



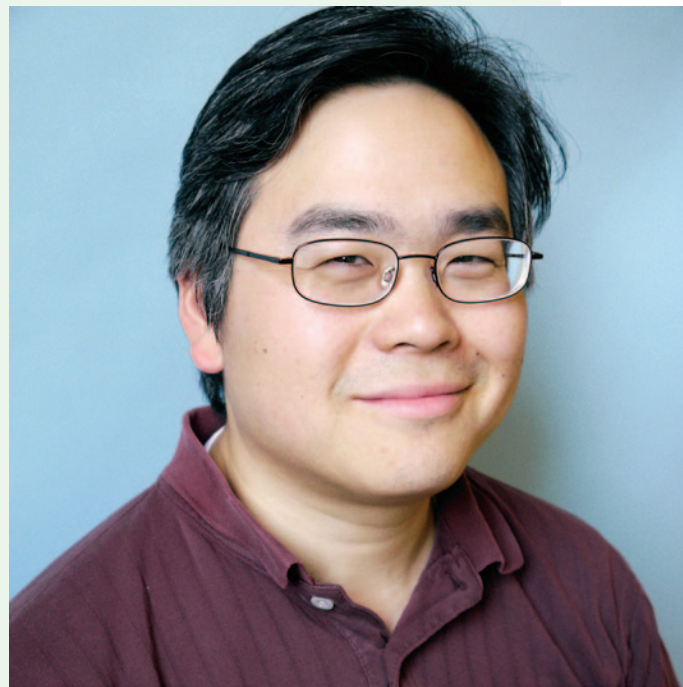
Math Education:

A FORTUNATE APPROACH

BY KIMBERLY SMITH

“If you make the class a narrative, you may just hook the student the way you can capture a reviewer with an interesting grant application.”

DR. ERIC HSU, a math professor at San Francisco State University, employs two highly useful tools in his effort to win funding for research grants on math education: Luck. And story telling. Hsu’s homepage lists some of those grants, including the \$489,000 career grant he won from the National Science Foundation (NSF) to research math teaching. “The number one reason I get these grants,” he says modestly, “is because I am lucky.” The second reason is that “people who get the money have worthwhile projects.” Luck helps in finding and developing a good project, too, he says. “Maybe your project is interesting to you but not to others.” Finally, Hsu makes his grant applications “fun to read, and they tell a story,” so that readers—including reviewers at granting agencies—want to ask, “What happens next?” Ultimately, Hsu’s good fortune will benefit thousands of California educators and their students as he investigates new ways to improve the teaching and learning of math.



Eric Hsu, Professor of Mathematics

undergraduate students interested in teaching with K-12 teachers already employed in area public schools. Kysh was working with SF State graduate students and wanted to create a more intense preparation for their future teaching. Hsu wanted to pair graduate students who were teaching algebra at SF State with K-12 teachers.

