches, faculty partners and OCDE staff, will learn strategies and mechanisms to use throughout the year, including ways to work together in teams, the ground rules for working with the standards, what it means to align curriculum with the standards, and new approaches to classroom assessment. Counselors and principals at the participating schools will take part in the portion of the summer institute dedicated to learning about using data to get results. During the 2003-04 school year, the coaches, OCDE staff and CSUF faculty partners will work with teachers at the school sites.

In each subsequent summer for the duration of the project, through 2007-08, there will again be a retreat to gauge the participants' progress in the process and determine next steps, followed by a five-day summer institute. Summer institutes in years 2 through 5 will take place at the high school sites and will focus on different topics in mathematics. There will be some joint high school–middle school activities, as well as break-out sessions for high school and middle school. For high school teachers, the topics will progress from pre-algebra and algebra through geometry, algebra 2, math analysis and calculus. The institutes for the middle school teachers will address areas of student weakness, as determined by the results of the MDTP and CST. For example, depending on student scores, topics may include integers, fractions, decimals, exponents and square roots, simple equations, geometric concepts and applications, linear equations and inequalities, polynomials and graphical representations. For both high school and middle school, the institutes will set up plans and strategies for tackling the specific areas of focus during the school year and developing the skills teachers need to follow through on their own, including how to

look at the standards for that topic, analyzing the existing curriculum and textbooks for alignment with the standards and how to locate and identify exemplary curriculum materials to supplement the text. The institutes will also explore issues of articulation between middle schools and high schools. The needs of teachers coming in new mid-program will be addressed on a case-by-case basis (drawing on the existing CSUF professional development institutes or mini-courses), as will the needs of teachers, new counselors and principals who require more training in using data to get results.

An additional summer component of TASEL-M during years 2 through 5 will pair a novice teacher with a master teacher to co-teach a mathematics course in a summer school classroom. This co-teaching may or may not take place at the teachers' own schools. Two afternoons a week for the five weeks of summer school, they will do lesson planning and professional development together. This format will provide an opportunity to improve both the pedagogy and the pedagogical content knowledge of the novice teacher.

Staffing

Principal investigators

David L. Pagni, Ph.D., professor of mathematics at CSUF, will serve as TASEL-M's principal investigator, project director and one of the faculty partners. A member of the CSUF mathematics department faculty since 1969, he has a long history of accomplishment in K-12 mathematics education partnerships in Orange County. He has served as principal investigator on numerous successful projects since 1973, most related to teacher professional development and increasing precollege students' mathematics knowledge and achievement. He is the author of two books and more than 175 articles on teaching mathematics and has received numerous awards for his teaching and contributions to mathematics education.

Since 1987, Dr. Pagni has been principal investigator for five NSF projects focusing on professional development of K-6 teachers and co-principal investigator for an Eisenhower project for mathematics teachers in grades 7-12. He is currently PI for an NSF Local Systemic Change project (K-8) with the Santa Ana Unified School District and a GEAR UP project with the Anaheim High School District. He has served as an officer in the California Mathematics Council and Orange County Mathematics Council and has made over 440 presentations at conferences or schools to mathematics teachers at the K-12 levels. As director of the California Academic Partnership Program Mathematics Diagnostic Testing Project, he has hosted conferences for grade 7-12 mathematics teachers in Orange County since 1986. Dr. Pagni is also the editor of the Orange County Mathematics Council newsletter, *Math Matters*.

His responsibilities as PI and project director will include organizing, coordinating and delegating the tasks necessary to carry out the program; serving as liaison between the participants; working with the different project staff to ensure smooth implementation; as well as heading the steering committee.

Dianne DeMille, Ph.D., coordinator of GSE/Mathematics/Assessment-Region IX for the Orange County Department of Education, will serve as co-principal investigator. She has 30 years of experience in education at both the K-12 and post-secondary levels, as a teacher and administrator. Her classroom experience, which was at the secondary level in mathematics, earned her many awards for excellence, including teacher of the year and several Who's Who designations. She has presented on many mathematics and assessment topics for the NCTM, California Mathematics Council (CMC) and state, county and district conferences. Dr. DeMille has worked with the Orange County Department of Education (OCDE) in mathematics and assessment for the past ten years. She has conducted many workshops with administrators and teachers in mathematics, assessment and standards-based instruction. Part of her responsibility has included the coordination of the three mathematics development teams for California's GSE test development.

