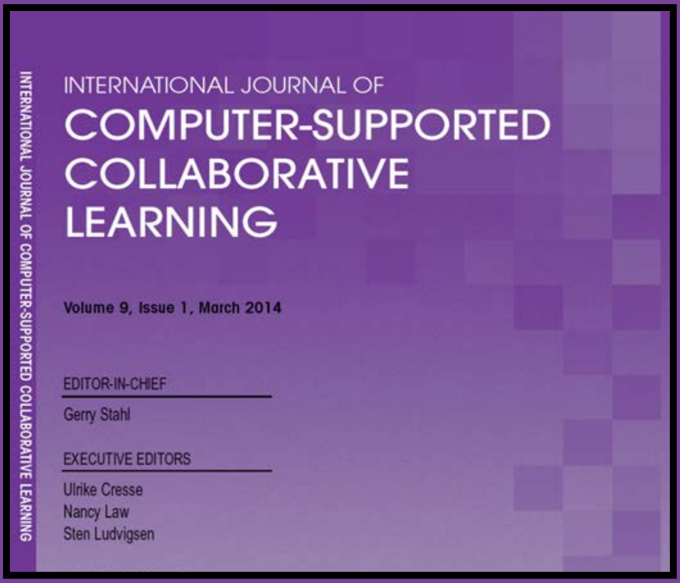
Gerry Stahl's assembled texts volume #16

Editorial Introductions to *ijCSCL*



Gerry Stahl

Gerry Stahl's Assembled Texts

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Editorial Introductions to *ijCSCL*

Gerry Stahl

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Introduction

This volume reproduces the editorial introductions to the *International Journal of Computer-Supported Collaborative Learning* (*ijCSCL*) since its beginning in 2006 and through 2015, when I retired as Editor-in-Chief. The introductions situate the articles in each quarterly issue within current CSCL (Computer-Supported Collaborative Learning) research activity and highlight the unique perspectives and important contributions of the included papers. The introductions also present reflections on topics of CSCL theory and methodology, providing concise contributions of their own. Written in different styles, the introductions as an ensemble provide a lively, stimulating introduction to the CSCL research field as it has grown over the years.

I wrote the introductions in collaboration with the Executive Editors. Friedrich Hesse and I were the founding Executive Editors of *ijCSCL*. When Friedrich stepped back, Nancy Law, Sten Ludvigsen and Ulrike Cress became Executive Editors. They reviewed drafts of introductions.

The versions of the introductions reproduced here are the prepublication versions, without the layout and pagination of the final published versions.

ijCSCL was established by the international CSCL research community in 2005 and began publication through Springer in 2006. It is published quarterly in print as well as electronically on the websites of Springer and *ijCSCL*. The CSCL community is active around the world and supports the journal though an Editorial Board of about 50 leading researchers and another 100 regular reviewers.

ijCSCL is an official publication of the International Society of the Learning Sciences (ISLS); subscription to *ijCSCL* is available to members of ISLS for free—see http://ISLS.org for further information about the organization and membership.

ijCSCL is published quarterly by Springer; electronic versions of all articles are available through many university libraries at http://www.springerlink.com/content/120055.

Pre-publication versions of all articles are available for free to the world at the *ijCSCL* website—see http://*ijCSCL*.org for further information about the journal, instructions for submitting manuscripts, and pre-publication copies of articles.

The first time that *ijCSCL* was rated by ISI, it was rated the #2 educational journal in the world. In September 2010, the ISI Web of Science released its annual report that *ijCSCL* had an impact factor of 2.692, the second highest impact factor of the 139 ISI-indexed journals in the category "Education and Educational Research."

The rating reflected *ijCSCL* articles published in 2007 and 2008 and cited by ISI-indexed journals during 2009.

All publications of Gerry Stahl are available at http://GerryStahl.net/publications. Materials about CSCL and the international CSCL conferences are available at http://GerryStahl.net/cscl. A CSCL Community blog is available at http://cscl-community.blogspot.com.

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1(1): *ijCSCL* – a journal for research in CSCL

A journal of the community

The launch of the *International Journal of Computer-Supported Collaborative Learning* (*ijCSCL*) is a propitious step forward for the CSCL community: It heralds a transition of the field to a new level of academic maturity. It provides an appropriate communication medium and a selective knowledge archive for an increasingly global research network.

ijCSCL was proposed by the CSCL community and is sponsored by the International Society of the Learning Sciences (ISLS). The Board of Editors includes many leading CSCL researchers from around the world, and others participate as reviewers. Many of the articles in *ijCSCL* originate in papers at CSCL conferences and regional workshops.

This journal is committed to serving as an important communication vehicle of the growing CSCL community and cognate fields. As such, *ijCSCL* will contribute to our collaborative learning as a knowledge-building community of practice.

The first ten years of CSCL

The term *computer-supported collaborative learning* (CSCL) was first publicly coined at an international workshop in Maratea, Italy, in 1989. Since 1995, a biannual series of international CSCL conferences has been held in North America, Western Europe and most recently Asia. The 2005 CSCL conference held in Taiwan celebrated the tenth anniversary of the conference series with the theme, "CSCL: The Next Ten Years." Most of the articles in this issue of *ijCSCL* are based on conference papers from there.

As the CSCL conference series evolved over the past ten years, an international community of researchers formed around it. Participants had professional roots in diverse fields, such as artificial intelligence, educational and cognitive psychology, software development, instructional design. While the conference proceedings served as boundary objects to tie this interdisciplinary community loosely together, more was felt to be needed. In recent years, a CSCL book series was launched through Springer and already offers five edited volumes. *ijCSCL* was proposed as an additional medium to support this fast-growing discipline.

Meanwhile, ISLS was founded to provide an institutional support for CSCL and other learning science conferences and journals. Along with the *Journal of the Learning Sciences*, *ijCSCL* is an official journal of ISLS. Another important factor in the development of the CSCL community has been the establishment of regional networks of CSCL researchers and local centers; the oldest of these is the Ontario Institute for Studies in Education in Canada and the largest is the CSCL SIG of Kaleidoscope in Europe. Such collaborative networks have been essential to progress in this field, and stand in the background of much of the work presented in this issue.

The next ten years of CSCL

Establishing this journal, like holding the latest conference in Taiwan, reflects a strategy that aims to make the CSCL community fully international. We live in a global world and we learn together. The issues that confront the field of CSCL today are far too complex to be solved by individuals or small labs working independently. We must pool our resources, our insights and our findings. The journal's mission is to share seminal innovations and proposals from around the world, so they can be taken up and collaboratively developed. This issue features contributions from Brazil, Canada, China, Denmark, Germany, Sweden, the United Kingdom and the United States.

Over the next decade, *ijCSCL* will contribute to the development of the CSCL field by providing a peer-reviewed venue for the exchange of high-quality analyses and ideas. Although it is now well established as an academic specialty and as a leading-edge research domain, like all vigorous research fields CSCL faces many challenges in specifying its subject matter and approaches. The journal will help to define and project the field's identity.

As a heritage of its interdisciplinary origins, CSCL research includes a mixture of theories, technologies and methodologies. Most of these were developed in different academic contexts and are tuned to conflicting sets of criteria. While it may have been feasible to make progress on CSCL problems during the first decade of the field's existence from exclusively within an educational-psychology perspective or using an artificial-intelligence approach, it is less likely now. We have learned meanwhile that the issues are complex and intertwined. One must address system-building, instructional-design, experimental-analysis and other aspects simultaneously. The guiding theories, technologies, methodologies, curricula and classroom practices must co-evolve in orchestrated efforts.

This not only means that CSCL research must be practiced by collaborative research teams with diverse training, but also that we need to develop theory, technology, research methods and educational practices that are specific to CSCL, and not simply inherited. We need theories of collaborative interaction that are not necessarily based on individual learning models. We need technologies with specific supports for collaborative learning, not just generic communication media. We need methodologies that capture both micro-level interactions in small groups and community-level developments as mediated by social practices and by technical infrastructures. The articles in this issue start to move in such directions.

A journal of the future

The technology of knowledge dissemination is changing rapidly. An international journal of CSCL should be at the forefront of such change. Today, more academic research is conducted by Internet searches than by browsing a library's back-room stacks. Research not readily available online is doomed to obscurity. Without losing sight of the importance of archival preservation, Open Access must be a priority. Through a unique arrangement with the prestigious academic press Springer, *ijCSCL* is able to make the full text of its articles freely available on the Web, indefinitely, while still publishing them electronically and in traditional hardcopy journal form.

All articles published in *ijCSCL* are subject to a rigorous peer review process, typically going through several rounds of revision at the direction of at least three Board members in order to bring out their most important contributions. Once a paper is officially accepted it is typeset, assigned a unique Digital Object Identifier (DOI) and posted on ijCSCL.org where it is permanently available for free. Subsequently, the final and official version is published on SpringerLink.com. Quarterly issues of the journal are printed and mailed to subscribers.

Springer is a leader in the field of academic publishing. They bring to this endeavor a wealth of experience and prestige, and they will continue to do so as the publishing industry evolves. Working together, *ijCSCL*, ISLS and Springer have developed a number of ways to make the journal accessible to the widest possible audience. *ijCSCL* is already included in Springer's catalog of education journals, which is distributed to thousands of universities worldwide. Additionally, members of ISLS receive free electronic access and can choose to subscribe to *ijCSCL* as part of their membership fee at ISLS.org. Springer has an alert service at www.springerlink.com/alerting and various free access offers to selected electronic articles. These broad access efforts ensure that *ijCSCL* will be indexed and ranked highly by ISI and other relevant abstracting and indexing services.

Introducing the inaugural issue

In keeping with the Taiwan conference theme, "CSCL: The Next Ten Years," volume 1, issue 1 of *ijCSCL* includes articles that propose new directions for the CSCL field. Topics range from reflections on the evolution of the CSCL community itself to innovative theoretical perspectives, pedagogical practices, research methodologies and technological developments.

These articles illustrate the variety of methods, theories and approaches active in contemporary CSCL work. They draw on research traditions, theoretical frameworks, quantitative measures, qualitative analyses, case studies and iterative trials to support their claims and proposals. In future issues, the scope will be broadened further by including more empirical studies based on classic experimental methodology. Rigorous scientific analyses from any approach that contribute to progress in CSCL are welcome. This issue features the following:

1. The CSCL community in its first decade

The journal opens with an analysis of the history and development of the CSCL research community. First, a variety of quantitative measures are applied to test prevailing notions about the nature and composition of the community. A key question has to do with continuity of membership: to what extent do attendees at one conference increase their level of participation in subsequent conferences and what is the effect of the high turnover of newcomers? Is the conference series really international; what factors influence its geographic mix? While certain trends emerge from the data, it is necessary to also incorporate qualitative analyses to gain a better understanding of the significance of these trends. The study provides an initial scientific look at CSCL as a research community and establishes a baseline for further investigation, but it also raises enduring methodological questions about how to assess such a fluid and multi-faceted community. It is suggestive of how to continue to deepen the international character of the community.

2. A relational, indirect, meso-level approach

Much CSCL research focuses on the individual learner or on local interactions in dyads and small groups. The role of technology is conceptualized as mediation by affordances of artifacts, which exist within socio-cultural contexts, influenced by relatively stable large-scale factors. This paper confronts these current views with theoretical challenges emerging from two European Union projects. It suggests that technologies like the Internet cannot be treated as simple artifacts, but form infrastructures at a meso level that mediate between people and social structures. Infrastructures are not objects with attributes, but are enacted in use in ways that help to evolve social edifices. Their relational character implies that design of CSCL technologies and interventions can only be indirect, establishing preconditions for educational opportunities, but not causally determining learning outcomes. This result has not only methodological implications, but ethical ones as well.