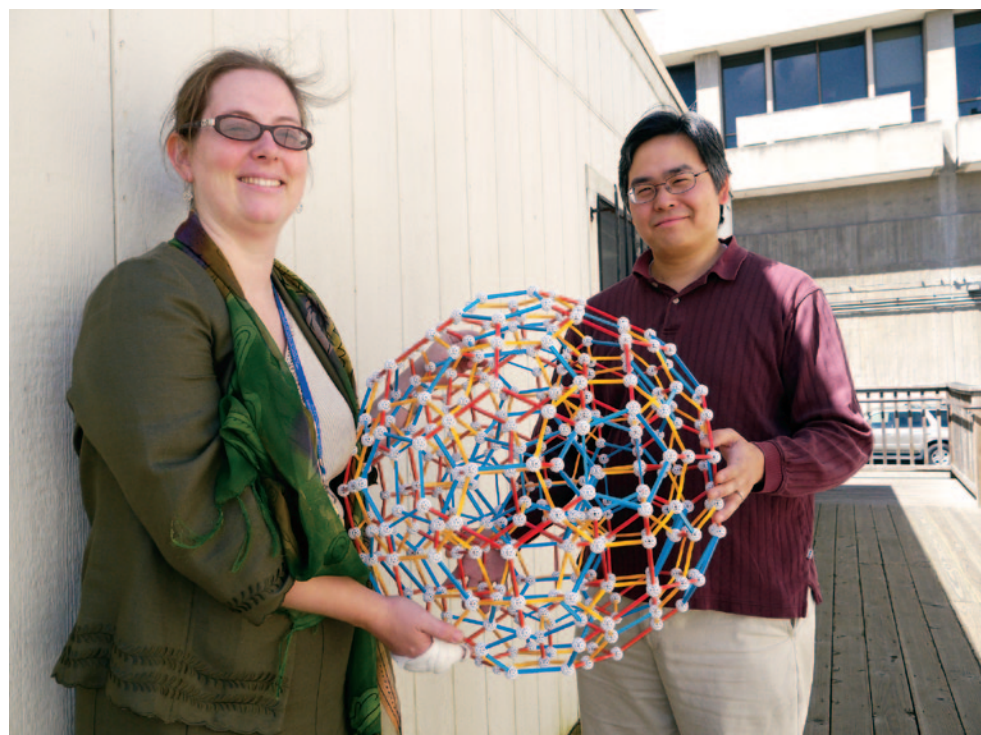
As luck would have it, NSF began funding new Math Science Partnership projects the same year that Hsu, Resek, and Kysh were brainstorming their related ideas. The three formed a team and began working on a grant proposal. The best approach, they decided, would be to describe exactly how their three-way partnership evolved. Hsu recalls that they looked at each other and said, "Why can't we just say that Eric had this idea, and Judy and Diane had those ideas, and we were hanging out and we tried to combine them?" They wrote the proposal that way, more or less, Hsu says, "and we got the money, so at least it didn't hurt us!"

Hsu credits continued good luck in devising one worthwhile research plan after another. In 2008, for example, he helped develop "PRIME"--Partners as Resources to Improve Mathematics Education--with SF Unified School District. In an attempt to help 4th and 5th grade teachers deepen their math knowledge, they proposed a five-day summer institute where teachers could gain math skills that would, in turn, highly benefit their teaching and thus their students. This, too, won a \$1 million dollar grant and led to a successful training program.

Hsu's own career began with an abiding math interest that appeared in grade school and grew. In middle school, he found it fun to solve math problems printed in puzzle books. During high school, Hsu continued to excel in math courses, including the beginning and advanced levels of calculus. His math skills inspired him to take an introductory physics class during his first

As an example of how luck and story telling helped him win a grant and start a successful educational program, Hsu tells the

background of the NSF Math Science Partnership project he founded with SF State professors Diane Resek and Judy Kysh. Soon after Hsu began working as a math professor at SF State in 2001, the three met up at a teaching conference and began talking about ideas for projects to help graduate and undergraduate students improve their math teaching skills. Resek wanted to pair



year of college, and to entertain the idea of becoming a physics major. He found physics class to be quite boring, however, and his pursuit of the subject ended soon thereafter. His success with calculus and later math courses led him to pursue an undergraduate degree in mathematics. He continued to think that "math class was still a little boring," however, and this left his future direction somewhat undecided.

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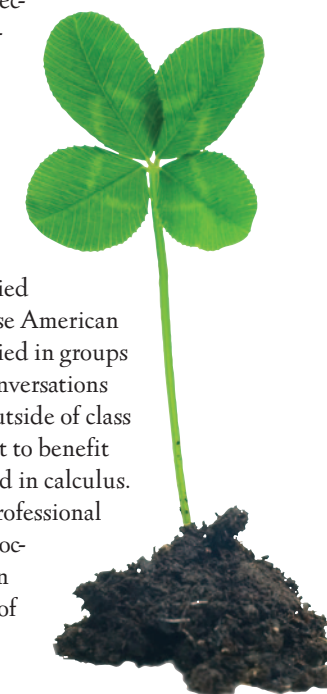
p48. Dr. Brandy Wieggers, CSME Program Director of Outreach and Student Success, and Professor Hsu hold nested polyhedra models built by secondary school students in SF Math Circles.

p49. (top) Professor Hsu challenges (left to right) Jessica DiSanto, Erin Davis, and Jacqueline Benitez to create all the Platonic Solids using Polydrons as facilitates.



