EDUCATION OPINION

Coding as a Literacy for the 21st Century

By Matthew Lynch — January 29, 2018 4 min read

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By Marina Umaschi Bers

The idea of teaching coding to children is not new. Back in the late 1960s, my mentor at MIT, Seymour Papert, developed the first programming language for children, called LOGO. Although computers were big, expensive machines that occupied full rooms, Seymour anticipated that the technology would get smaller and the thinking bigger. That is to say, children could learn how to think in new ways by programming these devices. At the time, this was a novel idea. Today, few people would disagree with this statement.

In the recent years, coding has made a comeback. However, according to the nonprofit Code.org, when compared with other countries, the United States lags behind. This is troublesome given the demands of the new automated economy. The workforce needs coders. Thus, initiatives are on the rise to engage students in science, technology, engineering and math (STEM). While I applaud the push for STEM, I find it problematic.

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There is no problem with STEM education per se, but it restricts the power of coding to a limited group of disciplines, to a limited group of students and teachers, and to the particular demands of the workforce. It limits coding's power as a true literacy.

What is literacy? It is the ability to use a symbol system (a programming language or a natural written language) and a technological tool (paper and pencil, or a tablet and computer) to comprehend, generate, communicate, and express ideas or thoughts by making a sharable product (a text, an animation, a robot) that others can interpret. This definition applies to both textual and coding literacy.

What is the function of literacy? To engage new ways of thinking and new ways of communicating and expressing ideas. Literacy ensures participation in decision-making processes and civic institutions. Those who can't read and write are left out of power structures. Their civic voices are not heard. Will this be the case for those who can't code? For those who can't think in computational ways?

One of the goals of education is to help people think creatively to solve the problems of our world. Only a subset of those problems can be solved by STEM disciplines. As more people learn to code and computer programming leaves the exclusive domain of computer science and become central to other professions, the civic dimension of literacy comes into play. Literacy has the power to bring about social change.

If coding is the literacy of the 21st century, we need to start teaching it early, at the same time that we teach students how to read and write. Research, including the work by the economist Nobel laureate James Heckman, shows that both from an economic and a developmental standpoint, educational interventions that begin in early childhood are associated with lower costs and more durable effects than those that begin later. We know that, as a literacy, coding will open doors, many of them that we cannot anticipate now. But we also know that these young coders are children. It is not enough to copy models of computer science education that were developed for older students.

At the DevTech research group that I direct at Tufts University, we create programming languages and curriculum that invite playful, creative, and social coding experiences for children 4 to 7 years old. Students can have their first experiences with or without computer or mobile device screens. For example, we developed KIBO, a robotic kit that can be programmed with wooden blocks and decorated with recyclable materials. KIBO is used in more than 51 countries, and Singapore included it in its national award-winning Playmaker program for preschools. Also, in collaboration with Mitch Resnick at the MIT Media Lab, we built a free programming app called ScratchJr that empowers children to create their own animations, interactive stories, and games.

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Since we launched it in 2014, we have over 9.5 million downloads. The success of both KIBO and ScratchJr demonstrate the hunger for technologies that are developmentally appropriate for early childhood education. However, innovative technologies are not enough. We also need pedagogical approaches that guide the use of those technologies to support learning. Over the years, I developed the Positive Technological Development framework (PTD) to inform the design of educational programs, evaluation assessments, and innovative tools that promote children's positive behaviors while coding.

The metaphor of "playground vs. playpen" is helpful to better understand this framework. While playgrounds are open-ended and invite socialization, conflict resolution, and imagination, playpens are limited. Within the pedagogical approach that I developed, coding can become a playground, an environment to be creative, to express ourselves, to explore alone and with others, to learn new skills and problem-solve--while having fun. In a coding playground, children become producers, not only consumers, of digital artifacts that can be shared with others. They also develop coding literacy to express themselves through their technological projects.

This pedagogical approach goes beyond teaching computer programming to prepare students for STEM careers. It means providing intellectual tools, character virtues, and integrated curriculum so they grow up to have a voice and to play a role in our civic society. In today's world, those who can produce digital technologies, and not only consume them, will be in charge of their own destiny. Those who can innovate and problem-solve will create the democracies of tomorrow, ready to take on the challenges of a multi-cultural, multi-ethnic, multi-religious. and complex global world.

Marina Umaschi Bers is a professor at Tufts University, where she directs the DevTech research group. She is the author of the book Coding as a Playground: Programming and Computational Thinking in the Early Childhood Classroom, *and is the co-founder and chief scientist at KinderLab Robotics, Inc.*

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