

AAAS NEWS & NOTES



Educators collaborate to optimize STEM teacher prep

AAAS 2016 Noyce Summit unites academics and practitioners to develop research agenda

By **Michaela Jarvis**

New Tech High School teacher Ben Woodford lives and breathes mathematics, and every day before class, he asks each of his students to send him a text. Their messages, however, may have nothing to do with equations or diagrams. Instead, they answer the question, what's going on that's most meaningful in your life?

Answers vary from the trivial to the tragic, the third-year teacher reported at the 2016 Noyce Summit education conference, but most importantly, the messages give Woodford an opportunity to know his students, to convey that he cares, to help out if he can, or at least to talk with a student facing a challenge. He said that his digital "daily check-in" is a crucial part of being an effective STEM (science, technology, engineering, and math) teacher in his high-need school district in Nipomo, California. "I don't know how I could do what I'm doing without it," said Woodford. "Being able to bond with students and create a trusting relationship helps us to overcome psychological hurdles that could prevent them from learning math."

Woodford's strategy is an example of a new current in education that advocates learning who your students are in order to teach them effectively. Presented at the 20 to 22 July summit, which was co-hosted by the AAAS Education and Human Resources Program and the National Science Foundation (NSF) Division of Undergraduate Education, the approach represented just one idea of potential value to the 500-plus attendees at the conference, among them, college and university faculty and researchers, students training to be teachers and researchers, and current K-12 teachers.

The NSF Robert Noyce Teacher Scholarship Program helps talented STEM majors and professionals to become K-12 science and math teachers. While building a community and giving teachers a venue where they can share ideas is among the important goals of the yearly Noyce Summit, this year's event also advanced a \$3.7

million AAAS initiative, funded by NSF, to help stimulate research and foster evidence-based innovations in the preparation of STEM teachers for high-need schools.

"What we want to do is provide a guide for researchers who want to investigate STEM preservice education," said Yolanda George, deputy director of the AAAS Education and Human Resources Programs, adding that the resulting information would be disseminated "as widely as possible" throughout the education field.

Responding to this country's critical need for STEM teachers, and for teaching that supports students all the way to graduation and employment in ever-expanding STEM fields, education researchers and practitioners have fought hard to build effective approaches, and AAAS has helped to spearhead those efforts, said Rush Holt, AAAS CEO and executive publisher of the *Science* family of journals. "The STEM education reform movement—hands-on, inquiry-based, standards-based—grew out of AAAS activities, meetings we convened," said Holt, who spoke at the conference, adding that STEM education is important, not only to provide the workforce needed in the 21st century, but also to ensure that citizens understand the importance of basing policy decisions that determine our future on sound evidence.

"You're the centerpiece of the national effort to give America the STEM education that we need, so there's a lot riding on your shoulders," Holt told the Noyce Summit attendees. "I don't think it's an overstatement to say it's the most important challenge facing the country right now."

The challenge of training enough effective STEM teachers in this country is complicated by persistent problems. For decades, experts have referred to a "leaky pipeline" in STEM education. "Of every 100 people who walk in [to earn a bachelor's degree], we have about eight who stay through getting a bachelor's degree in STEM and actually working in STEM. And for minority students, it's even

PHOTO: AAAS/COLELLA DIGITAL

Ben Woodford and teacher Sunshine Roque, of San Francisco's Lincoln High School, participated in a panel discussion.

worse. It really is dismal," said Roni Ellington, associate professor of mathematics education at Morgan State University.

The problem of recruiting STEM teachers is compounded by high attrition. Of every five new science teachers, one quits in the first year, said University of Pennsylvania Board of Overseers Professor of Education and Sociology Richard Ingersoll. That percentage can be dramatically improved, however, with preservice preparation such as coursework in teaching methods, practice teaching, instruction in selecting course materials, and child psychology classes, Ingersoll said.

Among the evidence provided at the conference of the need for improved outreach to potential STEM teachers was a graphic presented by Susan Singer, then director of the National Science Foundation's Division of Undergraduate Education. It showed that bachelor's degree attainment by age 24 in the highest quarter of the socioeconomic scale went from 40% to 77% between 1970 and 2013. For the lowest-income quartile, that percentage was 6% in 1970 and had only grown to 9% in 2013. "The gap has widened," said Singer, "and it represents a tremendous amount of untapped talent out there [among students who could be] future teachers." To cultivate that untapped talent, Singer said, educators have solid evidence of methods that work in STEM education—such as focusing on conceptual learning, problem-solving, and use of representations such as diagrams and evolution trees—but those methods are used in very few undergraduate classrooms where STEM teachers receive their training, Singer said.

