

**Inside TC profile: Dan Schwartz**  
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**Headline:**  
**Using technology to teach 21st-century skills**

**Summary:**  
Dan Schwartz (TC '88, '92) emphasizes the role of technology as a supplement to the school curriculum

**Key words:**  
Teachers College, Dan Schwartz, teachable agents, Stanford University, Vanderbilt University, Alaska, education, learning, technology, Stats Invaders

By Barbara Finkelstein

**Story:**  
Dan Schwartz tells a story about a graduate student at Stanford who wanted to offer students in his native India an alternative to the one history textbook available to them.

"Our grad student got five teachers, each very different from the others, to give a lecture based on the same chapter," Schwartz says "He put the lectures online and the students in his test group were able to choose the lecture they wanted to hear."

Schwartz, a professor in the Stanford University School of Education, likes this story because it demonstrates what technology can do to expand choice in the classroom. Ever since the mid-1980s, when he encountered the Apple IIe as a teacher in an Alaskan village school and saw its possibilities for educational instruction, Schwartz has been riveted by one question: "What is the best way to teach?"

One way is the counterintuitive project Schwartz developed called teachable agents. The premise in this series of software programs is that some students learn better when they teach something to somebody else. And when that somebody else is some form of technology, students benefit from instantaneous feedback -- "Let's try that again!" -- and response -- "Here's how you can come up with a better solution."

A teachable agent called Betty, for example, will wait for the student to impart knowledge to her. The student might ask Betty to answer what happens, say, when algae is added to a fish pond. After much sophisticated give-and-take between human and computer, the student will have created a "concept map" in Betty's "brain." By asking Betty what she now knows, the student ultimately teaches her that a fish population increases with the introduction of more algae.

Another teachable agent called Milo generates more than one interpretation of the data that the student gives him. Information about a rectangle, for example, whose length  $x$

width = 8 will let Milo produce a 1x8 rectangle, a 2x4 rectangle or a parallelogram with an area of 8.

Do these pedagogical video games really work?

To test the effectiveness of teachable agents, Schwartz and his colleagues designed an experiment in which half of the teachers in the test group used conventional science kits as well as teachable agents to teach their classes. The other half used only the science kits. Schwartz found that students who had the advantage of both teaching tools acquired greater understanding of scientific concepts.

Moreover, when teachable agents were removed from the classroom, the students were able to apply what they learned about causal relations to the next unit in the science curriculum.

Another remarkable result: Teachable agents have been particularly effective with low achieving students. Schwartz believes that the technology makes up for learning experiences that the students didn't have when they were younger.

Schwartz notes that a research project called Stats Invaders had a comparable outcome. The gaming goal here was to shoot down aliens and determine which of two displayed distributions (normal or uniform) was generating the alien attack. The educational goal was to see if playing Stats Invaders would better prepare the students for their classroom lecture on probability distribution.

Half of the students in the test group played Stats Invaders; half didn't. Schwartz believes that the game-playing students developed the intuition that made the lecture more understandable to them.

"This is a nice example of using technology to do what technology can do well," Schwartz says. "Technology can give you a set of experiences that will prepare you to understand a more formal treatment that you will go on to get from a textbook or a class."

Schwartz further observes that technology can help researchers identify the choices that students make to learn. "How do students deal with failure?" he asks. "Do they try to resolve contradictions or do they slide over them? Technology is helping us teach and understand twenty-first century skills, which aren't so much about facts and procedures but about making good choices when you need to solve a problem."

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#### **inline links**

teachable agents

<http://aalab.stanford.edu/teachable.html>

Betty

[http://aalab.stanford.edu/teachable\\_agents/ta\\_betty.html](http://aalab.stanford.edu/teachable_agents/ta_betty.html)

Milo

[http://aalab.stanford.edu/teachable\\_agents/ta\\_milo.html](http://aalab.stanford.edu/teachable_agents/ta_milo.html)

Stats Invaders

<http://workingexamples.org/frontend/project/49>