Sing a new song: Computer scientists use music to lure students to STEM majors

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To students in Jennifer Burg's computer science classes, making music is the main objective. But her goal is to get them to understand how the underlying technology works – and to love it so much they decide on a science-based career path.

And that, Burg's study has shown, has helped Wake Forest University fulfill the national imperative to increase the number of majors in the STEM disciplines of science, technology, engineering and math.

The results of Burg's research, "Computer Science 'Big Ideas' Play Well in Digital Sound and Music," will be published during the upcoming Special Interest Group on Computer Science Education conference, on March 9 in Denver.

"We know that the United States is lagging when it comes to training future scientists and engineers – the people who will keep us at the forefront of developing technology," Burg said. "We're trying to find a way to make our piece of the STEM universe interesting and engaging to more students.

"It's easy to motivate the kids in our classes now, because they get to make music."

Burg and her colleagues – Jason Romney of the University of North Carolina School of the Arts and sound designer and audio engineer Eric Schwartz – decided to use music projects to help students in lower-level

classes latch onto highly technical concepts in digital media.

They had to "flip" the classroom more than once, Burg said, throwing the traditional lecture structure out the window.

She used to make reading assignments about computer science concepts, and then lecture on those concepts and, lastly, test students' knowledge.

"I was trying to give them this foundation of knowledge first, so they could go in there to learn the tools," she said. "But I bored a lot of the kids before I got there."

Now, she doesn't approach her class in that traditional, linear way. She lets students immediately use the tools, such as applications including Audacity and Sonar, while she asks questions and performs demonstrations. Then she assigns textbook readings, followed by a quiz. After that, the students use the technology again – but this time, they have a project to complete, instead of just trying to get the technology to work.

Across the board, students in Burg's Digital Sound and Media course reported increased understanding of such topics as sampling and quantization; sound synthesis for MIDI; and aliasing. On average, those students also showed increased aptitude and interest in electronics, physics and math, among other topics.

"Students don't learn linearly anymore," Burg said. "They are of a much more need-to-know nature, because there is so much more information out there. It's accessible in a web-like fashion, and they go out there and learn what they need to know when they need to know it. "Educators need to fill in the gaps between those webs of information, without boring the students."

Burg now uses this approach in higher-level classes, as well.

Burg, Romney and Schwartz created an interactive, online text to accompany the coursework, and the team is working on modes of publication. The eight-chapter text and accompanying tutorials are accessible for free at digitalsoundandmusic.com. The package, which has been used in classes at Carnegie Mellon University and UNC Asheville, also includes demos and exercises, keyed to the chapters.

Burg also plans to expand the curriculum concepts she introduced in this study into a program dedicated to increasing STEM majors at Wake Forest. A study by the Organization for Economic Cooperation and Development in 2003 showed that, among 15-year-olds in 30 of the world's developed nations, the U.S. ranked only 18th in math and a dismal 24th in science. In 2007, the National Academy Sciences challenged the U.S. to increase the number of STEM undergraduate degrees awarded.

Provided by Wake Forest University