Workshop: Across Levels of Learning:
How Resources Connect Levels of Analysis

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Abstract: CSCL research typically involves processes at the individual, small-group and community units of analysis. However, CSCL analyses generally each focus on only one of these units, even in multi-method approaches. Moreover, there is little data-based analysis of how the three levels are connected, although it is clear that such connections are crucially important to understanding learning in CSCL contexts. This workshop will explore one possible way of doing research about how the levels of individual learning, group cognition and community knowledge building are connected: through a focus on emergent *interactional resources*, which can mediate between the levels.

Workshop Theme: The Problem of Connecting Levels

Learning, cognition and knowledge building can be analyzed at multiple units of analysis. For instance, analyses of CSCL are often conducted on one of three levels: individual learning, small-group cognition or community knowledge building. This tri-partite distinction is grounded in the nature of CSCL. With its focus on collaborative learning, CSCL naturally emphasizes providing support for dyads and small groups working together. In practice, CSCL small-group activities are often orchestrated within a (physical or virtual) classroom context by providing some initial time for individual activities (such as background reading or homework practice) followed by the small-group work and then culminating in whole-class sharing of group findings. Thus, the typical classroom practices tend to create three distinguishable levels of activity. Often, the teacher sees the group work as a warm-up or stimulation and preparation for the whole-class discussion, facilitated directly by the teacher. Conversely, the importance of testing individual performance and valuing individual learning posits the group work as a training ground for the individual participants, who are then assessed on their own, outside of the collaborative context. In both of these ways, group cognition is treated as secondary to either individual or community goals. By contrast, the role of intersubjective learning is foundational in Vygotsky (1930/1978), the seminal theoretical source for CSCL. Regardless of which is taken as primary, the three levels are actualized in CSCL practice, and the matter of their relative roles and connections becomes subsequently problematic (Dillenbourg et al., 1996; Rogoff, 1995; Stahl, 2006).

While these different units, levels, dimensions or planes are intimately intertwined, research efforts generally each focus on only one of them, and current analytic methodologies are designed for only one (Stahl, 2013; Suthers et al., 2013). Furthermore—and most importantly for this workshop—there is little theoretical understanding of how the different levels are connected. To the extent that CSCL researchers discuss the connections among levels, they often rely upon commonsensical notions of socialization and enculturation, popularizations of traditional social science. There are no explicit empirical analyses of the connections, and it is even hard to imagine where one would find data that would lend itself to conducting such analyses (Stahl et al., 2012).

The individual unit of analysis is the traditional default in the learning sciences and in cognitive psychology. It is supported by widespread training of researchers in the methods of psychology and education. In the era of cognitive science, analysis made heavy usage of mental models and representations (Gardner, 1985). With the "turn to practice" (Lave & Wenger, 1991; Schatzki, Knorr Cetina & Savigny, 2001), the focus shifted to communities-of-practice. Group cognition lies in the less-well-charted middle ground (Stahl, 2006). It involves the semantics, syntactics and pragmatics of natural language, gestures, inscriptions, etc. These meaning-making processes involve inputs from individuals, based on their interpretation of the on-going context (Stahl, 2006, esp. Ch. 16). They also take into account the larger social/historical/cultural/linguistic context, which they can reproduce and modify (Stahl, 2013).

This workshop will explore ways in which the connections between the individual, group and community planes take place through the mediation of *interactional resources*. To provide specificity and to ground the presentation in empirical data, the workshop will consider the resources that appear in recorded examples of CSCL settings.

Computer technologies play a central role in mediating the multi-level, intertwined problem-solving, learning and knowledge-building processes that take place in CSCL settings. From a CSCL perspective, innovative technologies should be designed to support this mediation. This involves considering within the socio-technical design process of collaboration environments how to prepare groups, individuals and communities to take advantage of the designed functionality and to promote learning at all levels.

Workshop Theory: The Emergence of Interactional Resources

While we are interested in linguistic interactional resources in this workshop, it may be helpful to first consider the more intuitive case of a physical resource. A ramp or bridge often creates a possibility that did not otherwise exist for going from one level to another at a given point. To go from a local road to a limited-access superhighway, one must first find an available on-ramp. To cross a river from one side to the other, one may need a bridge. This is the

individual driver's view. From a different vantage point—the perspective of the resource itself—the creation of a ramp or the building of a bridge "affords" connecting the levels (Bonderup Dohn, 2009).

