

NSF Grant to Fund UA Research on Math Proficiency Among English Language Learners

UA cognitive science professor Carole Beal and her research team are developing and testing a Web-based tutorial to help English language learners perform better in algebra.

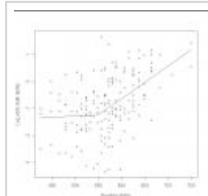
By La Monica Everett-Haynes, University Communications
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Several years ago, Carole Beal noticed that English language learners in California were having difficulty in math, particularly those whose primary language was Spanish.

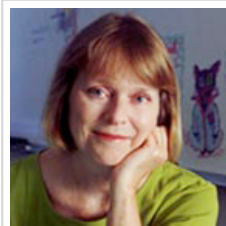
The bottom line was that overextended educators who were barred from teaching in anything but English did not have the necessary tools to help their English language learners keep pace with English speaking students in math.

Ultimately, this could have affected their chances of graduating from high school and excelling in college-level math courses, said Beal, a University of Arizona cognitive science professor.

This reality is not bound to California, but occurs in communities across the nation, said Beal, who set out with her colleagues to create a tool that would serve to improve the math skills of English language learners.



Math isn't simply about numbers. UA cognitive science professor Carole Beal and her colleagues have found a positive correlation between student performance in reading and their ability to comprehend math. (Click to enlarge)



Carole Beal, a UA cognitive science professor, is the principal investigator on a newly awarded National Science Foundation grant.

Beal and her team recently received a three-year, \$1.5 million grant from the National Science Foundation's Discovery Research K12 program for their the project, "Closing the Math Achievement Gap for English Language Learners: Technology Resources for Pre-Algebra."

The grant, which became effective Jan. 15, will allow the research team to work with the UA-affiliated Wildcat School and middle schools in the Amphitheater School District to develop a Web-based instructional tool to help English language learners.

"We are seeing a huge group of students who previously could get through high school without algebra but now cannot," said Beal, the principal investigator on the new NSF grant.

"The failure rates are especially devastating in the Los Angeles area, but the problem is particularly acute for English language learners, most of whom are Spanish speaking," Beal said.

She and her colleagues have spent years developing AnimalWatch, a Web-based intelligent tutoring system designed to help students taking pre-algebra.

AnimalWatch uses artificial intelligence algorithms to choose word problems for individual students based on their problem solving performance. The original AnimalWatch project was also supported by NSF, as well as the U.S. Department of Education's Institute of Education Sciences.

With the newly funded NSF grant, the UA team is tailoring the AnimalWatch software to English language learners and plans to begin prototype testing with local students using the software as early as this fall.

The new project will add modules to the AnimalWatch software to help math teachers track the progress of their English Learner students in mastering math terms and vocabulary.

U.S. Shifting Demographics Driving Need

Beal is working with UA graduate students – Otilia Barbu, a master's student in the teaching and teacher education department, and Nassim Mafi, a computer science master's student. UA computer science department head Paul Cohen, computer science professor Richard Snodgrass and research programmer Tom Hicks also are working on the project.

"I believe AnimalWatch is going to help the English language learning students," said Barbu, who is from Romania and identifies as an English language learner.

Barbu, who also teaches math at Pima Community College, said she will begin intervening students in about three weeks.

She emphasized the importance in distinguishing familiarity of English versus math performance in understanding the real problem English language learners face.

"We're trying to understand what the problem is – whether the problem is in the proficiency in English or whether the problem is in the proficiency in math," Barbu said.

Both Barbu and Beal noted that the nation's ethnic demographic shift is happening at a time when states are beginning to add more math requirements for a high school diploma. In 2007, the Arizona Board of Education approved a third year of math – up from two – for high school students.

Based on research she conducted, Barbu estimated that in 1980, 2.5 million students between the ages of 5 and 14 were English Language Learners. By last year, that figure had reached 5 million, she said.

And estimates have indicated that, by 2030, about 40 percent of the nation's student population will be comprised of English language learners, Barbu added.

Math is Not Simply About Numbers

Barbu and Beal noted that now is a critical juncture in public education. Then there is the issue of teacher training.

Nationally, about 15 percent of math teachers are trained to work with English language learners, Beal said. Arizona has an advantage there, she said, noting that educators must have 40 hours of instruction to work with the English language learners.

But another problem exists – the assumption that math is only about numbers.

But Beal is wrapping up another research project that has returned indicators that tie language acquisition to a propensity for math achievement.

The team believes that "ELLs who work with word problems selected on the basis of both text characteristics and math topic will be able to make better progress than ELLs who are presented with problems chosen only on the basis of math topic."

That said, the current project will involve the design and evaluation of a tutoring system based on artificial intelligence. The system would tailor instruction to adapt to the needs of English language learners, tracking their progress in algebra as they move through modules and guiding them along should they have difficulty in particular areas. The team will also gauge students' self-confidence in math and perceptions about the difficulty of math.

The project's progress will be monitored through an affiliation with the RAND Corporation, a nonprofit think tank that has numerous offices in the United States and abroad.

Beal said the tutoring system should also help improve student perceptions about field such as science, technology and engineering.

"I think we're really beginning to realize the low achievement of American students in math and that algebra in particular is becoming a critical filter for students graduating from high school," Beal said, noting that the program will eventually be available at no cost to any student who has Web access.

"But 25 years ago, students could get a high school diploma without taking algebra," she added. "That's no longer true. It's good we're expecting more from our students, but there is a lot we can do that would be helpful regardless of a student's primary language."