

# New direction in teaching computer science emphasizes activity, interaction, critique

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Contrary to the words of a popular song, there is such a thing as the real world. Computer science faculty at Washington University in St. Louis are exposing their undergraduate students to learning in ways that prepare them for interaction in the real work place.

It's not about "staying between the lines," though, more about getting out of your seat, moving around and interacting with your classmates. It's called active learning, a learning-laboratory- based tutorial teaching concept.

Kenneth Goldman, Ph.D., associate professor of computer science and engineering, initially secured a grant from the National Science Foundation in 2007 to explore active learning at WUSTL. He is on leave, and now Cindy Grimm, Ph.D., associate professor of computer science and engineering at Washington University in St. Louis, and Ron Cytron, Ph.D., associate chair of the department, are carrying out the work to put the old paradigm of lecture-based instruction in moth balls.

"At the heart of active learning is the hallmark of interactive face time and students taking a more active role and not just repeating what a professor wants to hear," said Grimm, the principal investigator of the grant. "We think it provides a motivation to learn things that they have to know to do something that they really want to do. This is more readily learned by participation with other students."

Lectures are posted on the Web and students typically watch them in the

evening before coming to class, so they are prepared for active learning in the classroom.

"The struggle for the teacher used to be, 'How do I fit my three hours of lecture a week and work interactive things into that,' Cytron said. "Now, it's the other way around." Cytron said that active learning is based upon the Socratic teaching method.

"It's asking a question and having the students struggle with it versus giving students a bunch of solutions and lecture and then have them find the answers on their own," he explained.

## **Different attention spans in the 21st century**

Both say the concept is not comfortable, initially, for either students or professors because the lecture is an "old friend" that professors are comfortable with and have relied on. Active learning is often unscripted and relies on students working in groups and learning from each other.

Some argue that the lecture is going to the sideline in computer science because the new generation of students has poor attention spans. Cytron disputes that.

"Students today have a different attention span and use more of their sensory inputs when it comes to learning," he said. "Today's freshman has been doing interactive things with friends for years. We find that we need some kind of stimulus to keep them involved."

The lecture still hasn't gone completely the way of the dodo bird. Grimm said that in more theoretical and mathematically based course, active learning is hard to do because of the density of the topics.

"Courses dealing more with algorithm and theory students find more

difficult to grasp on their own," she said. "So we guide them a little more and give lectures from time to time."

On the other hand, a course such as Computer Science and Engineering 332, software design, needs very little lecturing.

"No one solves problems in vacuums anymore," Cytron said. "I think today, 'What were we thinking when we told students to solve on their own and not consult with anyone else?' I tell people today that all of the programs written by just one person have already been written. Collaborations are what happens in the real world."

## **Avoiding ruffled feathers**

Grimm said she and her colleagues today emphasize group work, teamwork and peer reviews.

"Students learn the art of critiquing substantively without ruffling feathers," she said. "This is a benchmark of art and architecture classes and industry, too. A big motivator for the students is to add critiquing. Industry has always liked the skill set we impart to our students, but they also want them to be familiar with teamwork, explaining their ideas, and being comfortable with the critique. We haven't taught that as much until just recently."

A challenge for computer science professors is grading teamwork. Grimm's system is based on a hypothetical 100 tokens given to each person of, for instance, a five-member group. At the end of a project, team members are asked to evaluate their own role as well as the role of the other four in terms of relative contribution. If they all did the same work, they'd each get 20 points, but the spread is always uneven, she said.

"Surprisingly, most students are very honest," she said. "This kind of safety net is like having a Wal-Mart greeter at the front of the store so no one gets away with anything. Nearly all of the time, it comes out very candidly."

Source: Washington University in St. Louis

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