By "affords," we do not simply mean that the connecting is a happy characteristic or accidental attribute of the bridge, but that the bridge, by its very nature and design, "opens up" a connection, which connects the banks of the river it spans. This view of artifacts was largely introduced in the philosophy of Heidegger and later became influential in CSCL through various theories influenced by Heidegger. In his early work, Heidegger (1927/1996) analyzed how the meaning of a tool was determined by the utility of the tool to the human user, within the network of meaning associated with that person's life and world. In his later writings, Heidegger (1935/2003) shifted perspective to focus on things like bridges, paintings, sculptures, pitchers and temples in terms of how they themselves opened up new worlds, in which people could then dwell. In considering the intersubjective world in which collaboration takes place on multiple connected levels, we might say that the work of resources like bridges is to contribute the spanning of shores within the way that the world through which we travel together is opened up as a shared landscape of resources for discourse and action.

This transformation of perspective away from a human-centric or individual-mind-centered approach became characteristic for pioneering theories in the second half of the 20th Century, including recent theories of situated and distributed cognition. It is a shift away from the individualistic, psychological view to a concern with how language, tools and other resources of our social life work. It is a post-cognitive move since it rejects the central role of mental models, representations and computations. The things themselves have effective affordances; it is not just a matter of how humans manipulate models in which the things are re-presented to the mind.

The analytic focus and even the locus of agency are shifted from the individual mind to tools, artifacts, instruments, discourse and inscriptions. In phenomenology, Husserl (1929/1960) called for a return to "the things themselves" (*die Sache selbst*) and Heidegger (1950/1967) analyzed "the thing" (*das Ding*) separate from our representation of it. In ethnomethodology, Garfinkel and Sacks (1970) followed Wittgenstein's (1953) linguistic turn to focus on the language games of words and the use of conversational resources (Koschmann, Stahl & Zemel, 2004). In distributed cognition, Hutchins (1996) analyzed the encapsulation of historical cognition in cultural artifacts. In actor-network theory, Latour (1990; 1992; 2007) uncovered the agency of various kinds of objects in how they move across levels in enacting social transformations. Recently, Rabardel (Rabardel & Beguin, 2005; Rabardel & Bourmaud, 2003) analyzed the genesis of socio-technical instruments, which only gradually become useful as they are adapted and enacted in practice.

Our proposal in this workshop to use the term "resources" is intended to carry forward into the 21st Century these groundbreaking approaches into the study of how the various planes of human interaction are connected. The phrase "interactional resource" is proposed as an inclusive expression for all the kinds of things that can be brought into discourse. Vygotsky (1930/1978) used the term "artifact" to refer to both tools and language as mediators of human cognition; we prefer to use the broader term "resource" as it has more recently been used in sociocultural analysis (Furberg, Kluge & Ludvigsen, 2013; Linell, 2001; Suchman, 1987) for entities referenced in discourse. Like artifacts, resources are often identifiable units of the physical world (including speech and gesture) that are involved in meaning-making practices—spanning the classical mind/body divide.

A central research issue for CSCL is how collaborative knowledge building takes place. The main problem seems to be to understand the roles of both individual cognition and societal institutions in small-group meaning-making processes. We do not mean to reify different levels or processes as necessarily having some kind of independent existence outside of our analyses, but to suggest that there are important constraints between different phenomena and possible flows of influence across levels. We distinguish between levels and we try to identify resource-mediating connections between them in order to operationalize the infinitely complex and subtle matter of collaborative knowledge building for purposes of concrete analytic work by CSCL researchers.

Some researchers, such as ethnomethodologists, argue against distinguishing levels. However, the view of levels of analysis in this workshop may actually be consistent with ethnomethodology. For instance, in their introduction to ethnomethodologically inspired Conversation Analysis (CA), Goodwin and Heritage (1990, p. 283)—two of the writers most explicit about the theory underlying ethnomethodological studies—open with the following claim: "Social interaction is the primordial means through which the business of the social world is transacted, the identities of its participants are affirmed or denied, and its cultures are transmitted, renewed, and modified." This statement implicitly distinguishes social interaction, individual identities and community cultures—asserting the tight connections between them and a priority to the first of these. Social interaction typically takes place in dyads and small groups, so interaction analysis can be considered to be conducted at the small-group unit of analysis. Although CA, as a branch of sociology, refers to community-level social practices and linguistic resources, its case-study analyses involve interactions in dyads or small groups. CSCL researchers focus on small groups, but also want to analyze the levels of the individual and of the culture as such—e.g., the individual identities and learning changes or the cultural practices and institutional forces. In this workshop, we propose that interactional resources are centrally involved in mediating these connections within CSCL settings. The resources that CSCL must analyze are different from those of interest to CA and the approach to interaction analysis is different: CA studies the interactional structure of informal conversation rather than the building of knowledge in online chat of school-domain content, has a different conception of resources for interaction and is interested in the co-construction of social order rather than of domain knowledge. However, analysis of the ways in which interactional resources bridge from group phenomena to individual and community phenomena should be of similar concern to CA and CSCL.

