

# Understanding educational computational artifacts across community boundaries

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Computational artifacts such as scientific simulations, productivity software, organizational knowledge repositories and educational systems are designed by one community (e.g., software developers, educators, domain experts or former employees) for use by another (end-users, students, novices or future employees). The two communities typically operate within contrasting cultures; their shared artifacts must cross cultural boundaries to be effective. Diversity among interacting communities of practice leads to many of the same issues and misunderstandings as cultural diversity among traditional communities.

A computational artifact embodies meaning in its design, its content and its modes of use. This meaning originates in the goals, theories, history, assumptions, tacit understandings, practices and technologies of the artifact's design community. An end-user community must activate an understanding of the artifact's meaning within their own community practices and cultural-historical contexts. Given the diversity between the design and user communities, the question arises: how can the meaning embodied in a computational artifact be activated with sufficient continuity that it fulfills its intended function?

This paper investigates the process of meaning-activation of computational artifacts through a combination of empirical and theoretical approaches:

1. It reports on a micro-ethnographic analysis of an interaction among middle school students learning how to isolate variables in a computer simulation. The analytic affordances designed into the computational artifact were activated through the involvement of the students in a specific project activity. Their increasing understanding of the artifact's meaning structure was achieved in group discourse situated within their artifact-centered activity.
2. It conducts a critical review and extension of philosophical analyses of meaning co-construction in communities. Hegel pointed to the role of the artifact as expression of meaningful form in a physical content during the construction of self-consciousness in interpersonal interaction. Vygotsky argued that external knowledge, abilities and symbolic artifacts created inter-personally may subsequently become internalized to form an individual's mental processes. Heidegger proposed a more adequate ontology for comprehending the social nature of meaning construction, overcoming the inappropriate distinctions of form/content and

internal/external with a view of shared human activity situated in a historical and meaningful world of artifacts. However, he slipped into an ahistorical, individualistic emphasis with his jargon of authenticity. Schutz, Garfinkle and Habermas successively analyzed the social nature of the achievement of meaning within historically-specific discourse communities, providing a framework for studying the activation of meaning by communities.

The paper concludes with implications for the design and use of computational artifacts within educational settings. These artifacts should not be designed as isolated software applications, but as integral components of activity systems that support learning as collaborative knowledge building. Participatory design with teachers and students should be used to ground the artifact design in the culture of the potential user communities. Perhaps most importantly, community discourse processes should be supported to help groups of users to re-activate and interpret the meaning of the artifact in their own terms and from their own perspectives. Without such measures, computational artifacts will continue to fail to effectively cross the boundaries between diverse design and usage communities.