Technology Affordances for Intersubjective Meaning-Making

Daniel SUTHERS
Department of Information and Computer Sciences, University of Hawai`i, USA
suthers@hawaii.edu

Abstract: The broad field of "computers in education" includes a diversity of approaches to using computers for learning. Each approach is based on an epistemology: a theory of how knowledge is gained. In this presentation, I will characterize the uses of technology and their corresponding epistemologies. I will single out intersubjective epistemologies as timely for research and practice, and call for development of technologies that offer social affordances and resources for meaning-making. The study of intersubjective meaning-making requires interactional analyses, but in new forms that transcend some of the assumptions and limitations of microanalysis and that can be coupled with other methodologies. The presentation illustrates these ideas with my research program on representational affordances for collaborative learning.

Keywords: epistemologies of learning, representational guidance, technology affordances, interactional construction of meaning, research agenda

1 Introduction

The broad field of "computers in education" includes a diversity of approaches to using computers for learning. For example, we can find technology used as a *publication medium*, to present information or problems; as *task-oriented tools* for aiding performance, keeping track of information and organizing the learner's activities; as *conceptual tools* for relating features of problem instances to useful abstractions or expressing and testing the learner's own ideas; as a *communication medium* through and with which learners engage with each other in peer tutoring, argumentation, or collaboration in making sense of a situation; and as a *proxy for the teacher*, selecting the next problem or activity, selecting learning partners, giving hints or correcting errors during performance, and confirming or correcting learners' solutions. Each of these approaches is based on assumptions concerning learning and how technology can support it. These assumptions should be identified and used to guide design in a dialogue between theory and practice [26]. New forms of technology-mediated learning are possible if we re-examine our beliefs about learning and the roles of media in learning. My keynote presentation will provide an overview of my own quest. This extended abstract outlines the ideas to be covered and provides a bibliography for those who wish to pursue some of these ideas further. I first summarize relevant theories of how knowledge is gained, called *epistemologies*. I then single out *intersubjective* epistemologies as most timely for research and practice, and suggest lines of investigation into *social affordances* through which technology media can serve intersubjective meaning-making at various scales. The reader is referred to [30] for a more developed account of the material of this presentation, focused on the field of computer-supported collaborative learning (CSCL).

2 Epistemologies of Learning

When the actual practices of our field are examined, we find that a great deal of work is based on a *knowledge-communication epistemology*. Knowledge communication is "the ability to cause and/or support the acquisition of one's knowledge by someone else, via a restricted set of communication operations" [39]. Research conducted under this epistemology examines how to more effectively generate or facilitate communications that "cause and/or support" the desired acquisition of knowledge. The best work in this paradigm (e.g., [2]) eschews a simplistic view of learning as the transfer of information from outside to inside the learner's head, and treats knowledge communication in the context of *constructivist* and *interactional* stances, considered below.

A *constructivist epistemology* [21, 37] emphasizes the agency of the individual learner in the learning process. Learning can only happen through the learner's efforts at making sense of the world, although a mentor might arrange for the learner to have challenging experiences in order to accelerate the change process. Most researchers do not take constructivism to its solipsistic extreme, but instead view social interaction as helpful and even essential.

Interactional epistemologies are diverse, and include accounts that emphasize both individual and social agency. With *individual agency*, the individual is the unit and agent of learning yet this learning can be enhanced through social interaction. Examples include cognitive dissonance theory [8] and socio-cognitive conflict theory [6]. Contribution theory [3] is interactional in its account of the construction of "common ground," but is yet based on an individual epistemology as it does not explain how knowledge that did not predate the communication is jointly constructed within the communication process. At the boundary of individual and social agency, we find Vygotsky's [38] oft-cited observation that developmental learning through social interaction can be understood as the internalization of interpersonal processes as intrapersonal processes.

Intersubjective epistemologies are interactional epistemologies with social agency: they locate meaning-making and even learning at the group level. In a distributed or group cognition account, the group and its cultural/technological artifacts collectively constitute the proper unit of analysis [11, 28]. Knowledge and meaning can be understood as jointly created through interaction: learning *consists of* this interaction [16]. An intersubjective epistemology is distinguished from grounding in that interpretations emerge within the interaction, and so are shared from the outset.

Learning is also conceived of as a community level phenomenon. A *participatory epistemology* sees learning as a process of increasing participation in the practices of a community [19], constructing personal and collective identity [40]. Another community level epistemology is *knowledge building* [25], the enterprise in which a community intentionally expands its cultural capital by reflecting on limits of understanding and choosing actions that address these limitations.