3. Student assessment of collaborative inquiry

Perhaps the most vexing issue today in transforming instruction into collaborative knowledge building is how to assess student benefits. If learning takes place through the group, classroom or community, then how can outcomes be measured or credit assigned? In a clever twist, this research has students in Hong Kong schools analyze and assess the knowledge building that takes place in their own classrooms, with a certain emphasis on their own individual involvement. Assessment thereby merges with meta-cognition and promotes deeper learning for both group and individual. This research earned the best paper award at the Taiwan conference; it is part of a long-term research agenda related to the work of Scardamalia and Bereiter, who were there given the lifetime achievement award for their seminal contributions to CSCL. The paper uses quantitative quasi-experimental statistical results to support its claims, as well as qualitative analysis and case-study examples to convey a more detailed understanding of these results.

4. A scholarship of application

The conventional assumption is that scientific research must result in a generalizable discovery of new knowledge. However, in a new and interdisciplinary scientific community it is also important to integrate existing knowledge from other fields, with appropriate adaptation. This paper proposes yet another form of valuable work in the learning sciences: Exploring how a technology can be applied in a spectrum of situations. The applicability of specific technologies to the support of collaborative learning is not a binary question. Interestingly, this paper demonstrates both the potential and the limitations of wiki technology for CSCL. Within the same university with the same tech support, the use of wikis succeeded easily in certain subject matters and classroom cultures but failed in others. The authors explore in detail the reasons for this and the potential for overcoming the barriers in certain cases.

5. Evolving a chat tool to increase understanding

Instant messaging, SMS and chat are widely popular among students for socializing one-on-one. In principle, chat technology has the potential to support many-to-many communication for collaborative learning activities, overcoming the requirements of face-to-face interaction for turn-taking and physical presence. However, active chat sessions involving more than three or four participants become confusing and straining. The design-based research reported here undertook many iterations of re-design to respond to the problem of chat confusion. Each attempt led to new insights into the problem and ideas for technical responses. The research agenda spanning several years follows a systematic path of iterative inquiry and CSCL technology design evolution, tested in a Brazilian classroom setting. Thereby, the chat tool is successively modified to overcome the major barriers of this medium and to free chat to become an important technology for collaborative learning.

6. A dialogical understanding of teaching thinking skills

It is now popularly accepted that success in the contemporary world requires creative, sophisticated thinking skills, and not just the mastery of accepted facts and proven rules. Theoretical analysis of the nature of higher-order thinking skills ties them fundamentally to dialogic understanding as described in this final article. Thereby, it argues for the centrality of collaborative learning. A series of case studies illustrates the point that many core thinking skills of individuals are actually derived from dialogic skills of small groups of people interacting and collaborating. The skills include dealing effectively with multiple, potentially incompatible perspectives and complex problems that have no clear solution paths or final answers. The notion of teaching thinking skills rather than facts is re-conceptualized in terms of a dialogic model, bringing theoretic coherence to an important but hitherto ad hoc area of study. Perhaps these are the kinds of thinking skills needed in CSCL research itself, developed at the niveau of scientific methodology.

1(2): Building knowledge in the classroom, building knowledge in the CSCL community

If most people who read this journal were asked by a non-academic—say at a social event or by a relative—about their work and what they are striving to accomplish, they might respond that they are trying to help kids learn better. The image that they might evoke is one of students in a school classroom, on a field trip or in an online community working together with the aid of computer-based tools. The CSCL approach recommends collaborative-learning arrangements, and points to the potential of a broad variety of digital media and artifacts to enhance the group knowledge building. The articles in this journal showcase new ideas about designing, fielding and evaluating such pedagogical and technological interventions in classroom learning. This issue develops a variety of perspectives on knowledge building in the classroom, as you will see as you read each article.

In addition, *ijCSCL* addresses the concerns of the academic field. By providing a quarterly forum for innovative research, it promulgates the leading edge of grounded thinking and healthy controversy. By printing extended versions of exceptional conference papers and introducing other mature studies, it partakes of the life of the community. To promote the use of these articles in digital settings, the official electronic versions with CrossRef (an online reference-linking system) are posted upon acceptance for subscribers (including thousands of universities worldwide) at: www.springeronline.com/journal/11412. To provide open access, pre-publication versions of the articles are freely available at: http://ijCSCL.org/?go=contents.

The hardcopy version of the first issue of *ijCSCL* appeared at AERA ’06, the large gathering of the American Educational Research Association. This second issue will appear during ICLS ’06; all registered attendees there will be eligible for a free subscription to *ijCSCL* by requesting it from ISLS. Others can sign up at http://isls.org/membership.html. ISLS membership fees for 2007 will be fully deducted from registration for CSCL ’07, to be held in the New York City area—see http://isls.org/cscl. Note that papers for CSCL ’07 are due by November 1; some of them will eventually be published in *ijCSCL*.

ijCSCL has already been added to the ICO-journal list in the Netherlands, thanks to our Dutch colleagues. This allows *ijCSCL* publications to count for tenure and promotion there. This is a first step in *ijCSCL*'s eventual inclusion in other abstracting and indexing services.

A few future issues of *ijCSCL* will be special issues, and focus on specific themes of importance to the CSCL community. These topics have grown out of collaborative efforts by researchers in multinational projects or international conference workshops. Current proposals for special issues or themes include:

- Collaborative learning in mobile and ubiquitous environments
- Dynamic automated support for CSCL
- Networked learning
- Paradigms for learning in communities
- Scripting in CSCL
- Methods for evaluating CSCL
- Graphical support for CSCL

If you would like to contribute a paper on one of these themes, please send a brief note to info@ijCSCL.org.

The unity and diversity of the second issue

The second issue of *ijCSCL* continues to offer practical ideas for promoting collaborative learning with computer support, and related pedagogical approaches for use in the classroom. Simultaneously, it expresses a strong self-reflective tendency, proposing visions of desired futures for the field of CSCL research and arguing for innovative ways to advance the science. The mix of articles reflects a growing recognition that considerations of pedagogy, content, technology design, social context and theory must develop together, through mutual influence. The old distinctions between disparate disciplines and competing methodologies must be overcome in favor of professional collaboration and mixed methods.

The articles in this issue represent very different approaches to specialized concerns. They come, once more, from around the world: Norway, Israel, the US, Japan and France. Yet, in part by virtue of coming together in this journal, they partake of a unity—the unity of the CSCL research effort itself.

1. *Institutional Context* The first article in this issue explicitly raises the question of the role of the classroom context in contributing to the knowledge building that takes place in schools. Arnseth & Ludvigsen approach this issue from within the situation of theorizing in the CSCL community, which they construe as a tension

between systemic and dialogic paradigms. They work back and forth between the concrete phenomena and the meta-theoretical, uncovering the oft-ignored immediate social context of collaboration by bringing the two major theoretical orientations of the CSCL field into dialog with each other. From a systemic vantage point, CSCL approaches and tools have met with both substantial success and discouraging lack of effect in different kinds of classrooms. Close analysis of dialogic interactions reveals the crucial role of how classroom social and pedagogical norms are put into practice by students as they make sense of their work together and thereby determine how contextual variables are realized.

2. *Building Knowledge about Design Principles* Kali proposes a digital tool for the CSCL community itself, designed to enhance knowledge building in the classroom by building knowledge in the discipline. She follows cycles of design-based research to demonstrate how a database of pedagogical principles, best practices or design patterns can be used to improve classroom learning and how the database itself can evolve in the process. The Design Principles Database is available for the CSCL community to use and extend. Interestingly, the example of principled classroom practice presented here as a case study involves peer-evaluation, an approach discussed in depth by Lee, Chan & van Aalst last issue and reprinted within this one.

3. *Co-reflection and Narrative Analysis* The power of detailed analysis is illustrated in the paper by Yukawa. Using narrative analysis, she gets at the nature of collaboration between two adult students and their teacher, who communicated online via off-the-shelf technologies. The article presents the concept of co-reflection, showing both its tacit and explicit forms, as well as its cognitive and affective facets. This analysis of co-reflection locates individual reflection, made visible in shared narrative, as a part of group cognition. Conversely, it brings to the fore characteristics of the group interaction that have previously gone unnoted, emphasizing, for instance, the roles of metaphor and interpersonal relationship.

4. *Knowledge-building Activity Structures* The problem of building knowledge in a traditional K-12 classroom is addressed face-on in the Japanese context by the efforts reported here. Oshima, et al. describe how the use of the Knowledge Forum technology and associated principles of knowledge building were merged with established activity structures of elementary science classrooms in Japan. Two cycles of a design study are analyzed. The first year resulted in a discouraging lack of knowledge building, but after both the task and participation designs were refined in the second year, the results were much more encouraging. The tension for students between the drive to complete tasks and the goal of building community knowledge remains as an inertial brake on educational change.

5. *A Generic Framework for Chat* Last issue's investigation of techniques for overcoming problems of the chat medium by Fuks, et al. suggested the need to carefully design synchronous media for collaborative learning. Now, Lonchamp provides a framework for systematically considering alternative features to include in synchronous support under different conditions. The framework is designed to model systems that are flexible and can be tailored to a wide range of users, communities, goals and contexts. Although this work is preliminary, it is published in the hopes of sparking collaboration within the CSCL community in the design, development, evaluation and theory of chat support for knowledge building using ideas and open source technologies offered here.

Errata An unfortunate series of circumstances while publishing the first issue resulted in typographical errors in the article by Lee, Chan & van Aalst. To correct this, we republish both the print and electronic versions of this article in their entirety.

1(3): Focusing on participation in group meaning making

Welcome new subscribers

Many researchers participated in the International Conference of the Learning Sciences (ICLS 2006) in Bloomington, Indiana in June, joining ISLS and signing up to receive *ijCSCL*. Some of the papers from that conference may be submitted for publication in future issues of the journal.

The CSCL SIG of Kaleidoscope—a network of over three hundred researchers and doctoral students in Europe—is now joining ISLS through a special trial membership. Each member will receive an issue of *ijCSCL* in the mail and have electronic access during 2006. We hope they will become permanent subscribers.

Kaleidoscope will be holding an innovative regional CSCL workshop in January: an Alpine Rendezvous (http://craftsrv1.epfl.ch/events/alpine). Other regional conferences related to CSCL are CRIWG (http://www.criwg.org/) in Valladolid, Spain this September, and ICCE http://www.icce-2006.org/) in Beijing, China, in November.

It is already time to start preparing for the next international CSCL conference: CSCL 2007 will be held outside of New York City at Rutgers University in July. The deadline for paper submissions is November 1, 2006. The next ICLS conference will be in Utrecht, near Amsterdam, in the summer of 2008. ISLS members will receive savings on registration at these conferences. For non-ISLS members, the conference fees will also cover the cost of a full ISLS membership, including the option to subscribe to *ijCSCL*. So put these conferences on your schedule. If you would like to propose a site for a future ISLS conference, look for instructions at http://isls.org in the fall.

The CSCL Community of ISLS held elections recently. The new Executive Committee was announced at ICLS: Pierre Dillenbourg, Cindy Hmelo-Silver, Chris Hoadley, Paul Kirschner, Tim Koschmann, Naomi Miyake, Claire O'Malley, Roy Pea, Hans Spada, Gerry Stahl, Dan Suthers, and Barbara Wasson. The new members are all on the *ijCSCL* Editorial Board.

Please send news of interest to CSCL researchers to http://info@ijCSCL.org.