Singer singled out active learning as an educational strategy that research shows is effective, demonstrating the example of a bicycle wheel that could be held by its axis while being spun. Students who spun the wheel and then tipped it to the side felt the vector of the resulting angular momentum. "Students who actually got to hold this bicycle wheel did much better—in a statistically significant way—when tested on angular momentum problems," Singer said. The same students did no better on other types of physics problems after spinning the wheel. "This could be very important," said Singer, "especially for the lab and field sciences as we think about what things are going to be really important to have our students do. The difference [in achievement] between classrooms with and without active learning is stunning."

Meanwhile, researchers are trying to weigh preliminary evidence related to skills students possess that are not easily measurable, such as being able to work in a team, communicating well, having academic tenacity, and "grit." Possessing such skills, according to Singer, has been correlated with success in college, specifically in STEM majors, but much more research is needed to know, for instance, whether it is possible to coach students in order to increase those skills.

Brent Duckor, associate professor in the Department of Teacher Education at San José State University, frames such "noncognitive" skills in a different way, putting the emphasis, not on whether a student inherently possesses tenacity, for instance, but on what seems to encourage perseverance and the contexts for learning that advance deeper student engagement. Duckor is a former high school teacher at a nationally recognized high school in East Harlem that pioneered Habits of Mind, which emphasizes interdisciplinary and project-based learning.

"We know that purpose and meaning matter for kids," said Duckor, who led brainstorming sessions at the summit on how to increase STEM teacher effectiveness. "If our students find purpose in what they do, they tend to stick with it. When kids have a voice and a sense of agency in their learning, then they tend to stick with the subject. Effective teachers and schools help students meet real

scientists, mathematicians, engineers and technology specialists so they can engage more deeply with people in the outside world who are practitioners of STEM."

As researchers work to build "a deeper, richer evidence base" for the preparation of STEM teachers, they face the challenge of keeping the measures of educational research as uniform as possible, Singer said, emphasizing shared tools and clean data. "How are you going to make it interoperable?" she said. "How do we scale the great ideas?"

The Noyce networks of students, teachers, and researchers can help organize such research and the many approaches to a complex field, Singer said. "You're a beautiful example of connectivity in the departments of education and the colleges of arts and sciences," she said. "You're a wonderful model for where this should go."

Also expressing satisfaction with the cross-fertilization of the various communities represented at the Noyce Summit, Shirley Malcom, director for AAAS Education and Human Resources Programs, said that it is possible to experiment with new classroom methods and then to "backfill" according to what the research bears out in order to bolster and improve preservice education of STEM teachers, and STEM education itself, as quickly as possible.

Gabrielle Kristofich, an aspiring STEM teacher studying economics and elementary education at the University of Colorado, said that the Noyce Summit expanded her own network as she heads into her first year of teaching, and her awareness of new ideas in STEM education and the complex processes involved.

"It allowed me to reimagine what's possible," Kristofich said.

AAAS annual election: Preliminary announcement

The 2016 AAAS election of general and section officers is scheduled to begin in October. All members will receive a ballot for election of the president-elect, members of the Board of Directors, and members of the Committee on Nominations. Additionally, members registered in sections (up to three) will receive ballots for the specified section elections. Biographical information for the candidates will be provided along with ballots. The general election slate is listed below. The list of section candidates can be viewed at www.aaas.org/annual-election.

Names may be placed in nomination for any office by petition submitted to the Chief Executive Officer no later than 23 September 2016. Petitions nominating candidates for president-elect, members of the Board, or members of the Committee on Nominations must bear the signatures of at least seven members of the association. A petition to place an additional name in nomination for any office must additionally be accompanied by the nominee's curriculum vitae as well as a statement of acceptance of nomination.

General Election Slate

President-Elect

Margaret A. Hamburg, National Academy of Medicine; Douglas S. Massey, Princeton Univ.

Board of Directors

Mark C. Fishman, Harvard Medical School; S. James Gates Jr., Univ. of Maryland, College Park; Kaye Husbands Fealing, Georgia Institute of Technology; Thomas E. Lovejoy, George Mason Univ./United Nations Foundation

Committee on Nominations

To be announced