3 Intersubjective Meaning-Making

In my own analysis of CSCL [30], I single out intersubjective epistemologies as those that we most need to understand, at both the interpersonal and community levels. Given the pervasive social nature of learning, I maintain that this emphasis is of importance for other research communities such as the ICCE community. Intersubjective epistemologies lead to challenging unanswered questions. How is it possible for learning, usually conceived of as a cognitive function, to be distributed across people and artifacts [24]? What is the relationship of the change process we call "individual learning" to that individual's participation in socially accomplished learning? The study of intersubjective learning is

needed because we already have a substantial body of work on individual learning and on how the cognitive processes of participants are influenced by social interaction, while intersubjective learning is currently not prominent as a topic of study in our field (notable exceptions include [1, 16, 23, 27]). An intersubjective perspective will help designers understand how technologies can function as mediating resources in learning. In [30] I argue that "learning" is a judgment we make about the consequences of an activity, and to understand this accomplishment we must necessarily study the practices (the activity itself) of *intersubjective meaning-making*: how people in groups make sense of situations and of each other.

4 Implications for a Research Agenda on Social Affordances of Technology

In [30] I identify two distinct ways in which technology is applied to support collaborative learning—as a *communication medium* and as *constraint* (see also [10].) Both paradigms are limiting from an intersubjective meaning-making perspective, but both can contribute to a synthesis. Richer communication media are needed, particularly with respect to supporting the indexical nature of human communication [20]. Guidance for a learning agenda is needed for both discipline-specific practices and learning trajectories and for processes of intersubjective meaning-making, but without limiting creativity by excessively rigid scripting of action. In order to achieve advancements in these forms of support, we need to better understand the ways in which practices of meaning-making in the context of joint activity are mediated through designed artifacts [15] and apply this understanding to design *fundamentally social technologies* that are informed by the *affordances and limitations of those technologies for mediating intersubjective meaning-making*.

The remainder of this paper identifies some unique social affordances of computational technology for intersubjective meaning-making, suggesting lines of investigation in research and design.

Negotiation Potentials. Any medium offers certain potentials for action. Participants may feel an obligation to obtain agreement on modifications to shared workspaces. The potentials for action offered by the medium can therefore guide interactions towards ideas associated with the afforded actions [34]. If we would like users of our technology medium to focus on particular aspects of a problem, how can the medium be designed to prompt for actions that require negotiation of these aspects?

Referential Resource. Jointly constructed representations become imbued with meanings for the participants by virtue of having been produced through a process of negotiation. These representational constituents then become a rich referential resource for conversation [33], facilitating elaboration on previous conceptions. Rather than being vehicles for communicating expert knowledge, representations become objects about which learners engage in sense-making conversations [23] and can be designed to lead to productive conversation. How can we make salient that which learners would productively interpret, elaborate on and relate to new information or ideas?

Integration. The computational medium can leave a persistent record of activity [5]. How can traces of interaction and collaboration be designed to foster appropriate awareness of prior conceptions and the means to reference these in subsequent interactions so that they may be integrated with new information and ideas?

(Im)mutable Mobiles. The mobility of digital inscriptions provides opportunities for recruitment of partners in the sense-making process [18] and supports continued engagement in that process. How can we exploit this property of technology for its potential to make new social alignments and their interactions possible?

Reflector of Subjectivity. Computational media can be designed to foster group awareness [17], visualize conflict or agreement between members [12], or project representations of self into a social representation [14]. In what ways can we design technology to mediate intersubjectivity by reflecting activity, subjectivity, and identity?

Trajectories of Participation. Technologies offer social affordances for patterns of participation over larger spans of time and collections of actors [22]. How can we encourage productive entanglement of multiple individual trajectories of participation by selectively making their contributions salient and hence available for subsequent interpretation by others?

My colleagues and I have been engaged in work on social affordances of technology since we first realized that the visualizations and coach of Belvedere had significance primarily (if at all) in how they affected peer interaction [36]. This began a line of work on representational guidance [31] that investigated negotiation potentials [34], referential resources, and integration [33]. More recently, we have brought this work to an asynchronous paradigm [35], and have begun a new line of work examining the fundamental practices by which people appropriate the affordances of certain media for written communication [7].