p49. (bottom left to right) Kyra Redenbaugh and Joy Yoon deduce polygon angle formulas from pattern block explorations as Professor Hsu and Dr. Wieggers facilitate.

develop methods to help these students learn the subject more effectively. One particular study focused on how black and Chinese American students tended to study calculus. The results showed that black students often studied alone, while Chinese American students often studied in groups and actually had conversations about the subject outside of class



In 1991, he was accepted to do graduate studies in mathematics at UC Berkeley. It was there that a special Berkeley program ignited Hsu's interest in education. He learned about an honors program for minority students called the PDP or Professional Development Program. One goal of this program was to study how and why some minority students were failing calculus, and to

time. The group-study method turned out to benefit the group members and help them succeed in calculus.

In the 1990s, Hsu taught in the Professional Development Program and finished his doctoral studies in Mathematics. Luck was on his side once again: Hsu met the founder of

PDP, a MacArthur “Genius” Fellow named Uri Treisman. In 1998, soon after his graduation from Berkeley, Hsu joined Treisman’s math education team at the University of Texas at Austin. The work interested and satisfied Hsu, and in 2001, he took his current position at SF State to establish his own teaching and research in the area.

In the decade since, Hsu has focused his research on mathematics education across the country. In one project, he has looked at how graduate students present calculus to undergraduate students and acquire productive methods of teaching this tough subject. “Graduate students who go into teaching calculus know very little about teaching,” Hsu says, “so it’s interesting to learn how these students go from knowing the subject of calculus to actually being

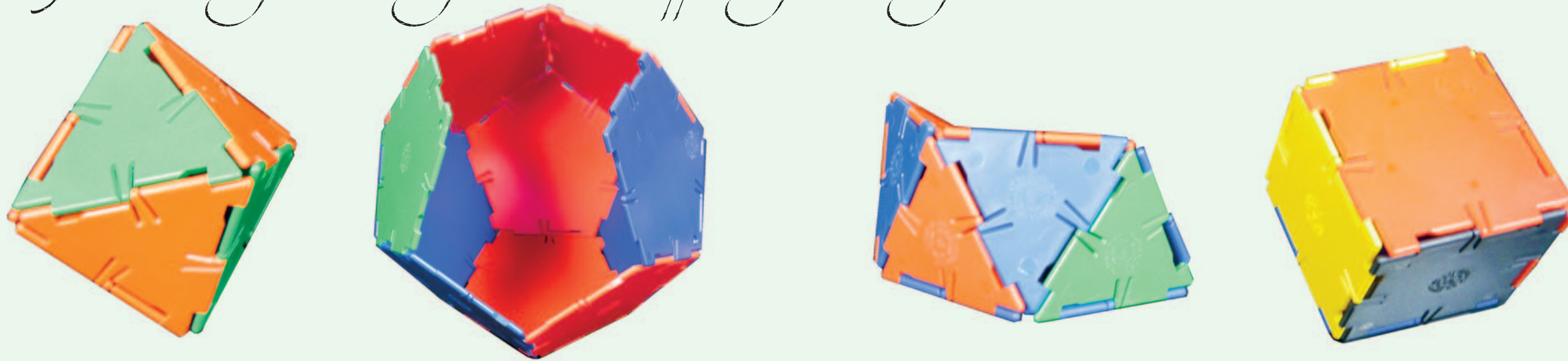
about their attitudes toward math, says Hsu. “Is it fun? Do you like memorizing stuff? Do you think it is all about being fast at answering problems?” They will survey the undergraduate students and graduate teachers both at the beginning and end of the semester to see if anything has changed and where the successes and failures occur. Hsu and colleagues hope that this study will answer the bigger question of how should instructors teach and students best learn calculus.

