Learning and expressing

by W. Bender

Of the rapid pace of change over the past decade, Mitchel Resnick said that there are two revolutions brewing. The first revolution is one of technology. The second revolution is one of learning. Taken together, it becomes clear that there is a third revolution, one of personal and interpersonal expression.

Learning has been a core research interest at the MIT Media Laboratory since we opened our doors in 1985. We have been attempting to develop tools for learning (in the manner of Soloway's learning-centric design as opposed to user-centric design) while aligning ourselves with the traditions of Jean Piaget, Seymour Papert, and Paulo Freire. Perhaps the most renowned byproduct of these efforts is the LEGO** Mindstorms**, the combination of the LEGO building blocks and the Logo programming language, which affords the opportunity not only for children to build things, but also to reflect on their inventions. These are "things to think with."

Likewise, expressing is part of the lab's fabric. Founding members Richard Leacock and Muriel Cooper brought with them the traditions of cinema and design. From the seeds they planted has grown an explosion of interactive storytelling and design. Particular emphasis has been placed on how computation both enhances traditional storytelling techniques and enables designers to invent their own tools of expression. The latter is exemplified by the work of John Maeda's students that is interspersed throughout this issue of the *IBM Systems Journal.*

Over the past few years, our work in learning and expressing has transformed itself into learning *through* expressing. Starting from the premise that we want to make use of what people already know in order to make connections to new knowledge, our approach is to focus on thinking, expressing, and communicating with technology.

In this section we begin with examples of computer systems that both learn and are expressive. In their paper entitled "Just-in-Time Information Retrieval Agents," Rhodes and Maes describe contextually aware applications that monitor a user's environment and proactively present information automatically from general sources for the user's consideration. A significant aspect of this work is the display technique for the user interface. One technique described by the authors is the ramping interface that expresses retrieved information in a way that minimally impacts the primary task.

Picard looks at another aspect of computer learning and expressing: affect. Her paper, "Toward Computers that Recognize and Respond to User Emotion," highlights research aimed at giving computers the ability to "comfortably sense, recognize, and respond to the human communication of emotion, especially affective states such as frustration, confusion, interest, distress, anger, and joy." Picard applies machine-learning techniques to the problem of understanding human affect and she leverages the expression of affect in building responsive and appropriate interfaces to a wide variety of tasks.

The next group of papers examine the theme of learning through expressing. We begin with Papert's paper, "What's the Big Idea? Toward a Pedagogy of Idea Power," an articulation of a pedagogy based upon "idea work." His approach is to use construc-

tionist activities, but while he advocates providing tools and contexts that facilitate and encourage learning through building and doing, he does not stop there. Programming is only a means toward a greater end. Papert argues that it is necessary to "talk about ideas" in order to achieve technological fluency.

In their paper "Silver Stringers and Junior Journalists: Active Information Producers," Smith et al. describe communities that have discovered the power of self-expression and social construction. Through the use of expressive technological tools, community members have changed in their relationships with each other and the traditional media. They have developed very high expectations regarding storytelling, accountability, and process and they are addicted to discourse, design, and debate. The role of technology here is to lead the active information producer to the sharing of questions and collaborative effort in seeking answers.

"Justifying Imagery: Multimedia Support for Learning Through Explanation," by Smith and Blankinship, advocates the use of technology in support of engagement in the task of formulating and critiquing explanatory models. The authors describe an approach that uses photographs and video as a primary data source for observational inquiry. They have built a framework for students to collaborate around photographs and video, and the collaboration leads to inquiry and the development of explanations. They go beyond technological fluency by engaging students in reflection about what they are doing.

"Emergent Design and Learning Environments: Building on Indigenous Knowledge," by Cavallo, presents a theoretical framework for investigating that consists of probing for skills and knowledge resident in a community and using these as bridges to new content. Cavallo describes a two-year project to bring new learning environments and methodologies to rural Thailand. He set himself the specific goal of breaking "educational mind-sets" that have been identified as blocks to educational reform. His salient example is the assumption that the population and teachers of rural areas lack the cognitive foundations for modern technological education. The role of technology is critical to Cavallo's approach—it allowed the discovery and use of expertise existent in Thai culture heretofore under-recognized and unutilized.

The final two papers in this section describe tools for learning through expressing. The authors put their emphasis on computation (students build their own computational tools), structure (the language is constrained to facilitate the development of solutions to design problems), and critique (students are able to compare and contrast their design solutions or games with each other).

In their paper "MetaCricket: A Designer's Kit for Making Computational Devices," Martin, Mikhak, and Silverman describe a follow-on project to the work that resulted in Mindstorms. This project provides a flexible environment for rapid hardware and software prototyping and iterative design. The underlying architecture makes it easy for designers to expand the basic construction kit with minimal engineering effort.

Orwant's paper, "EGGG: Automated Programming for Game Generation," describes an experiment in automated programming. By concentrating on a particular domain—games—his system allows users to create applications with a minimum of programming effort. Users can create fully functional games merely by describing the rules. In Orwant's system, any game described in the system reveals itself and its inner structure. This means that playing and authoring become, to a greater extent than ever before, synonymous.

The Media Lab's focus on learning through expressing is a reflection of a sea change. For the "e-community," this is a time for doing. (An e-community is one in which communication technology is used to help create, support, or define communities.) As documented by Smith et al., neither teenagers nor senior citizens are willing to be spoon-fed, nor are they willing to accept technological tools that restrict their ability to be expressive. The e-community expects to be engaged and acknowledged as thinkers and learners.

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