A proposal for a CSCL research agenda

This issue starts with a call for a theoretical focus that can bring together the many research strands within current CSCL research, directing them each in their own way to investigate the phenomena of intersubjective meaning making as the most appropriate object of analysis for CSCL as a unique and important science. It suggests that "intersubjective meaning making" is a more productive term than "collaborative learning," which is only visible indirectly and retroactively. Such a focus has implications both for the design of technology support and for the synthesis of multiple methodologies. The other articles can, coincidentally, be read as examples of taking this tack, each revealing subtle complexities that arise in practice.

Anchored discussion

The second contribution looks at how anchoring can aid technologies for intersubjective meaning making. Building on previous explorations of anchored discussion, this article provides quantitative evidence for the advantages and disadvantages of situating online postings about a document in the presence of that document, as compared to a generic discussion forum in which postings cannot directly reference locations within the discussed object. Issues of grounding and situating discourse are often investigated by looking closely at detailed cases; here quantitative measures can confirm hypotheses arising from such cases across a larger corpus of online textual interaction. By looking at how meaning is variously constructed in the different media, the authors refine our understanding of the pedagogical pros and cons of anchored discussion, which came from specific cases and participant impressions.

A handheld network

The third article shows that the technology of networked handhelds, the pedagogy of rich math settings and the scaffolding of collaboration roles can support intersubjective meaning making in small groups, but that the detailed results are hard to predict. A carefully crafted experiment in a real classroom included pre- and post-test measurements as well as qualitative and quantitative analysis of the student discourse. However, close attention to specific utterances showed that the students constructed their own ways of interacting and learning, often in opposition to the structures, hypotheses and measurements of the experiment. Learning can take place even by students whose participation in group meaning making is not very visible and, conversely, visible utterances can be used by students to avoid contributing to the group knowledge construction.

Participation networks

Social network analysis (SNA) has for several years appealed to many CSCL researchers as a way of quantifying the levels of participation of students in learning communities. It is even exciting to think of feeding such measures back to the students to increase their awareness and motivate their further participation.

However, SNA has often proven to be more work than it is worth for its shallow findings. This paper, however, enriches the depth of the analysis by carefully combining SNA with other quantitative and qualitative methods. It then investigates the use of this hybrid methodology in three strategically structured case studies, conducted at the University of Valladolid and the Open University of Catalonia in Spain. It thereby uncovers both the power and the limits of this particular approach to focusing multiple methods on group participation processes.

1(4): Social practices of computer-supported collaborative learning

CSCL and the study of social practices

Ever since Lave & Wenger's paradigm-shaking book on *Situated Learning* (1991), discussions about how people learn have included considerations of how participation in communities-of-practice and in related social institutions evolves. Concepts about learning have to take more seriously into account the identity and behavior of the learners within their sociocultural settings. Unfortunately, the theory of situated learning is too often construed as a questionable assumption of communities-of-practice everywhere, or as an antiquated romanticizing of apprenticeship. However, Lave's perspective is rooted in a serious philosophy of social praxis. To understand phenomena related to learning, one must study the ways in which people interact with one another.

The consideration of social practices seems particularly relevant to collaborative learning. Individual learning may take countless forms and can be analyzed in terms of the manifold theories of psychology and education; it is highly dependent upon mental conceptions, personal attitudes, modes of content presentation, etc. Learning that takes place in small groups, however, relies additionally upon the establishment of patterns of interaction to guide communication and to support coordination of the group.

When collaborative learning is computer supported, the need for the group to adopt effective social practices is both more necessary and more complicated. The subtle social cues of intonation, gesture, facial expression, body language, etc. that have accompanied human social life for millennia may be missing in virtual contexts. As people struggle to interact through awkward computer interfaces, they need to adapt accustomed social practices to the deficits and affordances of the technology, the objective of their activity and the constraints of their interpersonal relationships.

The four articles in this issue can be read — among other ways — as studies of social practices in CSCL settings, although the papers were not written with this as their central concern. They illustrate that this theme can be investigated with a variety of methods, and begin to suggest the centrality of social practices to both individual and group cognition.

1. Spaces for monologic/dialogic practices

In the first issue of *ijCSCL*, Wegerif (2006) argued that mastery of dialogic practices formed the basis for the development of individual thinking skills. He called for CSCL software that opened spaces for dialog among students. In this issue, Enyedy and Hoadley consider how software can be designed to support both monological and dialogical learning in concert by opening interaction spaces that help students to move between individual work and group practices. By carefully studying interaction excerpts from CSCL settings, the authors conclude not only that individual contributions are essential to dialog as the interanimation of multiple perspectives, but also that individual cognition should be considered as involving social practices of interaction.

2. Inquiry practices

For some years, the National Council of Teachers of Mathematics has included among its recommendations and standards pedagogical approaches in which students "analyze and evaluate the mathematical thinking and strategies of others; communicating mathematical thinking coherently and clearly to peers; and make and investigate mathematical conjectures" (NCTM, 2000). Subsequent research on math education indicates that it is particularly difficult for students to explain their problem solving to others and to engage in collaborative reflection. Moss & Beatty explore whether software designed for knowledge building can help to support social practices of mathematical explanation. They adopt Knowledge Forum with young students who are experienced with using the software for collaborative inquiry learning in science, and they have the students use it with pre-algebra pattern problems. Using both coding-and-counting and discourse analysis, the authors find that the students do succeed in explaining their work to each other and comparing different solution paths. The software defines social practices for doing this, which are reinforced within an inquiry-learning classroom so that the students can exert "epistemic agency" in carrying out these practices of building knowledge themselves, without direct teacher intervention.

3. Group dynamics

Clouder and colleagues explore the dynamics of blended learning, how social practices change as groups of students move back and forth between face-to-face and distance interaction. After analyzing various phases within an action research approach, the authors stress continuity across the changes that seem to result in advantageous group dynamics. They stress the pivotal role of the tutor in orchestrating the sequence of phases and the corresponding group dynamics. In keeping with other educational research, they indicate that blended learning has advantages over both face-to-face and distance by themselves. The virtual venue helps some students to find their voice — but only on the basis of healthy constitution of the group in the face-to-face socializing. This paper suggests that the study of social practices in CSCL should include consideration of contrasts and continuities between the alternating phases of blended learning.

4. Consistent practices

The topic of intersubjective meaning making was highlighted in the previous issue of *ijCSCL* in relation to technological affordances (Suthers, 2006). In this issue, Dwyer & Suthers investigate the establishment of consistent social practices to support synchronous interaction without visual contact. In this way, they explore how people compensate for one of the major differences between face-to-face and distant interaction. Interestingly, they do this in a lab setting where the participants can actually talk, see each other's hands and use ordinary household media like pencil and paper — thus isolating the difference that visual contact makes to social practices among dyads. They present pairs of college students with wicked problems to discuss using paper-based artifacts and observe the negotiation of innovative practices for textual communication, guided by an ethnomethodological approach. They thus establish a kind of baseline for computer-mediated interaction by seeing the kinds of practices formed using non-digital artifacts under conditions analogous to online environments.

A year of *ijCSCL*

This issue completes volume 1, a milestone for the journal. The vision of a high-quality, peer-reviewed international journal for the publication of innovative ideas and significant findings is now an established reality. The journal is readily available at www.SpringerLink.com in its official electronic format through the many universities worldwide that subscribe to Springer's educational journals. Archival paper copies are mailed quarterly to hundreds of individual subscribers through membership at www.ISLS.org. The full text of all articles is available in open source at www.ijCSCL.org.

The journal is truly a product of the CSCL research community. The Editorial Board includes 43 leading researchers of CSCL and CSCW. In addition, at least 54 other researchers participated in the reviewing of submitted papers. The reviews have been exceptional. Almost every article printed underwent major revisions in response to three or four incisive reviews. These revisions resulted in substantial improvements to the presentation format of the papers. The reviewers — including Board members — are the backbone of the journal. If you would like to join the review board and participate in this stimulating and important process, drop a note to info (at) ijCSCL.org. As of mid-October, we have received 84 submissions. Of these, we have published 19 and rejected 25. Seven are currently being revised in response to reviewer feedback and the remaining 33 are under review for volume 2. If you have empirical findings or theoretical developments that you think are important for the CSCL research community and that you feel are well developed enough for a journal presentation, please review the Submission Procedures and the Instructions for Authors at www.ijCSCL.org and submit your paper. We welcome submissions from every part of the world, from any discipline relevant to the concerns of CSCL and using any appropriate scientific methodology or academic style.

Please do not forget to subscribe to ISLS and *ijCSCL* for 2007. Your membership fee will be deducted from your registration at CSCL ’07 this summer or ICLS ’08 next summer — see www.ISLS.org for details.

2(1): Welcome to the future: *ijCSCL* volume 2

An advance in the field of CSCL

The start of a second year of *ijCSCL* marks a significant step forward in the history of the CSCL research field. The journal is not just a venue for academic papers, but a medium of discourse about new directions and new understandings within an active community exhibiting diverse perspectives.

The journal has not merely persisted for a full year/volume; it has been adopted by the CSCL community as an important voice. Almost a hundred papers have been submitted to the journal from around the world, covering all aspects of CSCL theory, methodology, technology and practice. A total of two hundred researchers have volunteered to be reviewers, including the illustrious Editorial Board of 42 people. Many of the submitted papers expand on exceptional presentations from CSCL conferences, workshops and research labs. The paper that won the "European CSCL Award for Excellence in the Field of CSCL Research" at January's CSCL SIG Rendez-Vous in the Swiss Alps (Arnseth & Ludvigsen, 2006) was published in *ijCSCL*.

Like a meeting or a conference, a journal can provide a place to communicate what is going on in a community. However, meetings and conferences permit certain kinds of informality and direct interaction with the audience. So it is natural to concentrate on meetings and conferences when a field like CSCL is starting to develop. When a journal becomes part of the community's communications, more formal ways of presenting assumptions, theories and outcomes start to take prominence. Journal articles reflect more mature research efforts, more intense peer review and more rigorous editing than conference papers.

During the first year of *ijCSCL*, a highly engaged Editorial Board and additional reviewers from the field did an exceptional job of carefully reading the submitted papers and providing deep and detailed constructive advice to improve the papers. Virtually all published papers went through extensive critique and revision. Although it may not be visible to most readers, all papers had clearer organization and stronger arguments as a result of the review process—even though they may have been based on conference papers or dissertations that had already benefited from a great deal of review and editing. In addition, the many papers that could not be published in *ijCSCL* each received several detailed reviews, helping their authors to learn from the experience and to understand what was needed for future publication. In such ways, the journal also serves as a means for mutual assistance within the community—for community-based collaborative learning.

The journal is thus both an avenue of more formal communication than conferences and a special form of interaction between authors and reviewers. This kind of anonymous interaction and critique can be more frank and detailed than at a conference. If *ijCSCL* serves these dual purposes of publication and feedback, then it's first anniversary marks a real start to advancing the field.