To capture his own math students’ interest, Hsu returns to storytelling. He tries to hook his students into the lessons of each class, he says, by teaching in a way that would encourage them to ask for more. Just as many of the grants Hsu must review are “too

major to teaching and support their preparation and early careers. Working with an advisory panel of other SF State math and science professors, Hsu helped found the Center for Science and Mathematics Education (CSME). Besides recruitment and financial support, the Center provides a place where future science and math teachers can improve their learning and motivation in a group setting. During the 2009-10 academic year, Hsu was one of several faculty co-directors for CSME. In early May 2010, Hsu was chosen to serve as the Center’s permanent director. Another faculty co-director who has worked alongside Hsu is astronomy professor Dr. Adrienne Cool. Cool describes Hsu as a very “innovative teacher

Teacher preparation and high achievement in science and math courses are easy stories to tell, Hsu adds, and this makes it all the easier to write successful grants. It also helps that many agencies and even some private individuals are anxious to support these kinds of programs. Since 2010, Hsu says, a private donor who wishes to remain anonymous and who happens to be a child of a teacher, has donated \$75,000 to CSME. This person believed in the importance of educating people to become good teachers and acted on that conviction. As the new director of CSME, Hsu has a lot of plans for the Center and his students. “Hopefully,” he says with a broad smile, “my luck will continue.” ❖

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able to teach it effectively.” No graduate class “really trains you to be the best teacher,” Hsu observes. “These students become good teachers by developing within their community of practice.” This, he explains, is a group of people engaged in similar work, be they personal friends, coworkers, or “old timers”—professors and instructors with many years of teaching experience. Hsu says that by developing their skills within this community, graduate students themselves acquire skill in the tough craft of teaching. Hsu’s project is currently in its first year, and Hsu will use his clear, compelling writing skills to help it advance. Hsu’s grant-writing “luck” has already helped win a \$2 million award for the work over five years.

In conjunction with a few other math researchers and the MAA (the Mathematical Association of America), Hsu will help create and conduct a survey of calculus teaching methods in over 100 schools across the country. They will gather facts from both graduate-student instructors and undergraduates on how the classes are being taught. Are they strictly lectures? Do the students ever work in groups? Are computer animations used to stimulate learning? And so on. The team will also ask undergraduate students

boring,” some students think of calculus class as inherently boring and hard to understand. If you make the class a narrative, Hsu says, you may just hook the student the way you can capture a reviewer with an interesting grant application. Through the large-scale survey research Hsu is conducting, he hopes to gather additional techniques from the ways others teach their calculus classes.

Student perceptions of calculus and other math classes have contributed, in a roundabout way, to a serious problem in California: A marked shortage of qualified math and science teachers. Because math and science are “hard and boring” for many students, many who could have succeeded leave the sciences. A minority of those declared majors actually finish their degrees in math or science. And fewer still choose to become teachers because they can generally command much higher salaries in industry and academia than in K-12 education. Finally, because the job and working conditions can be so challenging, most of the college graduates who do become math or science teachers quit after just a few years.

To help address this shortage, Hsu in 2004 proposed the creation of a campus center that would attract math and science

(who) cares deeply for his students and the students he mentors in CSME.” Says Cool, “We are extremely fortunate to have him in the college.”

One of Hsu’s on-going projects at CSME relates to the shortage of both math and science majors and teachers. Historically, about one-half of the declared majors in the College of Science and Engineering at SF State drop out of college or end up majoring in a non-science or math subject. Hsu feels that the teaching and tutoring methods in some classes may contribute to this attrition rate. SF State used to supplement “bottleneck” courses such as calculus and chemistry with help sessions, Hsu recalls, and these counted as one unit of college credit. The extra classes helped students succeed in these courses with high failure rates. Unfortunately, Hsu says, the University cut the help sessions for financial reasons.

In an attempt to help SF State retain more of its math and science majors, Hsu and colleagues at CSME will bring back these supplementary courses, and, says Hsu, try to “make them even better than before.” Once again, Hsu attributes a story-telling grant proposal to helping him win financial support for the project.

Update:

Since this article was written, Professor Hsu’s luck did continue. He and Professor Larry Horvath in Secondary Education at SF State were awarded a \$1.2 million grant from the National Science Foundation to expand the CSME Teacher Fellows program. The grant will last five years and will fund up to ten \$10,000 scholarships per year for future STEM teacher leaders. The development of these future STEM teacher leaders will be supported by the creation of expanded school and after-school partnerships, special coursework, and professional development activities. Each scholarship recipient will also agree to teach two years in an identified California high needs Middle or High School for every one year of funding.

