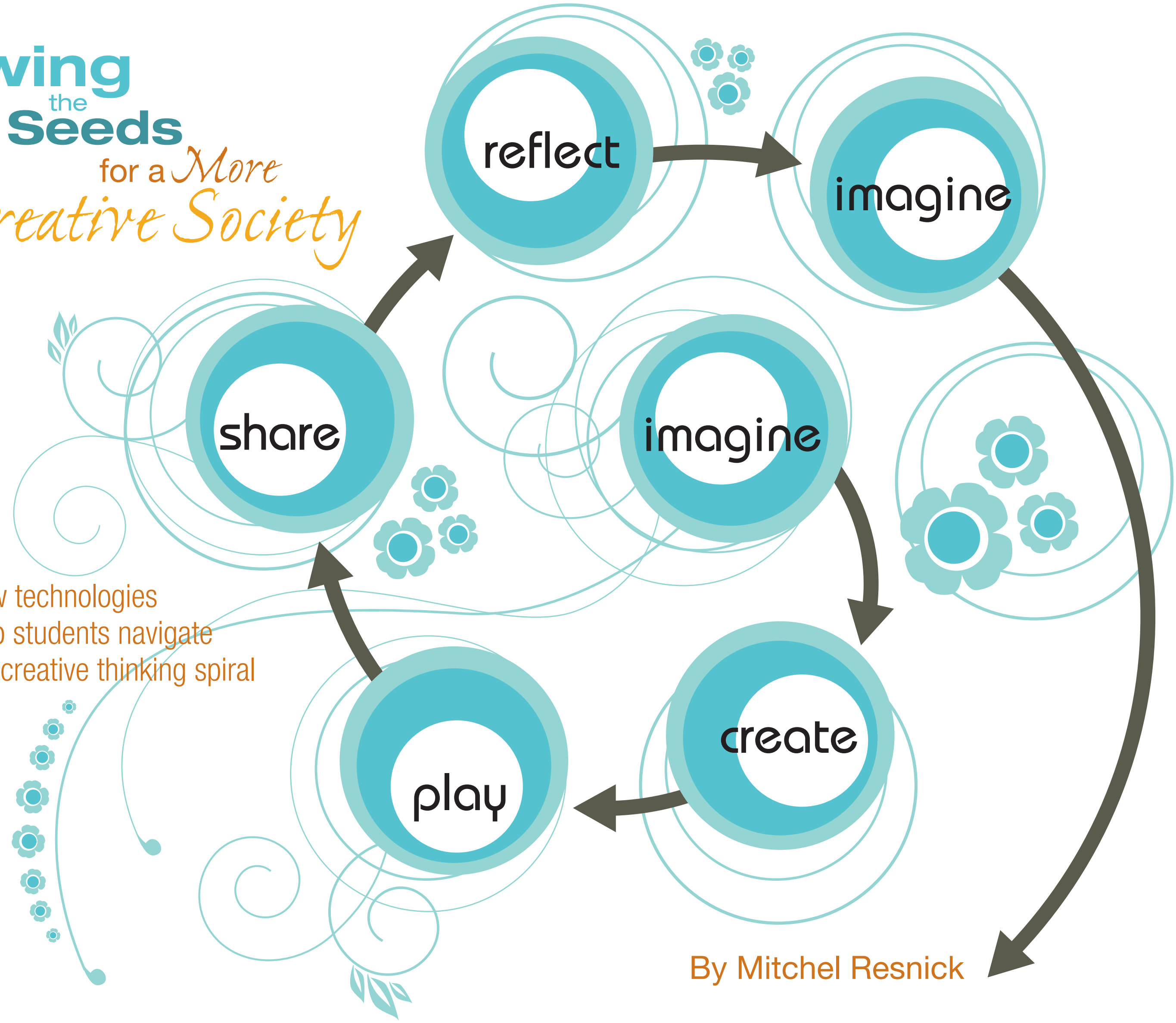
Sowing the Seeds for a More Creative Society



New technologies help students navigate the creative thinking spiral

By Mitchel Resnick

In the 1980s, there was much talk about the transition from the Industrial Society to the Information Society. Then in the 1990s people began to talk about the Knowledge Society, noting that information is useful only when it is transformed into knowledge.

