

# Khan Academy and Computer Science

Charles Severance, University of Michigan

*John Resig and Pamela Fox discuss the addition of computer science to the topics covered by Khan Academy, where instructors upload short educational lectures on YouTube.*

**K**han Academy was founded in 2006 when Salman Khan started recording short lectures on basic mathematics and uploading them to YouTube. Over time, these lectures expanded into new areas including history, medicine, physics, and economics. Software was also added to help track students' progress toward various learning objectives. Khan Academy is a very valuable resource for students of all ages and those needing remedial education. In 2012, computer science was added to the list of topics.

I spoke with software developer John Resig, who created the popular jQuery library, and curriculum builder Pamela Fox about Khan Academy's addition of computer science. You can see the full interview at [www.computer.org/computingconversations](http://www.computer.org/computingconversations).

John initially joined Khan Academy to develop its software platform, but he wanted to help when Salman and others started thinking about adding computer science to the curriculum in 2011. While working on jQuery, John interacted with some of the most talented software designers in the world. But to understand how

a learner might approach computer science with no prior knowledge, he revisited his own early experiences with programming.

*John: I was a teenager, maybe 14 or 15, and a friend of mine came over to my house with a floppy*

*disk. On it was a copy of QBasic with a program or two. He loaded a program that he had written that just printed something out. Up to that point, I didn't realize that you could actually tell a computer what to do. I decided I wanted to build an environment that would replicate my early experience of being able to read, learn, and try things and share them.*

Even though the Khan Academy program is called "Computer Programming," it's not meant to be equivalent to a college degree in the subject.

*John: It's a bit of a misnomer in that it's not what most people think of as a computer science curriculum. At this point, we aren't going to replace Computer Science 101 at a university. A lot of what we're doing is encouraging students to engage in exploration for themselves, to be able to look at code and see programs that other students have written or that we've written. I think the most important thing we can do is be able to create that little spark and really get them excited about programming.*

John built an environment that enabled experimentation and sharing, and Pamela added a curriculum and educational materials to his environment.



See [www.computer.org/computer-multimedia](http://www.computer.org/computer-multimedia) for multimedia content related to this article.



*Pamela: I was worried that we might lose some people who weren't able to figure it out just by exploring and tinkering. Those who needed to be explicitly told, "This is how a loop works; this is what a variable is and now you try it." So I took the JavaScript 101 curriculum that I'd been using in various settings and produced Khan Academy-style materials. I created "talk-throughs," which are like videos except you can actually pause at any time and use the editor to make changes, see how it happens, and then continue playing.*

Pamela also created auto-graded coding challenges and peer-graded projects that are somewhat open-ended to help students assess their progress and mastery of the materials.

*Pamela: For every talk-through there will be a coding challenge, and then every so often there will be a free-form creative project. This gives learners a lot of freedom as to what to do while still practicing what they've learned. One example is to make a fish tank after they learn functions. They create a fish function with parameters so that multiple fish can be different colors or sizes. But it's open-ended so they can add seaweed or bubbles or whatever they want to.*

The goal is to focus on the initial experience of learning to program as early as possible in the K-12 curriculum.

*Pamela: Sixth grade is a good age to start learning to program syntactically. You learn the basics of some language like JavaScript, and then you start making your own programs, and then you start creating programs for projects in other classes. I have seen some of*

*our students write programs for a science fair or make a timeline for a history assignment. As they keep going and are making programs, we really want them to be working with other people on programs because that's one of the most important things in software development. To make great software, you have to work with other people. Working in a group requires a certain level of skill, and is also a great experience.*

In addition to teaching programming, the Khan Academy computer science program aims to prepare students for a career in the field. It's a challenge to succeed if students take their very first programming course in college. John recounted his high school experience with programming.

*John: Another experience that was very formative for me was taking AP [advanced placement] computer science in high school. I had been in other AP classes like English and history with friends who were the smartest people I knew. When we got to AP computer science, I had no trouble at all, but my friends who had done well in other AP courses struggled. I realized that there are certain concepts in programming that are challenging, but if they had been taught in the right way, my fellow high school students would've done well in programming.*

As the Khan Academy computer science curriculum is developed, it's important to get feedback from students and teachers working with the materials.

*Pamela: Getting to visit classrooms that use the curriculum is always incredibly valuable.*

*Anytime I interact with teachers, I always come back with a bunch of feature requests. We've come up with new tools for teachers so now they have a much better dashboard that monitors the students' progress so you can see where they are in the curriculum.*

It's also important to provide technology that supports teachers to make teaching computer science at the K-12 level as simple as possible.

*Pamela: At a high school I visit, there's a teacher who uses our platform and then there's another teacher using a desktop Java application. When the students using the desktop software hand in an assignment, they have to zip it all up in a file and email it to the teacher, who then has to read them all to grade them. In contrast, the teacher using our platform just reloads her class's program page so she can see exactly what her students are working on. It has streamlined her efforts.*

If Khan Academy is successful in expanding the number of students exposed to programming during their K-12 education, it'll be interesting to see how computer science education in college will be influenced by a larger pool of incoming students with a strong understanding of programming principles. ■

**CHARLES SEVERANCE**, Computing Conversations column editor and *Computer's* multimedia editor, is a clinical associate professor and teaches in the School of Information at the University of Michigan. Follow him on Twitter @drchuck or contact him at csev@umich.edu.