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Imagine an iPad application that would enable students to view their teachers' lectures on an online bulletin board and post related questions, comments, photos, Web links, videos and other materials, which could be viewed by both students and teachers. This app is already a reality at Caltech and Pasadena City College (PCC), where some students and teachers are using the Su-Kam Intelligent Education Systems app, or SKIES.

SKIES was created by two Caltech alumni, Julius Su and Victor Kam, to provide more interactive instruction that would hold students' attention by allowing them to participate in the learning process. The app creates what Su calls “knowledge trees.” A teacher makes a “tree” by posting a lecture created as PowerPoint slides on the electronic bulletin board; during the lecture, students can add questions and related data to the board, which become the tree's branches. The teacher or the students can answer the posted questions either during the lecture or later. Both teachers and students can build additional branches at any time by adding related data to the board.

“The big picture here is to create a way in which you can choose what you learn,” said Caltech Professor Bruce Hay, who uses SKIES in his introductory genetics class. “You find a starting place... and then you draw a path between what you know and what you want to know and then look at the links that get you there.... This provides a way of getting to any one topic and seeing what's related to that, what questions come up along the way. It's a way of diving more deeply into any particular course than, say, you would get with a Wikipedia article.”

In addition to Hay, other Caltech professors have incorporated SKIES into three chemistry courses and a class on machine learning.

At PCC, James Maloney, another Caltech grad, uses the app in his two classes on mathematics for business management. Maloney and Su have also used SKIES in their work on behalf of the Community Science Academy, a Caltech-based organization that promotes scientific research and education.

Last summer, the academy sponsored a program for Muir High School students who grow fruits and vegetables in the school's garden. Their teachers asked the academy to provide core science instruction relevant to the students' gardening.

Su recalls how the students were easily bored when they initially listened to a five-minute lecture. But their interest piqued when they were asked to create questions based on the lecture. “The students could answer the questions,” said Su. “They could look things up on the Internet... The students were teaching the teachers; they helped other students answer the questions.”

Microscopic lenses and 3-D printers were later connected to the iPads, and students used the lenses to take photos, which were posted on the bulletin board and viewed by other students and teachers.

“In the old days, you’d take a photo, post it in a lab report, and the teacher could see it later,” Su said. But now, he added, teachers and students can “instantaneously” view photos posted on the electronic bulletin board.

Maloney said SKIES gives science students the chance to find their own way of solving a problem or attaining a result from an experiment instead of merely reproducing another scientist’s work. “A lot of students say, ‘In the science labs we do canned experiments where I know I'm supposed to get a certain result. If I don't get that result, I feel I've failed.’ Science programs are missing the real nature of science. OK, so you fail, but you don’t have to reproduce things — that’s the challenging part.”

The app also allows teachers to design lessons that are more interactive than merely assigning students to read a textbook: “Teachers don’t just want to be consumers of content, the recipients of things designed thousands of miles away,” said Su. “They want to be involved in making their own courses and sharing results.”

However, proponents of SKIES note the app can only be effective if a college or school has rapid Wi-Fi connectivity, a problem for institutions like Caltech, which were built long before the advent of the Internet. “The costs of this are not the iPads,” said Su. “The costs are upgrading the infrastructure, upgrading networks, getting faster connections, wiring, telecommunications — that’s a big cost.”

Although there is not yet conclusive data to prove that SKIES helps students learn, Hay said students in his genetics class who used the app improved their grades.

“The class was pretty much the same lecture-wise in terms of the basic material before and after SKIES, but literally the grades went up a full grade point,” he said. “It became almost embarrassing how good the grades were compared to before.”

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