The CSCL research community supports *ijCSCL*

As we start to publish our second volume of *ijCSCL*, the Board of Editors would like to thank all the members of the CSCL community who have supported the journal through its first year. The following researchers contributed reviews to *ijCSCL* to date:

> Shaaron Ainsworth, Hans Christian Arnseth, Daniel Bodemer, Jürgen Buder, Murat Perit Cakir, John M. Carroll, Carol K.K. Chan, Elizabeth Charles, Cesar Alberto Collazos, Charles Crook, Lucilla Crosta, Lone Dirckinck-Holmfeld, Nathan Dwyer, Noel Enyedy, Brian Foley, Andrea Forte, Hugo Fuks, Frode Guribye, Päivi Häkkinen, Christine Joyce Howe, James Hudson, Patrick Jermann, Richard Joiner, Christopher Jones, Regina Jucks, Yael Kali, Victor Kaptelinin, Manu Kapur, Andrea Kienle, Minna Lakkala, Victor Lally, Nancy Law, Lasse Lipponen, Jacques Lonchamp, Rose Luckin, Johan Lundin, Richard Medina, Anders Mørch, Daisy Mwanza-Simwami, Jun Oshima, Ruediger Pfister, Janet Read, Peter Reimann, Jochen Rick, Tim Roberts, Nikol Rummel, Nadira Saab, Johann Sarmiento, Wesley Shumar, Jan-Willem Strijbos, Berthel Sutter, Gustav Taxén, Ramon Prudencio Toledo, Jan van Aalst, Ravi Vatrapu, Marjaana Veermans, Jim Waters, Rupert Boudewijn Wegerif, Gordon Wells, Martin Wessner, Tobin Frye White, Joyce Yukawa, Nan Zhou.

Along with the members of the Editorial Board, these reviewers not only determined what was selected to publish in the journal and gave valuable insights to all submitting authors, they also contributed significantly to guiding the major revisions that all accepted papers passed through before being published. In this way, the community establishes the content and tone of the journal.

We look forward to thanking you in person for your support and your interest in *ijCSCL* at the international conference of CSCL 2007 at Rutgers University, New

Brunswick, NJ, USA, near New York City, July 16-21 (see http://www.isls.org/cscl2007).

Flash themes in CSCL

As mentioned in the introduction to issue 2, a number of workshops on topics in CSCL proposed developing special issues for *ijCSCL*. These were not topics solicited by the *ijCSCL* Editorial Board, but arose out of the work and concerns of practitioners. They are themes that "flashed" up in the field through a kind of spontaneous combustion of hot topics, stirred up by experiences in the wild. Responding to these openly and welcoming such suggestions has been a way for *ijCSCL* to give voice to the concerns of the field in a timely and flexible way and to stay at the leading edge of a rapidly evolving discipline.

This year, *ijCSCL* begins to publish papers on these flash themes. Reviews of papers on these themes are being coordinated by Associate Editors of *ijCSCL* (as indicated in parentheses below) in a move to broaden editorial responsibilities as the journal becomes more established. Future issues will include papers on the flash themes of:

- Scripting in CSCL (reviews coordinated by Barbara Wasson)
- Methods for Evaluating CSCL (Claire O'Malley)
- Graphical Support for CSCL (Daniel D. Suthers)

In this issue, two papers on the theme of "Learning in Communities" are published. They arose out of a workshop by that name organized by Jack Carroll and Chris Hoadley at Penn State University (USA), August 14-17, 2006. The workshop was attended by 29 researchers, mostly from North America, and was sponsored by NSF (grant IIS-0511198). A report on the workshop itself appeared previously in the *Journal of Community Informatics* (Carroll & Bishop, 2005). Six other papers derived from the workshop are under review for the *Journal of CSCW*. The workshop at Penn State built on related workshops at ICLS 2004 and CSCL 2005, which resulted in special issues in the *ACM SigGroup Bulletin* (Klamma, Rohde, & Stahl, 2004) and in *Behavior & Information Technology* (Rohde, Wulf, & Stahl, 2006).

Computer-supported community-based learning

Lave & Wenger (1991) brought home the importance of "communities of practice" (CoPs) for learning. In this issue, we have a pair of articles investigating the role of communities in learning within contemporary institutions. Together, they suggest a specific form of CSCL, where the term "collaborative" is specified as referring to collaboration that is "community-based" in the sense of CoPs providing socio-cultural contexts in which collaborative learning can take place.

They illustrate community-based learning related to the university and related to what in the USA are known as non-profit organizations and elsewhere as non-governmental organizations (NGOs). By publishing these articles, we bring considerations from CSCW (computer-supported cooperative work) and HCI (human-computer interaction) into the CSCL discussion.

Fischer, Rohde & Wulf elaborate the concept of CoP with distinctions that have developed in reaction to Lave & Wenger, distinguishing networks of practice and communities of interest from CoPs as variants. The community-based focus is a move within CSCL to the level of what Jones, Dirckinck-Holmfeld, & Lindström (2006) called the "macro-scale" in the first issue of *ijCSCL*. Here, a community is not only learning via computer-supported media, but they are also learning about how to design and use computer-supported "community-based" learning technology. In a transitional period for institutions of higher learning when online learning threatens the viability and competitiveness of brick-and-mortar universities, it is timely to ask how residential research universities can develop unique and attractive approaches to computer-supported community-based learning by involving students in real-world research in academic labs and local industry.

Carroll & Faroque propose a middle layer of theoretical constructs they call frameworks, which mediate between general patterns and individual cases. Based on long experience working with non-profit community-based organizations who struggle with computer technology, the authors want to formulate generalizations that will provide practical guidance in dealing with common problems that arise in this context. They draw on the idea of design patterns (Alexander, 1977) and the literature that has developed in computer science and CSCL based on Alexander's approach. We may dispute the definition of pattern used here as a simplification of Alexander's pattern languages and may wonder if this sense of theory is strong enough for our field, as a reviewer did, but the authors seem to be pointing in a promising direction. Just as the nature of residential research universities in the age of distance education is in turmoil, voluntary and neighborhood-based organizations are threatened in the age of social fragmentation and globalization. In both cases, there seems to be no general solution; pattern languages of inter-related partial solutions generalized from multiple experiences and adaptable to concrete cases may provide the best solution.

Methods for analyzing collaborative interaction

The theme of methodology is one that permeates discussions of CSCL and generates endless controversy. This is not a flash theme, but an enduring one. It probably plays a role in every issue of *ijCSCL*, not only this one.

To understand the nature of a collaboration or a set of collaborative activities, one has to know about the various dimensions of interaction that take place. What are the key dimensions and how can they be measured or analyzed? Researchers in CSCL have tried to apply diverse theories and methodologies, many borrowed from established fields of social science research. The results are still heavily contested. This issue of *ijCSCL* features two articles that explicitly explore importing quantitative methodologies into CSCL, in combination with complementary approaches.

Meier, Spada & Rummel differentiate as many as nine dimensions of interaction for quantitative analysis and assessment. They derived these through an interesting combination of bottom-up qualitative content analysis with generalization, refined through top-down theory-informed considerations. Operationalized for reliable application, these dimensions are then used to develop and successfully apply a rating scheme for assessing the quality of computer-supported collaboration processes among dyads of college students engaged in videoconferencing. It is suggested that such a ranking approach has advantages over coding for many research questions, still allowing a quantitative comparison of alternative conditions.

A quite similar interest drives the paper by De Laat, Lally, Lipponen & Simons. They are interested in synthesizing and extending the understanding of patterns of collaboration in the context of networked learning or CSCL. They start with a general overview of the utility of social network analysis (SNA) in social science and in previous CSCL studies. Then they bring in content analysis and critical event recall as complementary tools. Their paper provides an additional example of the usability of SNA.

While the last two articles mentioned strive to produce quantitative support for generalization, the paper by Rourke & Kanuka argues explicitly for a qualitative approach as a way of gaining deeper insight into important CSCL phenomena. Much CSCL research aims to support discourse that stimulates critical thinking and even argumentation; much CSCL literature also bemoans the common failure of online discourse to achieve high levels of critical reflection, often using quantitative measures based upon coding, ranking or SNA, for instance. This paper adopts a “naturalistic paradigm” in which “realities are multiple, constructed and holistic … so that it is impossible to distinguish causes from effects.” It inquires into the life contexts of several students in an in-depth case study of online learning in order to explore the manifold and subtle barriers that militate against the ideal of online critical discourse. Thereby, one catches a glimpse of personal factors that influence the diverse ways that individual students interact to co-construct reality, course materials and understandings of each other—factors that might well slip through the sieves of methods that aggregate data for the sake of generalized findings.

Perhaps the implication of the papers in this issue is that CSCL needs to promote the inter-animation of complementary quantitative and qualitative perspectives rather than hoping to converge on a single ideal method.

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2(2&3): A double issue for CSCL 2007

The first volume of *ijCSCL* followed upon CSCL 2005 in Taiwan and featured important papers from that conference, expanded into journal presentations. This double issue of volume two is timed to coincide with CSCL 2007 in New Brunswick. It introduces sets of papers on two "flash themes" that have flared up within the research field of CSCL between conferences. These papers arose out of research projects and workshops held in the interim on topics of abiding interest, as also reflected in volumes of the CSCL book series (Andriessen, Baker, & Suthers, 2003; Fischer *et al.*, 2006).

We hope to feature articles based on papers from CSCL 2007 in volume three of *ijCSCL*. We are particularly interested in articles that report on a mature research agenda, perhaps covering the work of a research lab or project consortium. A journal article should make a significant innovative contribution to the field. It might propose a new direction for theory, socio-technical design, pedagogical practice or research methodology. Ideally, it should investigate the use of computer support in learning and should feature collaborative interaction as the mode of knowledge building or shared meaning making. While proposals should generally be supported with concrete evidence based on some form of user experience, the evaluation of the evidence can take the form of any rigorous method: for instance, statistical significance of experimental results, ethnographic study, action research, case study. Please see our website at http://ijCSCL.org for details and examples of published papers if you are considering a submission.

In this issue

The paper by **Maarit Arvaja** reflects the Finnish concern with the enacted context in which knowledge-building discourse is situated, and which is constructed through that discourse. After reviewing theoretical concerns about the mediating nature of context, the study analyzes the work of two groups in a computer-supported discussion forum. The online discourse is coded and quantitatively compared to highlight different interaction patterns. One group used more co-text and course material in their discussion while the other referred more to personal experiences. Quantifying the data provided a valuable tool to measure and contrast knowledge construction in these groups. Complementing this, a detailed qualitative analysis of the groups' discussions and thick descriptions of the relations between the specific thematic content, communicative functions and contextual resources provided insight into reasons behind the similarities and differences. The paper includes both the coding scheme and extended excerpts from the group postings and their analysis, helping the reader to understand and evaluate the claims made. The combination of quantitative and qualitative analysis illuminates the situated and mediated nature of learning in the case studied. The students' knowledge construction activity was grounded in the immediate context in the sense that meaning negotiation was shaped by the moment-by-moment interpretation of each other's messages. Also, the students' activity was grounded in their contexts, in that knowledge construction and sharing were based on prior experience and background knowledge that were brought into the discussion. These two aspects of context were illustrated by the work of the two groups, respectively.

The report from New Zealand by **Nilufar Baghaei, Antonija Mitrovic & Warwick Irwin** discusses an intelligent tutoring system for object-oriented programming skills that also represent collaboration skills using the same user modeling and domain formalism. It is a CSCL environment that supports groups of students to work and learn together—something unusual for intelligent tutoring systems. The system provides a careful balance of supports for individual and group work, based on the CSCL literature. A pilot study and a controlled experiment in a classroom confirmed the effectiveness of the system in achieving its main goals. Attempts to use artificial intelligence in education have always been an important aspect of CSCL, and this paper represents that tradition with a new innovation. It also bridges the technological and software-oriented concerns of CSCL with the focus on supporting collaborative learning among programming students.

Many CSCL activities involve students or adults in searching the Web—either individually or collaboratively—and synthesizing the information that they find on multiple sites. **Marc Stadtler & Rainer Bromme** provide an analysis of the metacognitive tasks involved in modeling this flow of information from diverse documents. Metacognitive tasks include, above all, the ability to identify, rate and keep track of information sources—key concerns for CSCL designers who want students to critically assess Web resources and to acknowledge their sources. In the reported laboratory experiment, a web-browser equipped with optional prompts for supporting metacognitive tasks was used in a number of conditions with college students. Quantitative analysis of the results indicated that the integration of source information and content information while dealing with multiple sources on the Internet is not only a desired goal, but a realistic one that can be fostered through the metacognitive strategy of evaluating information.