But as I see it, knowledge alone is not enough. In today's rapidly changing world, people must continually come up with creative solutions to unexpected problems. Success is based not only on what you know or how much you know, but on your ability to think and act creatively. In short, we are now living in the Creative Society.

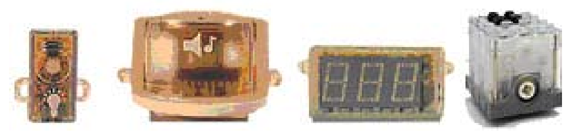
Unfortunately, few of today's classrooms focus on helping students develop as creative thinkers. Even students who perform well in school are often unprepared for the challenges that they encounter after graduation, in their work lives as well as their personal lives. Many students learn to solve specific types of problems, but they are unable to adapt and improvise in response to the unexpected situations that inevitably arise in today's fast-changing world.

New technologies play a dual role in the Creative Society. On one hand, the proliferation of new technologies is quickening the pace of change, accentuating the need for creative thinking in all aspects of people's lives. On the other hand, new technologies have the potential, if properly designed and used, to help people develop as creative thinkers, so that they are better prepared for life in the Creative Society.

In this article, I discuss two technologies developed by my research group at the MIT Media Lab with the explicit goal of helping people develop as creative thinkers. The two technologies, called Crickets and Scratch, are designed to support what I call the "creative thinking spiral." In this process, people *imagine* what they want to do, *create* a project based on their ideas, *play* with their creations, *share* their ideas and creations with others, and *reflect* on their experiences—all of which leads them to *imagine* new ideas and new projects. As students go through this process, over and over, they learn to develop their own ideas, try them out, test the boundaries, experiment with alternatives, get input from others, and generate new ideas based on their experiences.

Cricket

Cricket Sensors:
Light sensor, touch sensor, sound sensor, resistance sensor.



Cricket Outputs:
Multi-colored light, sound box, numerical display, motor.

Crickets

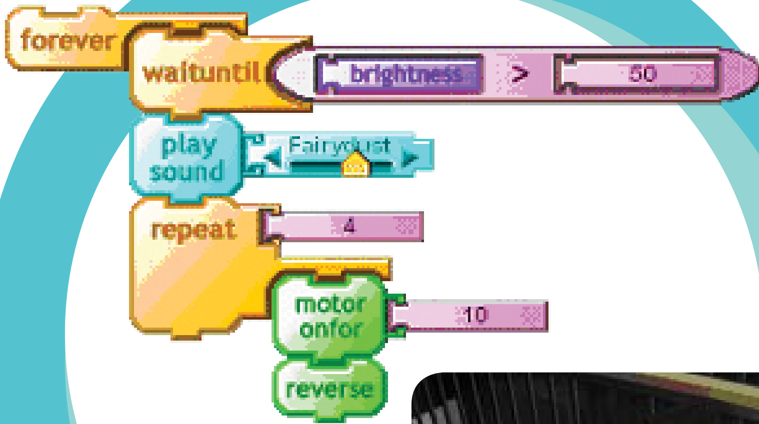
Today's world is full of objects that sense and respond: doors that open automatically when you walk toward them, outdoor lights that turn on automatically when the sun goes down, stuffed animals that talk to you when you squeeze them. Children interact with these objects all of the time, but most have no idea how they work. And if children want to create their own interactive objects, most have no idea how to do it.

The Cricket is designed to change that. Children can connect lights, motors, and sensors to a Cricket, then program their creations to spin, light up, and play music. Children can use Crickets to create all types of interactive inventions: musical sculptures, interactive jewelry, dancing creatures. In the process, children learn important science and engineering concepts, and they develop a better understanding of the interactive objects in the world around them.