Patricia Howell, Ed.D., assistant superintendent of education and services for the Fullerton Joint Union High School District, will serve as co-principal investigator. She has 29 years of experience in education at both the K-12 and post-secondary levels. She has served as a site principal of a National Blue Ribbon School and two California Distinguished Schools and has directed grant programs and special projects for the district, where she is also responsible for overseeing the development and implementation

of curriculum and content standards, and the assessment and curriculum alignment program. Dr. Howell is also in charge of the district professional development plan and articulation efforts with four feeder school districts.

The responsibilities of the co-PI's will include oversight of the project, along with the PI, and serving as leaders on the steering committee who represent their respective constituents.

Coaches

The five coaches will provide ongoing support and assistance to participating mathematics teachers in the TASEL-M program, under the direction of the school principals, OCDE staff, and CSUF mathematics faculty. They will be recruited via district newsletters, advertisements in national journals and CSUF's mathematics education Web site. Their qualifications will include five years of mathematics teaching experience at the secondary school level, a regular California Secondary Credential (or eligible), experience in collaborative planning and delivery of differentiated staff development to classroom practitioners**,** a willingness to continue with regularly scheduled mathematics content and pedagogy training and mathematics coaching and facilitation training, and ability to travel to the school sites. Ideally, the candidates will also have knowledge of differentiated classroom instructional practices that promote student academic success in mathematics; expertise in teaching mathematics at the secondary level with depth of content and high student success; and knowledge and understanding of the needs of a diverse student population.

CSUF faculty partners

CSUF mathematics professors **Martin Bonsangue, Ph.D.**, **Gerald Gannon, Ph.D.**, **Armando Martinez-Cruz, Ph.D.** and **Harris Shultz, Ph.D.,** along with PI David Pagni, will serve as the faculty partners. All teach undergraduate and graduate courses at CSUF, including those for prospective secondary school teachers. Between them, they also have experience teaching at the junior high and high school levels. All have strong backgrounds in developing professional development programs for secondary school teachers in the use of technology, pedagogy and content understanding—work they have done in partnership with local schools. In addition, they have published extensively in NCTM as well as Mathematical Association of America (MAA) journals.

Other staff

Additional TASEL-M staff include a part time (20%) ELL expert from the OCDE to work with teachers and coaches at the school sites in how to prepare and teach curriculum for English language learners, and part-time clerical support staff, 50% provided by CSUF and 50% by OCDE.

Evaluators

A team of three evaluators will oversee the TASEL-M evaluation (see Assessment/Accountability, below). **Ruth Von Blum, Ph.D., Judith Edgington, Ph.D.** (Mar Vista Research) and **Michael Oliver, Ph.D.** (Monterey Bay Heights Research) will evaluate TASEL-M. Two of the three have been lead evaluators on five NSF Local Systemic Change and two Collaboratives for the Excellence in the Preparation of Teachers projects. In addition to being a science educator, Dr. Edgington has taught physics and mathematics, and Drs. Von Blum and Oliver have evaluated reform projects in both mathematics and science.

Governance

A steering committee will be formed to oversee the project. The committee will consist of the principals of the five high schools, the PI and two co-PI's and the four other CSUF faculty partners. This committee will meet quarterly during the first year and biannually thereafter, monitoring the progress of the project, providing feedback and guidance to the PI's and helping to determine future courses of action.

Each high school principal will coordinate the activities and concerns of all the schools in his or her cluster. He or she will present any input from the school sites to the steering committee to resolve any issues that arise.

Incentives for participation

Because TASEL-M will require a considerable investment of time and energy from the teachers, they will be paid a stipend for participating in the summer institutes and academic year follow-up sessions and will have the opportunity to earn college credits and professional development units for their participation, which may help qualify them for salary increases.

CSUF will pay the novice teachers a stipend for co-teaching summer school during years 2 through 5, allowing them to teach alongside the master teacher being paid by the district.