Scripting in CSCL

The next two papers grew out of a European Research Team on 'Computer-Supported Scripting of Interaction in Collaborative Learning Environments' (CoSSICLE) funded by the 'Kaleidoscope' Network of Excellence. Pierre Dillenbourg and Frank Fisher suggested publishing a set of papers reporting on project findings in *ijCSCL*. Lars Kobbe coordinated the expansion of the papers and their submission. Barbara Wasson, Associate Editor of *ijCSCL*, supervised the peer review of these articles. In this issue, we initiate the flash theme of "Scripting in CSCL" with the first two papers that are ready for publication. We welcome submissions on this theme for future issues.

Lars Kobbe, Armin Weinberger, Pierre Dillenbourg, Andreas Harrer, Raija Hämäläinen, Päivi Häkkinen, & Frank Fischer introduce the theme with a review of the current state of the art of scripting and a framework for the specification of scripts, including a proposed standardization of terminology. Collaboration scripts aim to foster collaborative learning in shaping the way in which learners interact with one another. In specifying a sequence of learning activities, together with appropriate roles for the learners, collaboration scripts are designed to trigger engagement in social and cognitive activities that would otherwise occur rarely or not at all. This paper aims to consolidate and expand these approaches in light of recent findings and to propose a generic framework for the specification of collaboration scripts. The framework enables a description of collaboration scripts using a small number of components (participants, activities, roles, resources and groups) and mechanisms (task distribution, group formation and sequencing).

Tammy Schellens, Hilde Van Keer, Bram De Wever & Martin Valcke continue the theme with a relatively large, multilevel analysis of college freshmen discussing topics in online groups of about ten students. Their discussions were scripted by assigning four students in each group to well-defined collaboration roles: 'moderator', 'theoretician', 'summarizer', and 'source searcher'. By focusing on communication and coordination, the primary targets of the script instructions were interactions within the group rather than cognitive processes of individuals. The authors conclude from their detailed statistical analysis that the use of collaboration roles has the potential for improving knowledge construction. In part of the experiment, an overall positive effect of role assignment was detected. All students in the experimental condition outperformed the students in the control group without role assignment. Nevertheless, the study revealed that not all roles equally promote knowledge construction for the individuals who have to perform that specific role. It appeared that students in some roles were confined by their role and did not participate as well in the ongoing discussion. This points to the danger of over-scripting during collaborative interaction.

Argumentation in CSCL

The following four articles introduce the flash theme, "Argumentation in CSCL." An argumentation perspective exposes how learning in group settings can be accomplished by participants' critical analysis of claims and interpretations through dialectic processes. Research on argumentation has an established history in CSCL, particularly in the line of European work reported in the first volume of the CSCL book series (Andriessen, Baker & Suthers, 2003). This work has continued in two European projects, SCALE and DUNES, which have studied argument graphs as well as other media for conducting or representing argumentative dialogues. Jerry Andriessen and Michael Baker proposed this theme for *ijCSCL* to present some of the results of these research efforts and related work. Daniel Suthers, Associate Editor of *ijCSCL* supervised the peer review of submissions for this theme and wrote the following overview. The first four papers being published under this theme include two papers from SCALE and two from DUNES, representing a diversity of CSCL argumentation research. Argumentation and technological support for "arguing to learn" continues to be an active area of research in CSCL; the Journal editors look forward to additional contributions in this area.

Michael James Baker, Jerry Andriessen, Kristine Lund, Marije van Amelsvoort & Matthieu Quignard introduce Rainbow, a framework for analyzing debates. The analysis method aims primarily to quantify functional categories of interaction so that frequencies of these categories may be correlated with learning outcomes in experimental settings. Drawing upon prior research, seven functional categories are identified, exemplified and discussed in detail. Perhaps the most unique analytic category contributed by this paper identifies moves that *broaden and deepen* learners' understanding of a space of debate. Independently of whether learners are taking positions in a debate or studying others' positions, learners can advance their understanding by exploring a greater diversity of positions and the arguments that bear upon them (broadening), and elaborating on these arguments and the concepts on which they are based (deepening). Applications of Rainbow to other projects in the SCALE community are described, as well as potential extensions to nonverbal interaction media and relevance to other methodological traditions.

The other SCALE paper, by **Kristine Lund, Gaëlle Molinari, Arnauld Séjourné & Michael Baker** also offers an analysis method, ADAM, that is positioned within the experimental paradigm. Here, the emphasis is on analyzing argumentation diagrams as products rather than the process of argumentation that is addressed by Rainbow. ADAM measures the quality of argumentation diagrams according to quantifiable characteristics such as the number and nature of topics, opinions, arguments, relations and elaborations, along with judgments of correctness of the relations. The primary contribution of this paper is an experimental comparison of two instructional strategies for using argument graphs: as a *means for debate,* in which students interact through both chat and argumentation graph tools, and as a *tool for representing debate,* in which students interacted through chat and then transcribed their discussion to an argumentation graph. In both cases, students created individual argumentation diagrams before and after the debate: these diagrams were analyzed using ADAM to identify differences. Students who used the graphs as a means for debate tended to express more personal opinions, elaborating on argumentation (reasons); while students using the graph to represent debate sought to express the consensus of a "group voice," and elaborated more on causes and consequences. Thus, the paper illustrates the bidirectional influence of tool on argumentation and argumentation on tool.

The concept of a group voice plays an important role in the paper by **Baruch B. Schwarz & Reuma De Groot**, which shifts us from experimental to analytic methodologies in design-based research. Observing that the study of argumentation in CSCL is part of a direction in education that values collaboration over individuation and dialogic reasoning over thinking skills, the authors seek to identify evaluation methods that most appropriately reflect these values. This work was undertaken in the context of an evaluation of the Kishurim program, which was designed by the authors to foster argumentation and dialogic thinking skills under the guidance of several principles. Digalo, a software tool for the representation and management of argumentative discussions developed in the DUNES project, supported implementation of this program. Seeking to evaluate whether students improved their thinking on the historical topic studied, the authors first compared pre- and post-session essays on quantitative measures of argument structure such as the number of claims and reasons given, finding no differences. Recognizing that these structural measures are not criteria for the educational objectives they care about, the authors then analyzed the essays for openness, decisiveness and coherence, finding significant differences. Furthermore, the authors undertook a discursive analysis of students' argumentative dialogues to understand how these improvements came about. Schwarz & De Groot conclude that as students sought to find collective truth in a group voice, they became less motivated to produce "more arguments at any price," and hence numeric frequencies of the constituents of arguments fail to capture the educational outcomes that were of greatest importance to both researchers and students. The paper exemplifies the value of being reflective about our methods rather than following disciplinary traditions uncritically.

Nathalie Muller Mirza, Valérie Tartas, Anne-Nelly Perret-Clermont & Jean-François De Pietro also work with Digalo in the context of the DUNES, and similarly find that analysis of interaction best suits their educational goals. Mizra, et al. seek to foster students' understanding of a historical debate about the humanity of the natives of the New World. Students were assigned to three groups in which they role-played three protagonists. This instructional strategy should broaden and deepen the space of debate, because students are not only exposed to diverse frames of reference on the debate, but must understand these frames of reference deeply enough to act as representatives of those positions. Like Schwarz & De Groot, Mirza, et al. find that analysis of the structure of arguments would not address their educational goal, which is learning about the debate from argumentation, rather than learning to argue. Instead, they pursue a bi-level approach to analysis, one that traces the development of understanding of the historical topic throughout the dialogue, and another that treats argumentation as a social activity, analyzing triplets of argument-counterargument-reply to identify how challenges to a position are addressed. As a broad picture of the historical event was elaborated, students also developed argumentative strategies. The authors sought to identify Digalo tool affordances that were appropriated in these topic-development and argumentative processes, observing roles of representations consistent with those reported by Suthers and colleagues. As for Lund, et al and Schwarz & De Groot, the emergence of "collective reasoning" afforded by the shared representation was notable.

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2(4): CSCL and its flash themes

The dialectics of flash themes

Imagine a group of our prehistoric ancestors sitting around the tribal fire sharing their narratives and perspectives on the world. Cautiously, a youthful utterance emerges from beneath the adult voices to query, “Why do you always speak of the eternal fire? I see only a succession of burning logs.” Haltingly, the elders try to explain that while it is true that there could be no fire without the logs, none of the individual logs could burn the way they do if they were not part of the fire, which endures much longer than any of the logs in it.

A second youth nods with her friend’s question; she is also confused and stares into the glowing fire before her. She throws a new log onto the fire and observes it closely. Her log starts to smoke where it is lapped by surrounding flames. Suddenly, a flame flashes out of it. Soon, the tribal fire is brightest right around her log. She gestures to her friend, saying, “Look at that: the log would not have burned at all if not for the fire, and the fire would not be so excited without the contribution of my log and without the way that my log and the other logs enflame each other.”

The two youngsters turn to their elders and ask, “How are we to understand this interplay of log and fire defining each other, which cannot easily be spoken of in our language?” The elders pause wisely and face the warmth of the flames. Eventually one holds his palms out to the source of warmth and is moved to say, “We can understand the fire by measuring the heat that it gives off and we can understand the nature of different logs by measuring how long they burn in the fire.” Then another perspective comes to word: “We should look in great detail at how the log and the fire interact, how the logs catch fire and the fire endures.” Another position is voiced that argues that the fire is the important thing for the tribe and that one should understand its phases—how it ebbs and flows like the moon or the tides; how it first catches from a spark in kindling, then roars across timbers and finally glows with embers. Then another claims that the fire really is nothing but the sum of individual logs burning and that a true understanding must simply know how each of the different woods of the forest burns; from such knowledge one can predict how any collection of logs will burn. Yet another voice points out that the tribal fire is a special fire. It is situated in the village center, in a pit whose shape and orientation both shelters and fans the flames. It is watched over and cared for by the villagers, who depend upon it for their survival. It is a gift of the gods, which has been entrusted to the people and passed down through the generations. As the fire dies down for the night, the two youngsters dose off, comforted by the wisdom of their tribe, which is somehow more than the simple sum of the opinions of individual elders.

Despite our fancy and precarious technology, we are not so different from our predecessors. Today, each of us warms our social and conceptual bones in front of many tribal fires—some, like the conferences of the CSCL research community, require airplane travel and some, like our journal, require Internet access. If *ijCSCL* is a tribal fire, then the authors of its articles are the logs that must burn hotly, one after another. Here, the dialectical relationship between author and audience is mediated by the institution, practices and editors of the journal.

The CSCL research community requires scientific ideas in order to survive. In fact, the field of CSCL is nothing but a collection of these ideas. But these "ideas" do not emerge fully grown from the minds of individuals or the labs of small groups, like Athena (Minerva) from the head of Zeus. They may flash up in the minds or discourses of individuals or small groups, but they do so under specific historical and cultural conditions. They may be inspired by someone else's conceptual artifacts—a conference talk, a published paper, a stimulating question, a classic issue for the field. They then develop in various ways: as topics of informal discussions, as first drafts for a paper, as grant proposals, as experimental hypotheses.