At a week-long workshop in Iceland, for example, Richard, an 11-year-old boy, decided to use a Cricket to create an automatic alarm clock to wake him in the morning. He connected a light sensor, a motor, and a sound box to a Cricket, and he attached a feather to the motor. Then Richard programmed the Cricket so that it would play a melody and gently twirl the feather against his face when the light sensor detected the sun shining through his bedroom window in the morning. Richard experimented with his new alarm clock, and it seemed to work well. But a friend pointed out a problem. Because Iceland is located so far to the north, sunrise occurs at very different times over the course of the year, so the alarm clock wouldn't be very reliable. Richard thought about this problem, and when he created a poster about his project for the public exhibition at the end of the workshop, he included a warning at the bottom: "For Export Only."

As Richard worked on his alarm clock project, he actively engaged in all parts of the creative thinking spiral: he came up with an idea, created a prototype, experimented with it, shared his ideas with others, and revised his plans based on the feedback. By the end, Richard was full of ideas on how to improve his alarm clock—and he had refined his skills as a creative thinker.

In many ways, Crickets are similar to the Lego Mindstorms robot construction kits now used by millions of students around the world. But there are also important differences. While Mindstorms kits are designed especially for making robots, Crickets are designed especially for making artistic creations with colored lights, sound, music, and motion. Crickets are now sold commercially as part of a kit, called the PicoCricket Kit, that includes not only Lego bricks and electronic parts, but also arts-and-craft materials such as pom-poms, pipe cleaners, and googly eyes. By providing a broader range of materials and supporting activities involving light and sound (in addition to motion), we hope to encourage a broader range of projects—and spark the imaginations of a broader range of children. We are especially interested in broadening participation among girls. Even with strong efforts to increase female participation, only 30% of the participants in Lego Mindstorms robotics competitions are girls. In Cricket



Richard with his Cricket alarm clock, and the program controlling the clock.

activities at museums and after-school centers, participation has been much more balanced among boys and girls.

Crickets have become especially popular in Hong Kong, where government and industry leaders are concerned about the outward migration of manufacturing jobs to other parts of China, and thus feel an urgent need to develop a more creative workforce. Cricket workshops in Hong Kong provide a glimpse into an alternative educational approach, where creative thinking is a top priority.

At one Hong Kong workshop, an 11-year-old girl named Julia was inspired by a pair of shoes that she had seen that contained embedded lights that flashed as the shoes moved. But Julia wasn't interested in buying shoes with pre-programmed lighting patterns; she wanted to create her own patterns. So she connected a Cricket and a series of lights to her boots, then installed a sensor near the bottom of the boot, where it could detect the up-and-down motion of her foot. She programmed the Cricket to change the colors of the lights, based on how fast she was walking.

At the same workshop, an entrepreneurial 12-year-old named Anthony came up with a business idea: a wearable jukebox. He cut a coin slot in the top of a cardboard box, then installed sensors on the underside of the slot to measure the size of the coin inserted. He then programmed the Cricket to play different songs based on what coin the customer put into the box.

For Julia and Anthony, the Cricket provided a way to create and personalize their own interactive inventions. As Julia explained, "With Crickets, you don't have to use what someone else made. You can make it yourself."

Scratch

Just as Crickets give students the power to create and control things in the physical world, Scratch gives them the power to create and control things in the online world.

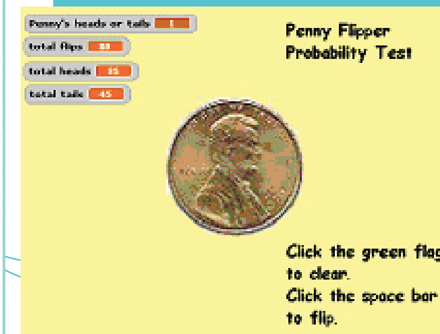
For many students, the Web is primarily a place for browsing, clicking, and chatting. With Scratch, students shift from media consumers to media producers, creating their own interactive stories, games, and animations—then sharing their creations on the Web.