CSCL sequential small-group discourse brings in—through indexical references, as described below—resources from the individual, small-group and community planes and involves them in procedures of shared meaning making. This interaction requires co-attention to the resources and thereby shares them among the participants. The process results in generating new or modified resources, which may then be retained at the various

planes. The resources that are brought in and those that are modified or generated often take the form of designed physical artifacts and adopted elements of language. In other words, "small groups are the engines of knowledge building. The knowing that groups build up in manifold forms is what becomes internalized by their members as individual learning and externalized in their communities as certifiable knowledge" (Stahl, 2006, p. 16).

The question of how the local interactional resources that mediate sequential small-group interaction are related to large-scale socio-cultural context as well as to individual learning is an empirical question in each case. There are likely many ways these connections across levels take place, and they involve mechanisms that are not apparent to participants.

Sawyer (2005, p. 210f) argues that we can conceptualize the general level-bridging processes as forms of "collaborative emergence"—involving both ephemeral emergents and stable emergents: "During conversational encounters, interactional frames emerge, and these are collective social facts that can be characterized independently of individuals' interpretations of them. Once a frame has emerged, it constrains the possibilities for action." Sawyer's theory of ephemeral and stable emergents suggests a relationship among different kinds of interactional resources along the lines pictured in Figure 1. While Sawyer's analysis addressed a much broader sociology of social emergence, we have confined and adapted it to the concerns of CSCL. What is most relevant in his theory is the view of emergence arising out of the subtle complexities of language usage and small-group interaction, rather than from the law of large numbers, the interaction of simple rules or the chaotic behavior of non-linear relationships. The vast variety of interactional emergents form an intermediate level of analysis between the level of individuals and the level of community structures, providing a dynamic and processual understanding of social structures and infrastructures.
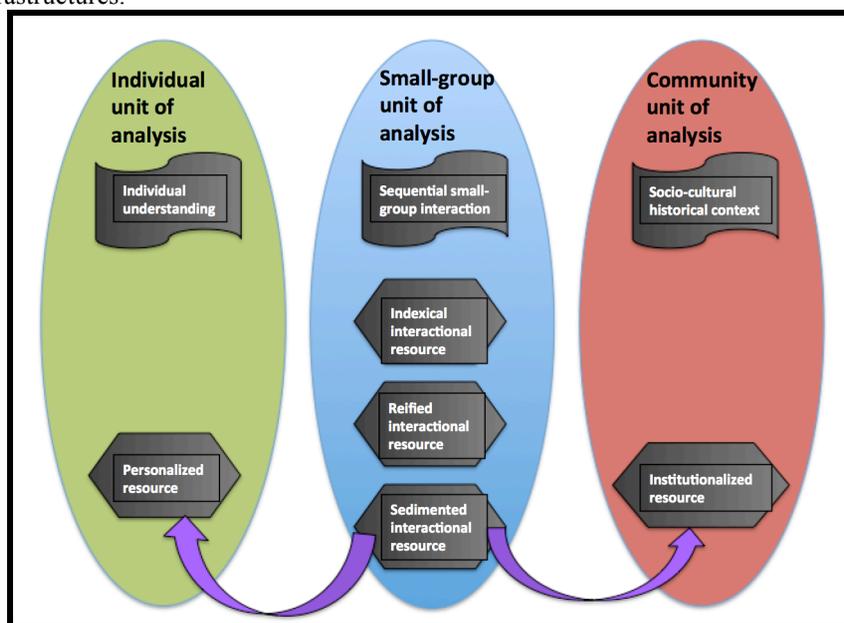

Figure 1. A diagram of emergent interactional resources bridging levels of analysis.