Sometimes, someone with a hot idea decides to organize a workshop on the topic and invite other researchers interested in the theme to share their views. Individual thinking on the theme may ignite through the planning, presentation and follow-up of the workshop, setting other people's reflections on fire as well. Before you know it, a new flash theme has burst forth on the community. This was the case in four recent events that led to papers in *ijCSCL* around flash themes. In each of these cases, the plan to publish in *ijCSCL* was integral to the workshop agenda. So, the individual papers prepared for the workshops were drafted with an eye to journal publication.

After the workshop took place, the organizers began the task of encouraging workshop participants to convert their drafts into journal papers and to coordinate the set of resultant papers to fit together. At the same time, the organizers negotiated with the *ijCSCL* editors. The editors decided that each paper would be subjected to the journal's full peer-review process, including rejecting papers that did not have the potential to make a significant contribution to the field in the opinion of reviewers. In most cases, this meant that even the best papers needed to undergo major revisions in response to several detailed critical reviews. Each flash theme was supervised by a different *ijCSCL* editor (an Executive or Associate Editor). As a final step, successful papers were edited for English and formatting.

Of course, one can view an issue of *ijCSCL* as simply a collection of papers by individual researchers. But—particularly for papers on one of the flash themes—the situation is more complicated. First, most of these papers are co-authored, often by people from different institutions and even different countries. Second, many of the papers report on work within EU or Kaleidoscope projects involving many participants. Third, the papers were drafted to fit into a workshop setting, with an eye to journal publication in a coherent special issue. Fourth, the papers were coordinated after the workshop for the journal flash theme. Fifth, major revisions of the structure, argument and presentation of the findings were undertaken by the authors under the guidance of the organizer, several reviewers and at least one journal editor. Sixth, like all journal papers, the discussions of flash themes were communications to an audience, appealing to the concerns, understandings and judgments of the community, speaking their language and rooting the new contribution within the history of previous discussions. In these and other ways, the development and articulation of the ideas by the authors took place collaboratively, situated within the institutional structures of the journal-publication process and of the research community. At the same time, the journal rules and procedures themselves evolved in response to the rise of these flash themes and the opportunities for some form of special issue topics. And the definition of CSCL as a field was modified to include the thematic flashes. The friendly, but occasionally confusing negotiations among all the participants constituted the details of enactment and reproduction which mediated between the immediate actions of individual actors and the enduring social practices and structures of academic publication and research.

The specifics of the flash themes

In 2006, our inaugural year, we ignited the new tribal fire of *ijCSCL* for the CSCL research community. Many of the papers in volume 1 had their origin in the CSCL 2005 conference in Taiwan, passing the flame from conference to journal. In 2007 (volume 2), we created the category of flash themes, a new way of bundling logs together to heat up the collaborative learning of the community on these topics that seemed to be of special interest as they arose in the field.

In the March issue (2:1), we presented our first flash theme. Jack Carroll and Chris Hoadley had organized a workshop under the title of "**Learning in Communities**" at Penn State University (USA), August 14-17, 2006. Papers for this flash theme were coordinated by Carroll and edited by Stahl. We published: "*Community-based learning: The core competency of residential, research-based universities*" by Gerhard Fischer, Markus Rohde & Volker Wulf and "*Patterns as a paradigm for theory in community-based learning*" by John M.Carroll & Umer Farooq.

The September issue was a double issue (2:2&3) associated with the CSCL 2007 conference in New Brunswick. It introduced two flash themes that continue in this and future issues. The first of these was "**Scripting in CSCL**." It originated as a workshop of the European Research Team on "Computer-Supported Scripting of Interaction in Collaborative Learning Environments" (CoSSICLE) funded by the Kaleidoscope Network of Excellence. Proposed as a set of publications for *ijCSCL* by Pierre Dillenbourg and Frank Fischer, it was coordinated by Lars Kobbe. Barbara Wasson supervised the peer review. We published: "*Specifying computer-supported collaboration scripts*" by Lars Kobbe, Armin Weinberger, Pierre Dillenbourg, Andreas Harrer, Raija Hämäläinen, Päivi Häkkinen, & Frank Fischer, and "*Comparing knowledge construction in two cohorts of asynchronous discussion groups with and without scripting*" by Tammy Schellens, Hilde Van Keer, Bram De Wever & Martin Valcke.

The other flash theme in the previous issue was "**Argumentation in CSCL**." Jerry Andriessen and Michael Baker proposed this theme for *ijCSCL* based on two European projects, SCALE and DUNES. Review of these submissions was supervised by Dan Suthers. We published: "*Rainbow: A framework for analyzing computer-mediated pedagogical debates*" by Michael Baker, Jerry Andriessen, Kristine Lund, Marije van Amelsvoort & Matthieu Quignard; "*How do argumentation diagrams compare when student pairs use them as a means for debate or as a tool for representing debate*?" by Kristine Lund, Gaëlle Molinari, Arnauld Séjourné & Michael Baker; "*Argumentation in a changing world*" by Baruch B. Schwarz & Reuma De Groot; and "*Using graphical tools in a phased activity for enhancing dialogical skills: An example with Digalo*" by Nathalie Muller Mirza, Valérie Tartas, Anne-Nelly Perret-Clermont & Jean-François De Pietro.

Flash themes in this issue

In the following pages, we introduce the final flash theme for this year, "**Methods for Evaluating CSCL**." This flash theme was proposed by Daisy Mwanza, based on a workshop with the same title held at the Open University in the United Kingdom on November 17-18, 2005. The submission review was supervised by Claire O'Malley. The articles below by John B. Belbas & Christine M. Greenhow and by Giasemi Vavoula & Mike Sharples belong to this flash theme.

The paper in this issue by Karsten Stegmann, Armin Weinberger & Frank Fischer belongs to the theme "**Scripting in CSCL**." Coincidentally, it is also about argumentation in CSCL. The submissions from Baruch Schwarz & Amnon Glassner and from E. Michael Nussbaum, Denise L. Winsor, Yvette M. Aqui & Anne M. Poliquin below are about argumentation as well; they carry on the theme of "**Argumentation in CSCL**," although neither of them was submitted as part of the original group or reviewed as such.

The five team voices collected in this issue adopt different perspectives on the mediation of individual and group in CSCL activities, such as debating scientific issues. They might be said to:

- Identify how the fire and its logs interact with each other,
- Envision alternative ways of building fires,
- Measure the effects of different ways of feeding the fire,
- Measure how much the logs catch fire under different conditions, or
- Measure how high the fire roars under different conditions.

See if these different approaches all make sense to you and if together they give you a more insightful understanding of the complex nature of CSCL activities than any one of the voices by itself.

These four flash themes will continue into volume 3 (2008). Please submit papers on these themes if you have something important to contribute to these fiery discourses.

Don't forget to plan for the International Conference of the Learning Sciences (ICLS 2008) in Utrecht, the Netherlands (see http://www.isls.org/icls2008/). Renew your ISLS membership now for reduced registration at ICLS and to continue subscribing to *ijCSCL*.

3(1): The many levels of CSCL

Collaborative groups in context

Pierre Dillenbourg & Fabrice Hong bring our flash theme of scripting to a conclusion with a pedagogical design model for scripting classroom activities. Their theoretical framework for conceptualizing and structuring pedagogical scripts defines three primary social levels on which learning, interaction and knowledge building can take place: that of the individual student, the small workgroup and the class as a whole (including the teacher). An effective script not only works on a given level, but more importantly relates the activities at each level to each other to form an effective integrated pedagogical process. The authors propose their suggestive SWISH principle as a stimulus for collaborative learning. Collaboration, they argue, takes place most effectively in a relatively unconstrained small-group process of peers working together to overcome some cognitive barrier to the shared accomplishment of a joint task. In order to set up the groups oriented to their tasks and to introduce the barriers without interfering with the self-directed nature of small-group collaboration, a script specifies how to form small groups and organize tasks while operating on the teacher-centered classroom level, and then "split when interaction should happen" (SWISH) onto the small-group level. Following the collaboration phase, the script then specifies individual- and class-level activities to share, solidify and internalize the knowledge building that took place in the groups. While supporting the idea that small-group interaction is key to collaborative learning, the article stresses the essential role of integrating that interaction in coherent processes involving individual and class activities as well. This recognition represents a major step forward for CSCL theory. The article provides a detailed analytic framework for thinking about and supporting this complex and often overlooked need for an effective pedagogy that integrates across social levels.

Another major pedagogical problem in many CSCL applications is that students and teachers often focus on procedural learning and minimize the conceptual learning that was intended by the curriculum designers. *Ingeborg Krange & Sten Ludvigsen* illustrate this problem in striking detail. A computer system to support collaborative learning of genetic theory includes a table for identifying the DNA genetic codes of amino acids used to build proteins. It also includes a 3-D game interface for building a protein in a molecule-level virtual world and then using it in a human-level virtual world. The human-level game is supposed to motivate students to learn the science necessary to save a life, but instead distracts from the science altogether. During the problem-solving collaboration, most students are so focused on the game goal that they restrict the science learning to manipulating the information in the table without even allowing a curious student to ask what the symbols in the table are supposed to represent conceptually—i.e., how genes, amino acids and proteins are related. The game narrative distracts from, rather than motivating the science inquiry. The table artifact becomes an end-in-itself to manipulate, rather than a mediator for understanding connections among biological concepts. The authors argue that this common pedagogical problem in science education arose because of the way in which mediating tools at three social levels intersected in the concrete situation of this classroom: the school as curriculum deliverer, the knowledge domain (high school genetics) and the computer tool (a website with the table and the 3-D virtual world environment). Although the teacher and students enacted the joint task and their collaborative priorities together as a small group, they were situated in a context that included the institutional constraints of the school, the conceptualizations of the domain of biology and the pedagogical design embedded in the software. Without taking these multiple levels of constraints into account, one cannot expect CSCL activities to succeed in inspiring students with deep insights into contemporary understandings of genetics and other sciences.

The paper by *Bernhard Nett* looks at an even higher-level context for a CSCL application: a multi-institutional, inter-disciplinary consortium of the type becoming increasingly common, particularly in the European Union. A group of faculty from institutes of law, computer science and economics across Germany undertook the task of implementing innovative forms of CSCL for college education in "computers and law." Nett's analysis traces the emergence of a community of practice within the effort, in which the tutors associated with the project formed an effective small group that overcame serious institutional barriers to collaboration at the faculty level. Through both face-to-face and computer-mediated communication, the group of tutors proposed, implemented, refined and facilitated a MOO environment. The tutor community generally played an important integrative role within the project, allowing the curriculum provided by the faculty to be effectively taken up by the student body. As seen in this analysis, a community of practice evolves through specific group processes, which cannot be scripted as part of an organizational plan, but which may play a crucial role in the success of a larger, more formal learning organization.

Quantitative and qualitative analysis on many levels

The typical levels within CSCL interventions according to Dillenbourg & Hong are: individual, small group and class. The analyses of these and other levels by Krange & Ludvigsen and by Nett are qualitative. It is also possible to conduct quantitative analyses of processes at these levels and of the interplay between levels. *Ulrike Cress* argues for the importance of conducting such studies and provides an in-depth introduction to a statistical method for analyzing the results. Multilevel analysis (MLM)—or hierarchical linear modeling (HLM)—is becoming increasingly popular in CSCL and related research, but is relatively complicated to conduct. It allows one to do regression analysis when individual subjects are nested in groups, as is usually the case in collaborative learning. If one tests individual students before and after some group activity, then the learning that may have taken place could be a function of the skills, backgrounds and efforts of the individuals, but it could also be a function of the interactions that took place within the groups. For instance, if one wants to test whether girls learned more than boys, that comparison would be confounded by whether each of the girls or boys was in a good group or a bad group. MLM separates out the effects at different levels and reports how much of the variance is due to individual effects and how much to group effects. In order to do this, understandably but unfortunately, MLM requires larger sample sizes than are common in CSCL studies. Cress addresses this and other issues for adapting MLM to CSCL.

