Closing the Fluency Gap

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IN the years ahead, the declining cost of computation will make digital technologies accessible to nearly everyone in all parts of the world, from inner-city neighborhoods in the U.S. to rural villages in developing nations. That will bring an end to the so-called "digital divide," right?

Not necessarily. Even as people everywhere gain access to digital technologies, there is a real risk that only a small handful will be able to use the technologies fluently. In short: the "access gap" will shrink, but a serious "fluency gap" could remain.

What does it mean to use technologies fluently? To be truly fluent in a natural language (like English or French), you need more than phrase-book knowledge; you must be able to articulate a complex idea or tell an engaging story—that is, you must be able to "make things" with language. Analogously, fluency with new technologies involves not only knowing how to use technological tools, but also knowing how to construct things of significance with those tools [2].

Fluency means not just accessing information on the Web, but creating your own Web pages. Not just downloading MP3 music files, but creating your own digital-music compositions. Not just playing SimCity, but creating your own simulated worlds.

Such activities are especially important in the lives of children. Research has shown that many of children's best learning experiences occur when they are engaged in designing and creating things, especially things that are meaningful to themselves or others around us [1]. When children create pictures with finger paint, they have a chance to learn how colors mix together. When they make bracelets with colored beads, they have a chance to learn about symmetries and patterns.

Computers, like finger paint and beads, should be used as a material for making things. But in most places today, computers aren't used that way. Part of the problem is in the computers themselves. The computers in widespread use today were designed for and by the television generation. They even look like televisions. Is it any surprise that computers are so rarely used for designing, creating, and inventing?

We need to develop a new generation of computer technologies *worthy* of the next generation of children. These new technologies should provide children with design leverage, enabling them to create things that would have been difficult for them to create in the past. At the same time, the new technologies should provide children with conceptual leverage, enabling them to learn concepts that would have been difficult for them to learn in the past.

These new technologies might look very different from traditional computers. For example, my research group at the MIT Media Laboratory has developed a family of "programmable bricks": tiny computers embedded inside children's building blocks [4]. With these bricks, children can build computational power directly into their physical-world constructions, blurring the boundaries between the physical and digital worlds (and, we hope, providing children with the best of both worlds).

Children have used our programmable bricks to build a variety of creative constructions, including: an odometer for rollerblades (using a magnetic sensor to count wheel rotations); a diary-security system (using a touch sensor to detect if anyone tried to open the diary); and an automated hamster cage (using a light sensor to monitor the hamster's movements). In the process, they have learned engineering concepts (related to feedback and control) that traditionally have been taught only at the university level [3].

In the future, computationally enhanced devices will be ubiquitous, pervasive, and seamlessly networked with one another. We can be sure of that. What is unknown (but critically important) is how people will use and think about these devices. Will

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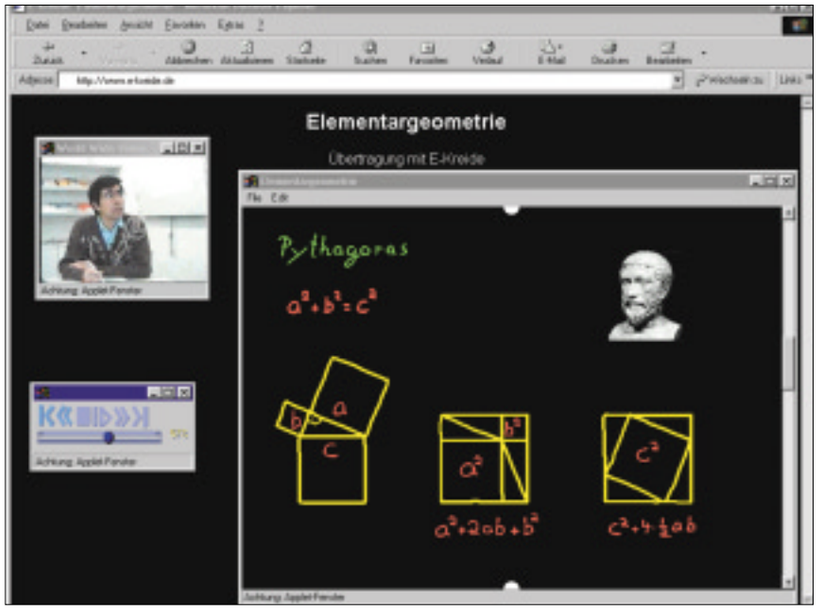
some people (like the children with the programmable bricks) become fluent with these devices, using the devices to explore the world around them and express themselves in new ways—while other people use the devices just to play games, download videos, and shop online?

Bridging this aspect of the digital divide won't be easy. Access alone is not enough. The goal must be fluency for everyone. That will require new attitudes about computing—and new attitudes about learning. If computers are to truly transform our lives in the future, we must treat computational fluency on a par with reading and writing. C



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