Laboratory Learning: Cognitive and Learning Practices in University Research Laboratories

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University research laboratories are rich sites for investigating the cognitive and learning practices of scientists and engineers. They are provide data for studying highly sophisticated cognition-in-action, and for addressing difficult theoretical issues of the interrelations among the cognitive, social, and cultural dimensions of cognition and learning. They also provide a window into how new practices emerge since in environments where innovation is at a premium and interdisciplinarity, often a desideratum. They are rich sites of learning because they are largely populated by graduate and undergraduate students who are undergoing cognitive apprenticeships. This symposium brings together on-going investigations in a range of science and engineering fields. The presentations are united in that they investigate cognitive and learning processes as situated in local interactions and embodied practices and as distributed across researchers and artifacts.

Interdisciplinarity on the Benchtop

Newstetter and Nersessian are studying two interdisciplinary research laboratories in bio-engineering. Our method of investigation couples ethnographic observations and interviews and qualitative methods of analysis with cognitive-historical analysis to study in a unified manner the evolution of practices and their enactment of in the daily problem-solving activities. In the laboratories researchers construct technological devices in order to perform *in vitro* simulations of current models of *in vivo* biological processes. Devices perform as what they call "model-systems" - locales where engineered artifacts interface with living cell cultures in specific problem-solving processes. Here we focus our analysis on how learning to solve problems with model systems requires developing *interlocking models* of and forming *cognitive partnerships* with these artifacts. Problem solving with model-systems requires that researchers develop models (mental and physical) that selectively merge concepts, models, and methods of biology and engineering relevant to the context.

Sculpting Embodied Models

Myers addresses the problem that learning to "think intelligently about structure" presents a challenge for protein crystallographers who build atomic-resolution models of protein molecules using the techniques of X-ray diffraction. This study of protein modeling practices shows that making sense of such intricate objects requires researchers to draw on their bodies as a resource to learn about, work with, and communicate precise molecular conformations. Contemporary crystallographic modeling relies on interactive computer graphics, and requires active and prolonged handling and manipulation of the model throughout the often-arduous process of model-building. Scientists achieve the intimate knowledge of the structures they model by sculpting *embodied models* of the molecules alongside the digital models they build onscreen. The analysis draws on historical materials and ethnographic interviews and observations, focusing especially on gestural forms and body movements.

Action as Cognition in the Lab Apprenticeship

Alac and Hutchins' analysis is based on an ethnographic study of cognitive science laboratories. In addition to traditional ethnographic data collection methods, we video-tape practitioners' interactions and hands-on apprenticeship practices. This allows us to trace the way in which practitioners coordinate embodied semiotic modalities with material structures in a culturally rich environment. We claim that these semiotic actions, while participating in the accomplishment of practical tasks, are directly involved in the processes of learning and understanding. Moreover, they not only reflect the operation of internal cognitive processes; they actively construct cognitive processes. In this respect, rather than being solely produced for the "recipient", semiotic actions are crucial for both interlocutors. The analysis suggest that scientific cognition is enacted in bodily and interpersonal activity in addition to mental activity.