One technique to finesse the problem of larger sample sizes is to "fake" the group interaction so that all the individuals experience the same small-group processes. The experiment reported by *Joachim Kimmerle & Ulrike Cress* does just that. Over a hundred subjects were put into conditions with varying forms of social awareness about the actions of other members of their small group. The experiment subjected the participants to a classic information-exchange dilemma in which individuals had a disincentive to contribute their own knowledge to the group but benefited if the group was well informed. Although subjects believed they were interacting with other subjects in small groups, the inputs from other members were simulated to standardize the group-level effects. The experiment was able to confirm its hypothesis about a group-level effect on the individuals without actually having real groups! In addition, finer analysis of the effects provided empirical evidence to refine the theoretical social psychology model behind the hypotheses.

Reviews in the first two years

From the founding of the journal until this issue was prepared for publication—basically during 2006 and 2007—354 reviews were completed, not counting meta-reviews by Executive and Associate Editors supervising the review processes. This resulted in 45 papers being accepted for publication and 63 papers being rejected out of a total of 128 submissions (there are currently 20 submissions in the review and revision pipeline). Following is a list of most of the reviewers involved; in many cases these reviewers sought the assistance of colleagues, who may not be included in this list:

Shaaron Ainsworth, Rick Alterman, Jerry Andriessen, Hans Christian Arnseth, Gerardo Ayala, Michael Baker, Daniel Bodemer, Jacqueline Bourdeau, Bertram Bruce, Amy Bruckman, Jürgen Buder, Murat Perit Cakir, John M. Carroll, Carol K. K. Chan, Tak-Wai Chan, Elizabeth Sandra Charles, Cesar Alberto Collazos, Charles Crook, Lucilla Crosta, Ton de Jong, Sharon Derry, Pierre Dillenbourg, Angelique Dimitrakopoulou, Lone Dirckinck-Holmfeld, Paul Dourish, Nathan Dwyer, Noel Enyedy, Brian Foley, Andrea Forte, Hugo Fuks, Ricki Goldman, Jonathan Grudin, Frode Guribye, Jörg M. Haake, Päivi Häkkinen, Thomas Herrmann, Cindy E. Hmelo-Silver, Christopher Hoadley, Ulrich Hoppe, Christine Joyce Howe, James M. Hudson, Sanna Järvelä, Patrick Jermann, Richard Joiner, Christopher Jones, Regina Jucks, Yael Kali, Victor Kaptelinin, Manu Kapur, Andrea Kienle, Joachim Kimmerle, Paul A. Kirschner, Matthew J. Koehler, Timothy Koschmann, Thérèse Laferrière, Minna Helena Lakkala, Victor Lally, Mary Lamon, Nancy Law, Lasse Lipponen, Jacques Lonchamp, Chee-Kit Looi, Rose Luckin, Sten R. Ludvigsen, Kristine Lund, Andreas Lund, Johan Lundin, Richard Medina, Naomi Miyake, Anders Mørch, Daisy Mwanza-Simwami, Bonnie Nardi, Matthias Nückles, Hiroaki Ogata, Claire O'Malley, Jun Oshima, Roy Pea, Ruediger Pfister, Janet Read, Peter Reimann, Jochen Rick, Tim Sean Roberts, Markus Rohde, Jeremy Roschelle, Liam Rourke, Nikol Rummel, Nadira Saab, Johann W. Sarmiento, Tammy Schellens, Gregg Schraw, Baruch Schwarz, Anna Sfard, David Williamson Shaffer, Wesley Shumar, Amy Soller, Nancy Songer, Hans Spada, Marc Stadtler, Constance Steinkuehler, Jan-Willem Strijbos, Masanori Sugimoto, Daniel Suthers, Berthel Sutter, Gustav Taxén, Ramon Prudencio Toledo, Jan van Aalst, Ravi Kiran Vatrapu, Marjaana Veermans, Barbara Wasson, Jim Waters, Rupert Boudewijn Wegerif, Armin Weinberger, Gordon Wells, Martin Wessner, Tobin Frye White, Fatos Xhafa, Joyce Yukawa, Nan Zhou.

We apologize if any reviewer names were unintentionally missed. Note that having two executive editors and five associate editors to supervise the double-blind peer-review process allowed us to review the last two papers in this issue from the research lab that Friedrich Hesse directs without involving anyone from the lab in the reviewing or the acceptance decisions.

The high quality of the papers published in *ijCSCL* is largely attributable to the incisive critiques and suggestions from these reviewers and the openness of the authors to adopt most of the suggestions in a collaborative spirit. Almost no articles are published without extensive rewriting in response to the double-blind peer reviews exchanged through our electronic system. In this sense, the production of the journal is itself an effective exercise in computer-supported collaborative learning and community knowledge building.

Welcome to *ijCSCL* volume 3!

We anticipate an exciting year now that *ijCSCL* is well established. If you have a breakthrough paper for the CSCL research community, please submit it. If you have any questions about a potential submission or would like to join our world-class community of reviewers, contact us at info@*ijCSCL*.org. Please make sure that your subscription is up to date by renewing your ISLS membership at www.isls.org. We look forward to seeing you at ICLS in Utrecht.

3(2): The strength of the lone wolf

For the strength of the Pack is the Wolf,
and the strength of the Wolf is the Pack.
(Kipling, 1894)

The collaborative group and its members

In his keynote at CSCL 2007, Gerhard Fischer cited Kipling's verse on the dialectic of group and individual. This is necessarily a primary concern for any theory of CSCL. The current issue of *ijCSCL* addresses this theme in diverse ways. While some established disciplines privilege the individual and others the social, theories of collaborative learning must center on the dialectical relationship between them. Approaches like cultural-historical activity theory (Engeström, 1999), actor-network theory (Latour, 2007) and situated learning (Lave, 1991) sketch their union in general terms. The papers in this issue take a more focused and applied approach, investigating the role of specific CSCL tools in mediating the relationship between individual and group.

If one accepts Vygotsky's (1930/1978) principle that distinctively human cognitive skills are developed in groups (socially, inter-subjectively) first, and only subsequently on that basis internalized into mental (individual, inner-subjective) abilities, then one can pose the fundamental CSCL question: How can technology be used to facilitate this intersubjective-to-individual process of collaborative learning? As we have discovered in past CSCL research, this is a complex problem. One must create and coordinate: (i) a group knowledge-building space, (ii) a set of individuals engaged as a group and (iii) channels of interaction between the social and personal systems. Structuration theory (Giddens, 1984) generalizes the relationship between these levels, stating that each of us as individuals with our identities are products of socialization processes within a society. The society, however, as Marx (1852/1963, p. 15) pointed out, is made by people: "but they do not make it just as they please… but under circumstances directly encountered, given and transmitted from the past." Stated more locally, action and interaction are radically situated in a reflexive way, with the situation created by and essentially including the behaviors for which it provides a context (Garfinkel, 1967). Even the lone wolf draws its strength from origins in the pack.

The interplay between a community wiki and its individual contributors

The paper by *Ulrike Cress & Joachim Kimmerle* presents a conceptual framework for thinking about an evolving Wikipedia article as a communication system in interaction with the people who write and edit it. The individual authors are also conceptualized as systems, although in their cases as cognitive systems. The paper borrows its notion of system from Luhman's influential work and pairs it up with Piaget's seminal view of equilibration to characterize the interactions between systems. Each system—the wiki and the user—forms a system with boundaries distinguishing its identity from the outside. From the viewpoint of each system, information crosses its boundary from the other system and causes changes such as accommodation or assimilation. Whether or not one accepts these descriptions as adequate or considers the cognitive-psychology perspective of the authors compatible with Luhman's systems theory, one must see this paper as an unusually clear attempt to model the interaction between individuals in a group or community and the social artifact that embodies their collaborative knowledge.

Representing the group's opinions to its members

Many people who analyze group processes in CSCL settings come up with the idea of feeding a representation of the processes back to the participants to guide their behavior. However, few of these researchers actually implement a system with such feedback, let alone measure the impact of such a feedback process. As we have seen in the flash theme on argumentation, continued in this issue, many CSCL systems have been concerned with how computer-mediated group discussion influences individual conclusions. *Jürgen Buder & Daniel Bodemer* study this in their paper. They show members of an online small group the opinions of other members on a topic being debated. Their study focuses on the influence of majority opinion and approaches this from a social-psychology perspective and methodology. Since its beginnings in the aftermath of fascism, social psychology has been critical of group cognition. It tends to emphasize negative possibilities of peer pressure, group-think and mob mentality rather than exploring how collaboration can be guided to positive outcomes. In this paper, the authors show how well designed feedback can provide such guidance—e.g., by having participants rate the novelty of postings in order to increase the salience of minority views. This paper and the preceding wiki analysis provide nice examples of the effort by the group at the Knowledge Media Research Center in Tübingen (directed by Friedrich Hesse) to apply the methods and theories of cognitive psychology to studying the behavior of computer-supported collaborative groups.

Annotating individual perspectives within a group document

Joanna Wolfe touches on the flash theme of argumentation in CSCL by exploring how annotations can spark critical thought about a text. Anchored annotations—where reader comments are placed visually adjacent to referenced textual sources—have often been recommended by CSCL researchers. Here the author compares different annotation styles in lab settings. Her findings are reminiscent of Piaget's concept of assimilation, where suggestions contrary to one's opinions stimulate critical reflection. She argues that annotations can be most effective in fostering reconsideration of one's opinions if the annotations are not only anchored but also selectively filtered to display just a couple of postings, representing conflicting perspectives. Of course, in such a quantitative and manipulated study, cognition tends to be taken as sets of fixed opinions of individuals rather than as results of the co-construction of meaning in group interaction. Although the lab studies reported do not reflect a strong sense of collaborative learning, they imply important lessons for individual and group learning in contexts of collaborative knowledge building, for they suggest that changes in individual ideas can be triggered and influenced by conflicting perspectives within a group.

Group practices to arrange individual arguments

Maarten Overdijk brings our flash theme of argumentation to a conclusion with the last paper from the original set of submissions coordinated by Dan Suthers. In this paper, the author problematizes the effect of technologies like scripts and computer-based work spaces for group argumentation. He insists that one sees how group practices emerge when a certain technology in a specific situation is appropriated (enacted) and reproduced (structuration) in group interaction. The paper provides a micro-analysis of how small groups of students visually organize their contributions in a graphical argumentation space. The particular characteristics of this collaboration medium force the students to adopt or invent procedures for placing their contributions next to each other. Different groups establish differing social practices and to various degrees negotiate or adopt group practices. The diverse appropriations of the technology both reflect and support varying degrees of collaboration or inter-animation of contributions from the members of the group. In the data provided in the paper, one can see that some teams develop group arguments through responses to each other while others mainly state individual beliefs, depending on their adoption of specific practices for communicating through the technological medium.

Individuals enact scripting of group processes

Pierre Tchounikine continues our flash theme on scripting, coordinated by Barbara Wasson. A macro-script, as defined in previous papers on this theme in *ijCSCL*, structures phases of the group process without interfering in the discourse that takes place within small groups during each phase. It may, for instance, specify how the groups are formed, what roles are assigned, which technologies and media are to be used, where the task is defined. All of these scripted factors can influence as well as enable the interaction of individuals within the structured group processes. Conversely, the script itself must be locally enacted and interpreted by involved individuals, such as students, teachers, researchers. As one reads this detailed paper, one realizes that there is an unlimited number of considerations entering into the process of operationalizing a macro script—and that these factors must be conceptualized in a flexible way to allow them to be adapted to concrete situations and people. The theme of scripting flashed up within a network of researchers steeped in computer science. Technology is central to their perspective. Although ideas like jigsawing groups of students originated in unmediated classroom practices, the scripting approach is particularly interested in ways to support theories, models, development tools, scripting and scripted interaction with computer software. In this way, the dialectic of lone wolf and pack becomes more complex in our case, transforming it into Vygotsky's triangle of mediation involving technology as well as the personal and the social.