In classrooms, students have begun to use Scratch to create reports and presentations—replacing traditional PowerPoint presentations with content that is far more dynamic and interactive. At the Expo Elementary School in St. Paul, Minnesota, one student created a book report on Ben Franklin, including an interactive game inspired by Franklin's experiments with lightning. Another student created an animated documentary on the dangers of mercury in their school building. At another school, students created a penny-flipping simulation,

Workshop participants in Hong Kong engage their creative thinking to develop Cricket projects.

The Scratch Web site is a YouTube-like environment for sharing and exploring student creations.

Scratch projects.



then ran experiments to test theories in probability and statistics.

"There is a buzz in the room when the kids get going on Scratch projects," says Karen Randall, a teacher at the Expo Elementary School. "Students set design goals for their projects and problem-solve to fix program bugs. They collaborate, cooperate, co-teach. They appreciate the power that Scratch gives them to create their own versions of games and animations."

Students program their Scratch creations by snapping together graphical blocks, without any of the obscure punctuation and syntax of traditional programming languages. In this way, Scratch makes programming accessible to a much broader audience—at a younger age—than ever before.

In the process of programming their Scratch creations, students learn important mathematical concepts in a meaningful and motivating context. While visiting an after-school center, I met a student who was creating an interactive game in Scratch. He didn't know how to keep score in the game, and asked me for help. I showed him how to create a variable in Scratch, and he immediately saw how he could use a variable for keeping score. He jumped up and shook my hand, saying "Thank you, thank you, thank you." I wondered how many eighth grade algebra teachers get thanked by their students for teaching them about variables?

Students can share their Scratch projects on the Scratch Web site (http://scratch.mit.edu), just as they share videos on YouTube. After the site was publicly launched in May 2007, more than 20,000 projects were uploaded to the site in the first three months. Students can browse the site for inspiration and ideas, and if they see a project that they like, they can download it, modify it, and then share the revised version with the rest of the community. The Web site has become a bustling online community. Members are constantly asking questions, giving advice, and modifying one another's projects. More than 15 percent of the projects on the site are extensions of previous work.

Collaboration on the Scratch Web site comes in many different forms. A 15-year-old girl from the UK with the screen name BeeBop created a project full of animated sprites, and encouraged others to use them in their projects. Another 10-year-old girl, using the name MusicalMoon, liked BeeBop's animations and asked if she'd be willing to create "a mountain background from a bird's-eye view" for use in one of her projects. MusicalMoon then asked BeeBop if she wanted to join Mesh Inc., a "miniature company" that MusicalMoon had created to produce "top quality games" in Scratch. A few days later, a 14-year-old boy from New Jersey who went by the moniker Hobbit discovered the Mesh Inc. gallery and offered his services: "I'm a fairly good programmer, and I could help with de-bugging and stuff." Later, an 11-year-old boy from Ireland calling himself Marty was added to the Mesh staff because of his expertise in "scrolling backgrounds."

The Scratch Web site is part of a broader trend toward a more participatory Web, in which people not only point and click but also create and share. Many Web sites enable students to share text, graphics, photos, and videos. Scratch goes a step further, providing the tools for students to create and share *interactive* content, and thus become full participants in the online world.

Learning in the Creative Society

Today's students are growing up in a world that is very different from the world of their parents and grandparents. To succeed in today's Creative Society, students must learn to think creatively, plan systematically, analyze critically, work collaboratively, communicate clearly, design iteratively, and learn continuously. Unfortunately, most uses of technologies in schools today do not support these 21st-century learning skills. In many cases, new technologies are simply reinforcing old ways of teaching and learning.

Crickets and Scratch are part of a new generation of technologies designed to help prepare students for the Creative Society. But they are just the beginning. We need to continually rethink our approaches to education and rethink our uses of educational technologies. Just as students need to engage in the creative thinking spiral to prepare for the Creative Society, educators and designers must do the same. We must imagine and create new educational strategies and technologies, share them with one another, and iteratively refine and extend them.

Acknowledgements

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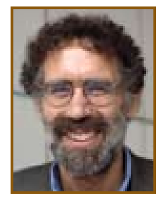
Resources

Cricket: http://www.picocricket.com
Lifelong Kindergarten: http://llk.media.mit.edu
Scratch: http://scratch.mit.edu.



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