

NSF grant supports education outreach

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As a child growing up in India, Tirupalavanam Ganesh remembers taking apart his mechanical toys – and his father's fountain ink pens – to figure out how they worked. Later on, he used an Erector Set he received as a gift to build any number of “contraptions.”

Ganesh, the assistant dean for information systems with ASU's Mary Lou Fulton College of Education, credits the imaginative play of his childhood for fueling his early career in engineering – and for his desire to create opportunities for female and minority youth to engage in learning activities designed to inspire and prepare them to pursue careers in information technology, science, technology, engineering and mathematics (IT/STEM) fields.

This fall, Ganesh and his research team earned a \$1 million grant from the National Science Foundation (NSF) to support a three-year project titled “Learning through Engineering Design and Practice: Using our Human Capital for an Equitable Future.”

The grant was awarded through the Information Technology Experiences for Students and Teachers (ITEST) program. ITEST was established by the NSF's Division of Research on Learning in Formal and Informal Settings in direct response to the national concern about shortages of technology workers in the United States, and it focuses on the need to expand and diversify the number of students prepared to enter careers in the field.

ITEST projects funded in communities across the country provide school-aged children and teachers with experiences that build the skills and knowledge needed to advance their academic study and expose them to STEM content careers.

“Children and youth are naturally curious and want to explore things on their own,” Ganesh says. “My family encouraged this curiosity and interest in me and provided informal learning experiences to develop it. Learning through engineering design and practice is an attempt to bring educational enrichment experiences and tools to youth who wouldn't otherwise have access to such experiences in their schools or homes. At the same time, NSF funding permits us to study the impact of long-term informal learning experiences on student learning.”

“Advancing STEM education is a top priority for ASU,” says Elizabeth D. Capaldi, ASU's executive vice president and provost. “We know that, in order to graduate the scientists, engineers and technology workers Arizona needs to compete, we have to cultivate interest in science, math and engineering at an early age by making these subjects exciting and capturing students' imaginations. Learning through Engineering Design and Practice does just that.”

The project brings together an interdisciplinary team of co-principal investigators from across the university, including:

- Monica Elser, education manager at the Global Institute of Sustainability.
- Jay Golden, an assistant professor in the School of Sustainability.
- Sheri Klug, ASU's director of Mars education outreach.
- Steve Krause, a professor in the School of Materials, the Ira A. Fulton School of Engineering and the College of Liberal Arts and Sciences.
- Chell Roberts, a professor and chair of the Department of Engineering at ASU's Polytechnic campus.
- Dale Baker, a professor of science education in the Mary Lou Fulton College of Education.
- Sharon Robinson Kurpius, a professor of counseling psychology in the Mary Lou Fulton College of Education.
- James A. Middleton, a professor of mathematics education in the Mary Lou Fulton College of Education.

The project, which launched this fall in collaboration with the Mesa Unified School District, will provide 96 seventh-, eighth- and ninth-grade students from Powell and Carson junior high schools with a multiyear, extracurricular and technological problem-solving experience. Participants and their families also will engage in career and educational exploration in the IT/STEM subjects.

"I wanted to create opportunities for youth from under-represented populations to explore technological tools and encourage the use of imagination and discovery while engaging them in socially relevant issues," Ganesh says.

The project will include a wide array of activities for participants, including summer internships and externships at the science center, industrial settings and research in the university, where they will work toward developing socially responsible solutions for challenging, real-world problems.

"I am excited about this opportunity for our students and families," says Ray Mercado, principal of Carson Junior High School. "This program will provide an opportunity for our students to make a difference in the world we live in today and influence the society they will lead in the future."

Debra Duval, superintendent of Mesa Public Schools, also anticipates many positive outcomes for students in her district as a result of the project.

“Our students at Carson and Powell junior high schools will have opportunities to learn about science, engineering and technology in an exciting and active after-school environment,” she says. “They’ll be motivated to learn more, take additional course work and hopefully pursue these areas as possible career interests.”

Duvall says the project activities also will likely generate enthusiasm and in-depth involvement that will enhance the students’ academic achievement.

The year-round program will provide participants with opportunities to simulate desert tortoise behaviors, research and develop designs to mitigate the “urban heat island” effect, build small-scale renewable energy resources and design autonomous rovers capable of navigating Mars-like terrain.

“Dr. Ganesh and his team’s large new research grant is triply exciting for ASU,” says Jonathan Fink, the Julie Ann Wrigley Director of ASU’s Global Institute of Sustainability. “First, it advances the goal of the Mary Lou Fulton College of Education, the Mars Space Flight Center and other parts of ASU to improve K-12 science and math education throughout the state and the nation. Second, it will work with grades seven through nine, when most students lose their earlier interests in science and math. Third, it focuses on many engaging topics about desert environments, with the goal of designing model habitats in which people might live in hostile environments, such as the surface of Mars.”

“The long term goal is to help develop the interests, attitudes and dispositions necessary to equip our students with a fundamental survival tool, a willingness to learn and re-learn, and engage in lifelong learning,” Ganesh says. “As a result of this experience, I would expect participants to thoughtfully consider and actively explore IT/STEM educational and career pathways.”

Nancy Guerra Roberts, the principal at Powell Junior High School, says the preliminary impact of the pilot project initiated at her school last year with 20 students is impressive.

“I had the opportunity to watch our students create, collaborate, problem-solve, and get frustrated and excited,” she says. “I also saw the positive impact that the pilot program had on the students’ self-confidence and belief in what they were capable of accomplishing.”

In addition to boosting student outcomes, the research team also endeavors to better prepare the adults associated with the project to influence and support IT/STEM learning experiences for under-represented students. The project evaluation will measure participants’ content knowledge, attitudes, workplace skills, and interest and intentions to pursue IT/STEM subjects and career pathways to understand their reactions, learning, transfer and results.

Partnerships with the Arizona Game and Fish Department, the Arizona Science Center, the Boys and Girls Clubs of the East Valley, the Arizona Foundation for Resource Education, Boeing, Intel, Microchip, Motorola, Salt River Project, the Institute of Electrical and Electronics Engineers-Phoenix Chapter and the Society of Women Engineers Phoenix and ASU sections, and a coalition of national groups via the U.S. Partnership Decade of Education for Sustainable Development have made it possible to offer project participants a wide range of experiences.

The developed curricula will be field-tested with the Boys and Girls Clubs of the East Valley, and at the Arizona Science Center.

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