Integrating Cognitive and Conversational Accounts of Conceptual Change in Qualitative Physics Learning

Jeremy Roschelle
Institute for Research on Learning
2550 Hannover Street
Palo Alto CA 94304
(415) 496-7900
(415) 496-7957 fax
jeremy@dewey.soe.berkeley.edu

ABSTRACT

Empirical data on students' science learning has demonstrated that learning science is a very complicated and fine-grained process. Simple replacement models -- destruct the misconception, and instruct the target concept -- have failed to cope with the observation that both states of knowledge are not unitary, monolithic, tightly coupled systems. At the same time, expert-novice research has produced a long list of specific areas in which students and scientists are said to fundamentally differ, spanning all the way from perception to metacognition. The deep irony is that Cognitive Science research, which should make instruction easier, has in fact expanded the "great divide" by locating more and more ways in which students and scientists differ.

Time has come to articulate the commonalties among students and scientists that enable conceptual change to occur. Students and scientists have commonalties both in cognition and conversation. Research in qualitative physics and epistemology is providing an account of physics learning in terms of re-using cognitive structures available to both students and scientists (i.e. p-prims and qualitative cases). Social studies of science show that turn-taking can allow negotiation of knowledge, both in everyday conversation and in the laboratory. This paper discusses research demonstrating the deep compatibility of cognitive and conversational accounts, and their potential symbiosis as an account of conceptual change in students' physics learning. In particular, I present data from students' use of a computer simulation, "The Envisioning Machine," which shows that students' conversational and cognitive processes can operate over the same basic data -- qualitative physics knowledge -- thereby allowing students to achieve conceptual change by simultaneously exploiting cognitive and social constraints.