In this diagram, interaction is taken as being based on an "indexical ground of deictic reference" (Hanks, 1992). This means that the "common ground" (Clark & Brennan, 1991)—which forms a foundation for mutual understanding of what each other says in conversation—consists of a shared system of *indexical-reference resources*, such as deictic pronouns, which are used to point to unstated topics or resources. Interactional resources, which can be indexically referenced in the interaction, may undergo a process like Rabardel's (Rabardel & Beguin, 2005; Rabardel & Bourmaud, 2003) instrumental genesis: they may initially be constituted as an object of repeated discussion—an interaction frame (Goffman, 1974)—which we might call a *reified resource*, something capable of being picked out as having at least an "ephemeral-emergent" existence. Over time, continued usage can result in a *sedimented resource*, something whose existence has settled into a longer-term "stable-emergent" form. A sedimented resource is then susceptible to being taken up by a larger community as an *institutionalized resource* within a structured network of such resources, as in Latour's social-actor networks (Latour, 2007), contributing to the socio-cultural-historical context surrounding the interaction: not only referencing it, but partially reproducing it. On the other hand, interactional resources at various degrees of reification can also be taken up into the individual understanding of community members as *personalized resources*, integrated more or less into the intra-personal perspective of one or more group members. The personalization of previously inter-personal resources by individuals renders them into resources that can be referenced in activities of individual understanding—corresponding to processes of micro-genesis in Vygotskian internalization.

The various components of this view of interactional resources have been hinted at in previous theoretical contributions grounded in empirical examples. The term "reification" goes back to Hegel's philosophy of mediation (Hegel, 1807/1967). It has been applied to the formation of mathematical concepts by Sfard (Sfard, 2000; 2008; Sfard & Linchevski, 1994). Husserl (1936/1989) argued that the ideas of the early geometers became "sedimented" in the cultural heritage of the field of geometry. Livingston (1999) differentiated discovering a mathematical proof from presenting a proof; a transformational process takes place, in which the byways of exploration and possibly even the key insights are suppressed in favor of conforming to the institutionalized template of formal deductive reasoning. Netz (1999) (see also the review by Latour, 2008) documented the important role of a controlled (restricted) vocabulary in the development, dissemination and learning of geometry in ancient Greece. Analogously,

Lemke (1993) argued that learning the vocabulary of a scientific domain such as school physics is inseparable from learning the science. Vygotsky (1930/1978, esp. pp. 56f) noted that the micro-genetic processes of personalizing a group practice into part on one's individual understanding—which he conceptually collected under the title "internalization"—are lengthy, complex, non-transparent and little understood. These seminal writings name the processes of reification, sedimentation, institutionalization and personalization of interactional resources; their empirical investigation remains as a major challenge for future CSCL research.

Workshop Contribution: The Analysis of Evolving Resources

Analyses of CSCL research show that few studies have bridged multiple levels of analysis (Arnseth & Ludvigsen, 2006; Jeong & Hmelo-Silver, 2010). Yet the desired CSCL research agenda (Krange & Ludvigsen, 2008; Stahl, Koschmann & Suthers, 2006; Suthers, 2006) calls for a study of representational artifacts and other resources that traverse between individual, small-group and community processes to mediate meaning making. The preceding sketch of emergent forms of evolving resources could be taken as a refinement of the research agenda for the field of CSCL: a hypothesis about how levels in the analysis of learning are connected and an agenda for exploration. This is intended only as a starting point, and we welcome the presentation of further ideas—grounded in CSCL case studies—that will guide the field in connecting levels of analysis.

Workshop position papers should begin that undertaking. They should present examples of interactional resources in computer-mediated small-group discussions. Future research will need to log the use of resources by teachers and students in order to analyze how resources connect levels of learning in CSCL settings. We need to track individual and group learning as resources and practices from community levels are taken up in sequential small-group interaction. Perhaps we will witness the formation of local practices and group interactional resources, which can influence individual and community levels over time. In these ways, we will study resources for connecting levels of learning in CSCL.

More generally, through analysis of the nature and work of interactional resources in case studies of a broad variety of CSCL interactions, the CSCL research community can expect to reach a better understanding of the nature of different levels of analysis in CSCL research and how the levels may be connected in terms of their mediation by diverse resources. Gradually, we will discover how resources are enacted, understood, shared, designed, adapted and preserved—and how they mediate connections among levels of learning through social interaction.

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