Sustaining the reforms

Because one of the primary goals of TASEL-M is to bring about a cultural change in the mathematics departments of the participating high schools and middle schools, the program by its very nature should be self-sustaining once it has been institutionalized at each site. With faculty members who have been trained to work together, the coaches will be unnecessary because the faculty will have changed how they operate. New teachers will be inculcated with the new, collaborative philosophy and will understand when they are hired the philosophy behind the department and the commitment to teamwork in ensuring the success of every student. CSUF will instill in the new teachers it educates the lessons of TASEL-M, especially how to work collaboratively with their peers, how use data to promote student achievement and the importance of student-involved classroom assessment. New teachers with gaps in their content knowledge will be referred to existing CSUF programs and courses designed to address those topics. The partnership itself will become a permanent collaboration, establishing ongoing relationships that continue to lead to improved teaching and enhanced learning.

The partners in TASEL-M are highly committed to reform in mathematics education and consequently will be pleased to take part in any NSF-sponsored research activities evaluating the efficacy of different approaches to enhanced learning. The NSF funds will in no way replace existing funds for mathematics and science among the participating organizations.

Assessment/Accountability

The evaluation of TASEL-M calls for using the districts' standardized student assessments of mathematical content knowledge (e.g., SAT-9 or CAT-6, CST, CAHSEE or GSE), as well as classroom assessments to evaluate the project's impact on student mathematics achievement. Impact on teachers' mathematical content knowledge will be assessed by the MDTP. The external evaluation will also: 1) Monitor the implementation of the project; 2) Provide formative feedback on the professional development implemented at schools and during the summer institutes; 3) Provide ongoing evaluation of the impact of the professional development on school culture and teachers' classroom practice; and 4) Conduct summative evaluation of project accomplishments. The following table lists the various evaluation strategies to be employed during the project.

	Implementation	**PD Formative**	**Impact on school culture, teacher practice, student achievement**	**Sum-mative**
Observations	Planning sessions, selection of materials, departmental meetings	Summer institutes, leadership training, team site work (including coaching, modeling)	Classroom, departmental, site, after-school programs	All

Interviews	PI's, project staff, OCDE and district staff, mentors, faculty	PD facilitators, project staff, participants	Principal, department chair, mentor/team, teachers, students	All
Surveys		PD facilitators, participants	Principal, department chair, mentor/team, teachers, students	All
Focus groups		PD facilitators, participants	PD team, teachers, students	All
Standardized mathematics assessments			Teachers (MDTP); students (e.g., SAT-9 or CAT-6, CAHSEE, GSE)	All
Journals		Facilitator/participants	Mentor/team/ teachers	All

The evaluators have had extensive training using the Horizon Research Inc. (HRI) mathematics and science classroom and professional development protocols that will be used when appropriate in this evaluation. Other instruments will be developed or found to assess the effectiveness of professional development or changes in attitudes and beliefs (e.g., CEPT or LSC meta-evaluation instruments). The evaluators have worked well with both the LSC and CEPT meta-evaluations and believe that they will work well with others in that role for this project.

Conclusion

TASEL-M is a targeted partnership between California State University, Fullerton, the Orange County Department of Education and four school districts that seeks to boost student achievement in mathematics at five low-performing high schools and their eight feeder middle schools in Orange County, California. It will reach over 100 mathematics teachers and more than 16,000 students, giving the teachers the knowledge and tools they need to accurately diagnose students' deficiencies, assess their progress, adjust the curriculum and pedagogy and transform the departmental culture to maximize student learning in mathematics.

Collaborative teacher professional development is the cornerstone of TASEL-M's multi-pronged approach, which is standards-based and grounded in research. The project will center around four strategies: using data to get results, improving classroom assessment, coaching and mentoring, and increasing pedagogical content knowledge. It will demand that teachers take an active role in their professional development, share their classroom experiences with one another, improve their content knowledge and develop new, standards-based approaches to curriculum and pedagogy. It will help them become student-focused rather than subject-focused, in order to increase student successes in mathematics. As their teachers become more knowledgeable and effective, students in turn will acquire the mathematics skills, knowledge and confidence they need to take more advanced mathematics courses in high school and college.

The nature and form of TASEL-M are expected to change administrative practice in the schools and the classrooms, effecting a cultural change that creates a self-perpetuating climate of improvement and achievement. The partnership itself will become a permanent collaboration, establishing ongoing relationships that continue to lead to improved teaching and enhanced learning.