5 Analysis of Intersubjective Meaning-Making

Although some of our prior work has been in a quantitative experimental paradigm, we have found that the study of intersubjective meaning-making requires coordinated use of qualitative interactional analyses [4]. Quantitative methods aggregate over many sessions, obscuring the actual procedures by which participants accomplish learning through the affordances of online media [16]. Methods for studying the interactional construction of meaning are available [13, 9], but have largely been developed for brief episodes of face-to-face data, and do not scale well to online learning where media resources, time scale, and synchronicity all differ. This analytic tradeoff between scalability and fidelity must be resolved in order to inform the design of improved online learning environments and participation structures that engage participants more deeply in intersubjective meaning-making during collaborative inquiry. My research group has been working on this problem for several years now [29]. As our current progress is reported elsewhere in this proceeding [32], it will not be detailed here. The short-term objective of the work reported in [32] is to scale up sequential and interactional analysis to distributed and asynchronous interactions while remaining grounded in participants' use of media. The long-term objective of the entire enterprise discussed in this extended abstract is to obtain a deep understanding of how learning is accomplished interactionally in technology-mediated setting, and then to offer learners environments that provide the resources and guidance they need for engaged learning.

Acknowledgments

This work was supported by the National Science Foundation under award 0093505. Any opinions, findings, and conclusions or recommendations expressed in this paper are those of the authors and do not necessarily reflect the views of the National Science Foundation.

References

[1] M. Baker, *Computer-mediated argumentative interactions for the co-elaboration of scientific learning tasks.*, in Andriessen, Baker and Suthers, eds., *Arguing to Learn: Confronting Cognitions in Computer-Supported Collaborative Learning Environments.*, Kluwer, Dordrecht, 2003, pp. 47-78.

[2] R. Bromme, R. Jucks and A. Runde, *Barriers and biases in computer-mediated expert-layperson communication: An overview and insights into the field of medical advice*, in R. Bromme, F. W. Hesse

and H. Spada, eds., *Barriers and Biases in Comptuer-Mediated Knowledge Communication -- And How They May Be Overcome*, Springer, New York, 2005, pp. 89-118.

[3] H. H. Clark and S. E. Brennan, *Grounding in communication*, in L. B. Resnick, J. M. Levine and S. D. Teasley, eds., *Perspectives on Socially Shared Cognition*, American Psychological Association, 1991, pp. 127-149.

[4] J. W. Cresswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, Sage Publications, 2003.

[5] P. Dillenbourg, *Designing biases that augment socio-cognitive interactions*, in R. Bromme, F. W. Hesse and H. Spada, eds., *Barriers and Biases in Computer-Mediated Knowledge Communication—and How They May Be Overcome*, Springer, New York, NY, 2005, pp. 243-264.

[6] W. Doise and G. Mugny, *The Social Development of the Intellect, International Series in Experimental Scoial Pscychology*, Pergamon Press, 1984.

[7] N. Dwyer and D. D. Suthers, *A Study of the foundations of artifact-mediated collaboration*, in T. Koschmann, D. D. Suthers and T.-W. Chan, eds., *Computer Supported Collaborative Learning 2005: The Next 10 Years!*, Lawrence Erlbaum Associates., Mahwah, NJ, 2005, pp. 135-144.

[8] L. Festinger, *A Theory of Cognitive Dissonance*, Stanford University Press, Stanford, 1957.

[9] C. Goodwin and J. Heritage, *Conversation Analysis*, Annual Review of Anthropology, 19 (1990), pp. 283-307.

[10] T. Hansen, L. Dirckinck-Holmfeld, R. Lewis and J. Rugelj, *Using telematics for collaborative knowledge construction*, in P. Dillenbourg, ed., *Collaborative Learning: Cognitive and Computational Approaches*, Elsevier, Amsterdam, 1999, pp. 169-196.

[11] E. Hutchins, *Cognition in the Wild*, The MIT Press, Cambridge, Massachusets, 1995.

[12] P. Jermann and P. Dillenbourg, *Elaborating new arguments through a CSCL script*, in Andriessen, Baker and Suthers, eds., *Arguing to Learn: Confronting Cognitions in Computer-Supported Collaborative Learning Environments*, Kluwer, Dordrecht, 2003, pp. 205-226.

[13] B. Jordan and A. Henderson, *Interaction Analysis: Foundations and practice*, The Journal of the Learning Sciences, 4 (1995), pp. 39-103.

[14] J. Kaput and S. Hegedus, *Exploring classroom connectivity by aggregating student constructions to create new learning opportunities*, in A. D. Cockburn and E. Nardi, eds., *26th Annual Conference of the International Group for the Psychology of Mathematics Education*, UK, 2002.

[15] T. Koschmann, *Dewey's contribution to the foundations of CSCL research*, *Proc. Computer Supported Collaborative Learning 2002*, Boulder, 2002, pp. 17-22.

[16] T. Koschmann, A. Zemel, M. Conlee-Stevens, N. Young, J. Robbs and A. Barnhart, *How do people learn: Member's methods and communicative mediation*, in R. Bromme, F. W. Hesse and H. Spada, eds., *Barriers and Biases in Computer-Mediated Knowledge Communication (and how they may be overcome)*, Kluwer Academic Press, Amsterdam, 2005, pp. 265-294.

