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Embodiment and the Learning Sciences: Taking the body seriously when designing learning environments and technologies

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Abstract:

Embodiment and Cognitive Science (Gibbs, 2006) and other comprehensive titles have presented converging evidence and a coherent theoretical account for the fundamental role embodied actions have in perception and cognition (Noë, 2004; Gallagher, 2005; Rowlands, 2006; Varela, Thompson, & Rosch, 1991). What are the implications of this for learning and education? There is no chapter on educational research in Gibbs' book, nor is there any discussion of embodiment in the de facto textbook for the learning sciences, *How People Learn* (Bransford et al., 1999) and other related texts on learning. This is despite the fact that a good number of instructional techniques have deep roots in cognition and perception research. While a handful of people have done work in this intersecting area of embodiment and education, I believe vast room for theoretical and empirical exploration still remains.

Cognitive and educational researchers, while not always espousing embodied cognition, have found evidence linking students kinesthetic behavior to their understanding of everything from complex dynamic systems to passages of text and mathematical formulas. For example Clement (1994) and Reiner (2000) have found that both students and experts may sometimes describe a system action in terms of a human action and use gestures that depict changes happening in a system. Sometimes this kind of anthropomorphic epistemology (Sayeki, 1989) may underlie the misconceptions and difficulties students have while learning various topics, but it can also be used positively, as a starting point for instruction. Roth and Lawless (2001) suggest that learning environments that do not support students use of body and gesture can limit what and how students learn, and, like Piaget, they have argued that actions and gestures can serve as a bridge between our everyday experiences in the physical world and the seemingly abstract and unnatural worlds of science, history, mathematics, and other expert realms (Wineburg, 2001).

Thus there is evidence for the role of embodiment in a range of learning and instructional strategies developed over the years by educators and cognitive scientists. I will also highlight how consideration of embodiment can help address some of the theoretical disagreements and empirical anomalies in existing cognitive research in education, such as in the literature on student misconceptions about science concepts. I also hypothesize as to underlying role embodiment may play in the success of various instructional techniques and technologies, including contrasting cases, animations/diagrams, simulations, and microcomputer-based labs (aka probeware). Finally, I present new instructional frameworks and strategies derived from and inspired by research on embodied cognition and perception, including enactive modeling, in which a student participates in the behavior of a dynamic system, effectively encoding abstract scientific concepts as action under constraint.