Cognitive Science and Education Research: Engaging Issues of Social Context

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Education research as Cognitive Science

When asked to justify the practical importance of their work, cognitive scientists often discuss the direct implications it has for education. Of course, those implications are real and they are important. But frequently underlying such discussions is an assumption that we in this symposium would seek to challenge: that applying cognitive science to education is a relatively straight-forward matter of little intellectual consequence. As is evident in the talks that make up this symposium, there is much heavy-lifting –theoretical, methodological, and analytic –that remains to be done before insights and finding from cognitive science can have the kinds of practical impacts on education that is desired.

The moderator, a program director at NSF, notes how little represented are cognitive scientists among those submitting proposals to programs in the education directorate, or serving on review panels, despite an explicit call for proposals from cognitive scientists. Happily, the speakers at this symposium are all exceptions, and as a result have influenced literatures and communities (to say nothing of federal funding decisions) outside of cognitive science proper. A theme running through all of these talks is the importance of engaging issues about the setting in which learning occurs. The speakers ask questions about learning in non-majority cultures, in inner city classrooms, in graduate laboratories, and in science museums. In all cases, the findings provide ways for us to examine, even re-examine, claims about the nature of individual cognition in social contexts. In all cases, the implications for educational practice are real and they are important.

Megan Bang and Doug Medin

Cultural Perspectives on Science and on the Natural World: A Relational View

How do people conceptualize nature and the relation of human beings to it? Recent research suggests that the answer to this question varies dramatically across cultural groups and that this variation has important cognitive and behavioral consequences. Much the same may be said for cultural perspectives on science. We report a series of observations on cultural understandings of nature among Native-American and European-American children and adults. We then link these observations to perspectives and practices associated with Indigenous and Western science. Finally, we describe implications for community-based, culturally-based science education, along with some evidence bearing on these implications.

Rochel Gelman, Christine Massey, and Kimberly Brenneman

Taking Developmental Cognitive Science to School: Challenges of Conceptual Change for Everyone

There is national urgency to improve science teaching and learning. Work in cognitive science suggests that such improvement will require learners to master a coherent body of scientific knowledge, including its language, representational formats, and the "tools" for doing science. We are studying the introduction, into inner-city preschools, of an educational program designed to support such learning. *Preschool Pathways to Science (PrePS)* embeds child-suitable science "lessons" into classroom activities. These lessons are connected by central ideas including change, the animate-inanimate distinction, form and function, and so on. PrePS also introduces vocabulary tied to science content, tools, and methods. These methods include observing, predicting, and checking; comparing, contrasting, and experimentation; and documenting findings in charts, graphs,

and science journals. We find that teachers adopt ways to develop children's understanding of these science *practices* relatively easily. It has been much more difficult to teach in-service teachers about the notion of an organized knowledge domain and to make clear that planning activities that cohere around a common central concept supports student learning in specific ways. Could this be because we are asking teachers to engage in conceptual change about appropriate material to offer the preschooler's constructivist mind? This challenge has required us to modify our own thinking about the materials and supports we offer teachers. Our experiences taking cognitive science to preschool have also highlighted issues about appropriate research designs for making progress on the educational front.

Nancy Nersessian and Wendy Newstetter

Learners in complex settings: Cognitive partnerships on the benchtop

Scientific research laboratories, recently, have been sites for observational and ethnographic studies of cognition. However, they have largely not served as for the study of situated learning. Our six-year investigation of cognitive and learning practices in three bio-science and -engineering research labs shows them to be ideal sites for studying learning at all levels, ranging from undergraduate through to laboratory director. Our mixed-method approach uses ethnographic and cognitive-historical analysis and is imprinted with an environmental perspective which from the start looks at individual cognitive development as it intersects with the socio-cultural environment and the relevant history of the lab. Here we discuss the interrelations of three practices we have found to be useful to distinguish in characterizing the learning processes: the cognitive, the investigative, and the interactional practices. Cognitive practices give rise to and interact with investigative practices, which in turn are enacted through interactional practices, which support and sustain both. We focus on these practices surrounding the technological devices created by the lab members, which drive research and learning, specifically on "cognitive partnerships" learners form with lab members and artifacts.

Laura Schulz

Naive Physics/Savvy Science: Causal learning in very young children ... and the rest of us

Considerable research suggests that children (and adults) have an impoverished understanding of particular physical mechanisms. Research also indicates that children are poor at designing informative experiments. Nonetheless, children understand a remarkable amount about the causal structure of the world by age five. Here I suggest some processes that might support such rapid and accurate causal learning. In particular, I suggest that children, like scientists, assess the causal structure of events by jointly integrating the statistical evidence they observe with their prior causal beliefs. I also suggest that they systematically engage in more exploration when the interpretation of evidence is uncertain, thereby tending to isolate relevant variables and spontaneously generating informative evidence. Finally, I suggest that the same processes that support rapid, accurate induction from minimal data also make children's (and adults') causal beliefs resistant to potential counter-evidence.

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