[17] K. Kreijns and P. A. Kirschner, *Designing sociable CSCL environments*, in J. W. Strijbos, P. A. Kirschner and R. L. Martens, eds., *What We Know About CSCL and Implementing it in Higher Education*, Kluwer, Dordrecht, 2004, pp. 221-243.

[18] B. Latour, *Drawing things together*, in M. Lynch and S. Woolgar, eds., *Representation in Scientific Practice*, The MIT Press, 1990, pp. 19-67.

[19] J. Lave and E. Wenger, *Situated Learning: Legitimate Peripheral Participation*, Cambridge University Press, Cambridge, 1991.

[20] G. Nunberg, *Indexicality and deixis*, Linguistics and Philosophy, 16 (1993).

[21] J. Piaget, *The Grasp of Consciousness: Action and Concept in the Young Child*, Harvard University Press, Cambridge, MA, 1976.

[22] P. Resnick, *Beyond Bowling Together: SocioTechnical Capital*, in J. M. Carroll, ed., *Human-Computer Interaction in the New Millennium*, ACM Press, Upper Saddle River, NJ, 2002, pp. 647-672.

[23] J. Roschelle, *Designing for cognitive communication: Epistemic fidelity or mediating collaborating inquiry*, in D. L. Day and D. K. Kovacs, eds., *Computers, Communication & Mental Models*, Taylor & Francis, London, 1996, pp. 13-25.

[24] G. Salomon, ed., *Distributed Cognitions: Psychological and Educational Considerations*, Cambridge University Press., Cambridge, 1993.

[25] M. Scardamalia and C. Bereiter, *Knowledge Building Environments: Extending the Limits of the Possible in Education and Knowledge Work*, *Encyclopedia of Distributed Learning*, Sage Publications Thousand Oaks, CA, 2003.

[26] D. A. Schön, *The Reflective Practitioner*, Basic Books, New York, 1983.

[27] G. Stahl, *Group cognition in computer-assisted collaborative learning*, Journal of Computer Assisted Learning, 21 (2005), pp. 79-90.

[28] G. Stahl, *Group Cognition: Computer Support for Collaborative Knowledge Building*, MIT Press, Cambridge, MA, 2006.

[29] D. D. Suthers, *A qualitative analysis of collaborative knowledge construction through shared representations* Research and Practice in Technology Enhanced Learning 1(2006), pp. 1-28.
[30] D. D. Suthers, *Technology affordances for intersubjective meaning-making: A research agenda for CSCL*, International Journal of Computers Supported Collaborative Learning, 1 (2006), pp. (in press).
[31] D. D. Suthers, *Towards a systematic study of representational guidance for collaborative learning discourse*, Journal of Universal Computer Science, 7 (2001).
[32] D. D. Suthers, N. Dwyer, R. Medina and R. Vatrapu, *Analysis of Meaning Making in Online Learning*, *International Conference for Computers in Education*, APSCE, Bejing, 2006.
[33] D. D. Suthers, L. Girardeau and C. Hundhausen, *Deictic roles of external representations in face-to-face and online collaboration*, in B. Wasson, S. Ludvigsen and U. Hoppe, eds., *International Conference on Computer Support for Collaborative Learning 2003*, Kluwer Academic Publishers, Dordrecht, 2003, pp. 173-182.
[34] D. D. Suthers and C. Hundhausen, *An experimental study of the effects of representational guidance on collaborative learning*, Journal of the Learning Sciences, 12 (2003), pp. 183-219.
[35] D. D. Suthers, R. Vatrapu, R. Medina, S. Joseph and N. Dwyer, *Beyond threaded discussion: Representational guidance in asynchronous collaborative learning environments*, Computers & Education (to appear).
[36] D. D. Suthers and A. Weiner, *Groupware for developing critical discussion skills*, *First International Conference on Computer Support for Cooperative Learning*, Bloomington, IN, 1995.
[37] E. Von Glasersfeld, *A Constructivist Approach to Teaching*. , in L. S. J. Gale, ed., *Constructivism in Education*, Lawrence Erlbaum Associates, Inc., New Jersey, 1995, pp. 3-16.
[38] L. S. Vygotsky, *Mind in society*, Harvard University Press, Cambridge, MA, 1978.
[39] E. Wenger, *Artificial Intelligence and Tutoring Systems: Computational and Cognitive Approaches to the Communication of Knowledge*, Morgan Kaufmann, Los Altos, 1987.
[40] E. Wenger, *Communities of Practice: Learning, Meaning and Identity*, Cambridge University Press, Cambridge, 1998.