The CSCL book series as part of our group knowledge

Not so long ago, it was difficult for individuals to find and access the CSCL community's research literature. Important contributions were scattered in diverse un-indexed journals, out-of-print edited volumes and unavailable conference proceedings. Thanks to efforts coordinated with ISLS, Springer, the ACM and others, things have improved dramatically. The first major advance was the establishment of a CSCL book series at Kluwer (now Springer), primarily for edited collections around specific themes. Then *ijCSCL* was founded explicitly to provide a home for new research publications on CSCL. CSCL conference papers have recently been made available in the ACM digital library. Of course, the world—driven by technological innovations—has also changed in the meanwhile, with increased copyright freedom for authors to make their publications available on the Web, well indexed by Google Scholar. In addition, overviews of CSCL research are available (Stahl, Koschmann, & Suthers, 2006; Strijbos, Kirschner, & Martens, 2004), with CSCL-related books for sale on Amazon (http://www.amazon.com/Books-collaborative-learning-CSCL/lm/R2OYK7US8LYVPN/ref=cm_lmt_srch_f_2_rsrsrs0).

The leadership of the CSCL book series published by Springer has recently transitioned from *Pierre Dillenbourg*—the founding editor—to *Naomi Miyake* and *Christopher Hoadley*. Coincidently, Pierre, Naomi and Chris are all on the *ijCSCL* Board of Editors and have been active in many ways in the building of the CSCL community, cognitive science, the learning sciences and ISLS. Under Pierre's editorship, the CSCL book series has published the following volumes covering many important themes in the CSCL research field:

1. *Arguing to Learn: Confronting Cognitions in Computer-Supported Collaborative Learning Environments*. Andriessen, Jerry; Baker, Michael; Suthers, Daniel D. (Eds.). 2003.
2. *Designing for Change in Networked Learning Environments: Proceedings of the International Conference on Computer Support for Collaborative Learning 2003*. Wasson, Barbara; Ludvigsen, Sten; Hoppe, Ulrich (Eds.). 2003.
3. *What We Know About CSCL: And Implementing It In Higher Education*. Strijbos, Jan-Willem; Kirschner, Paul A.; Martens, Rob L. (Eds.). 2004.
4. *Advances in Research on Networked Learning*. Goodyear, Peter; Banks, Sheena; Hodgson, Vivian; McConnell, David (Eds.). 2004.
5. *Barriers and Biases in Computer-Mediated Knowledge Communication: And How They May Be Overcome*. Bromme, Rainer; Hesse, Friedrich W.; Spada, Hans (Eds.). 2005.
6. *Scripting Computer-Supported Collaborative Learning: Cognitive, Computational and Educational Perspectives*. Fischer, Frank; Kollar, Ingo; Mandl, Hans; Haake, Jörge M. (Eds.). 2007.
7. *Dialogic Education and Technology: Expanding the Space of Learning*. Wegerif, Rupert. 2007.
8. *The Teacher's Role in Implementing Cooperative Learning in the Classroom*. Gillies, Robyn M.; Ashman, Adrian; Terwel, Jan (Eds.). 2008.
9. *The Role of Technology in CSCL*. Hoppe, Ulrich H.; Ogata, Hiroaki; Soller, Amy (Eds.). 2008.
10. *Interactive Artifacts and Furniture Supporting Collaborative Work and Learning*. Dillenbourg, Pierre; Huang, Jeffrey; Cherubini, Mauro (Eds.). 2009.
11. *Studying Virtual Math Teams*. Stahl, Gerry (Ed.). 2009.

Conferences remain important community events to share among individuals the knowledge being pursued in research labs around the world. Enjoy ICLS 2008!

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3(3): Explorations of participation in discourse

Theories of CSCL have often focused on the discourse of student groups and their possible modes of participation in this discourse as definitive of collaborative learning. Lave & Wenger (1991), for instance, analyzed the increasing participation of novices in the discourses of communities of practice. Scardamalia & Bereiter (1996) proposed the use of networked computers to promote literate participation of students in knowledge-building discourses. Many contemporary theorists define their approaches in terms of dialog, communication and interaction. Most recently, Sfard (2008) has analyzed mathematical thinking of students as growing participation in specific discourses.

Research methods in CSCL tend to focus on the analysis of traces of communication and other indicators of participation in discourse in order to study phenomena of collaboration and to assess effectiveness of computational supports. Researchers often complain that such analysis is time-consuming and tedious, wishing that computers could take over some of this burden. In their contribution to this issue, *Rosé and colleagues* review the current state of the art of computational linguistics and outline prospects for computer support of discourse analysis.

The major limitation of automated processing of natural language—and for that matter of reliable manual coding procedures—is the central role of context in discourse; the determination of the significance of a given utterance depends considerably upon its indexical references to other elements in the discourse context. *Kienle & Herrmann* present a context-oriented theory of communication and explore through design-based research its implications for the design of technology to support collaborative/discursive learning. They discover that understanding the contextual embeddedness of discourse can be problematic even for human participants, who also can benefit from computer support in CSCL settings.

The challenge of supporting participation in CSCL settings is taken up by *Schoonenboom* in her study of scripting and the design of the software interface. Her concern is to help students from different countries establish the common ground that is necessary for providing a shared context of discussion. Continuing the *ijCSCL* flash theme of scripting, she provides detailed steps for students who are working at a distance and do not know each other to begin to participate in a discourse on sustainable development in the European Union. She also provides a carefully structured interface for Blackboard threaded discussion to support the scripted sequencing of the discourse. She then measures the effects of the script and the interface on student participation.

The theme of participation takes center stage in *Ares'* investigation of the use of a computer simulation in a mathematics classroom with minority students. Here, the students already share a sub-culture, and the collaborative use of the simulation in the classroom serves to link their vernacular to a nascent mathematical discourse. The design of the technology, which provides networked collaborative control over the simulation, opens opportunities for the students to bring to bear their shared cultural practices as resources for mathematical learning and common ground for math discourse.

Oner, too, looks at participation in the discourse of mathematics, specifically at the genre known as "proof." She argues that in contemporary math discussion both formal proof and perceptually guided exploration are important. CSCL approaches can support these two aspects through the use of knowledge-building environments with appropriate scaffolding and computational applications like dynamic-geometry simulations. These can support not only the formal and exploratory discourses of mathematics, but also collaborative reflection on the relation of these complementary ways of knowing.

In this issue of *ijCSCL*, we introduce a new feature: a book review. We hope that book reviews will enliven the discourse within the journal by bringing in voices from outside of CSCL and confronting them with the issues of our field, or by taking a critical look at new book-length contributions by CSCL researchers. To inaugurate this feature, we review Sfard's (2008) volume in the Cambridge series on Learning and Doing. Anna Sfard is well known in CSCL circles and is a member of the *ijCSCL* Editorial Board. However, her book is in the domain of mathematical cognition, and focuses neither on computer support nor on small-group collaborative learning (except in the general sense that learning by communicating is fundamentally social, intersubjective, or collaborative). So we explore the implications of her participationist theory for collaborative small groups and computer-mediated discourse. For future issues, *ijCSCL* welcomes submissions of reviews on CSCL topics or books that could bring important new perspectives to CSCL or highlight major advances.

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3(4): CSCL practices

CSCL 2009 Conference

The CSCL 2009 international conference on the theme “CSCL Practices” will be held in Rhodes, Greece, on June 8-13, 2009. Paper submissions are due November 1 and workshop/tutorial proposals are due December 15. For conference information, see http://ISLS.org/CSCL2009.

The conference focuses on issues related to formal and informal learning through collaboration, promoting productive collaborative interactions with the help of the computer and other communication technologies. The conference theme “CSCL Practices” emphasizes practices relating to technology-based collaborative learning in schools, workplaces and daily life.

The CSCL community is not only concerned with studying and designing effective tools to support CSCL practices, but also with identifying specific educational and professional practices that are associated with their appropriate usages. In order to study practices in a reflective way, powerful theories and analytical approaches are required. The aim is to understand how learning emerges: on an individual level, on a group-cognition level, and at the community level.

The CSCL conference and the CSCL journal work together to advance the collective understanding of the community of researchers and practitioners. The journal organizes a symposium at each conference and publishes expanded versions of important conference presentations. We look forward to seeing you on the historic island of Rhodes.

Three years of *ijCSCL*

This issue completes the third publication year of the CSCL journal. Having aimed to produce a truly international venue for ideas and practices from around the world related to collaborative learning with the use of computer support, we are pleased to have published 58 peer-reviewed articles authored by researchers from 20 different countries. Electronic (http://www.springerlink.com/content/120055/) and print copies of the journal are available to all members of ISLS (see http://ISLS.org) and to all attendees of CSCL and ICLS conferences, as well as being available through hundreds of universities and research labs worldwide. Prepublication versions of all articles are freely available at http://ijCSCL.org.

This year we added several new members to the journal's Board of Editors. The Board now has 56 members, including leading researchers from 21 countries. In addition, over 200 other researchers have signed up at https://www.editorialmanager.com/ijCSCL/ to help review submissions. The quality of the journal depends directly upon the efforts of reviewers to judge the value of submitted manuscripts, to provide helpful feedback to the authors, and to guide the authors to improve the presentation of the papers. Our aim is to make valuable contributions to CSCL research readily available in a clear and useful format.

Now that the journal is well established as an important venue for research findings, we are preparing to apply for indexing and abstracting by ISI. This will make articles in the journal easier to find and will support the arguments of authors for tenure and promotion. You can help the application process by citing articles from *ijCSCL* and by downloading them from the SpringerLink site listed above.

Educational policy and communities of practice

One of the most important ways for CSCL practices to be promoted is for government policies to call for transforming educational systems in line with recent findings of the learning sciences, including promotion of collaborative-learning practices supported by networked computational devices. A leader in this growing movement is certainly the Ministry of Education in Singapore, which has made a serious commitment to such educational reform. Their commitment includes the establishment of a world-class research lab that is guiding the school reform effort with systematic research into CSCL practices. *David Hung, Denneth Lim, Victor Chen and Thiam Seng Koh* are centrally involved in this effort. Their lead article in this issue makes a provocative argument on theoretical grounds against incorporating "communities of practice" within educational institutions, and rather encouraging them to exist in a complementary but independent position. While some recent CSCL approaches to learning as a matter of participation in community discourses suggest looking at schools or classrooms as local communities of practice, this paper emphasizes the differences in structure, goals, and social practices between institutions of formal education and the more informal social networks of students or teachers with common interests. It suggests that rather than trying to merge the incompatible organizational structures, one should leverage the work of online communities of learners in ways that can foster adaptive schools, which meet the needs of the new knowledge-based economy.

Computer media and pedagogic goals

Another notable center of CSCL research is the Knowledge-Practices Lab, a large collaboration of universities and industry sponsored by the European Union. They are particularly focused on the CSCL practices that could promote collective knowledge building, as distinguished from more individual-oriented approaches to knowledge acquisition and participation. As we heard in Engeström's (2008) keynote talk at ICLS, one of the on-going theoretical topics at the K-P Lab is what Vygotsky (1930/1978) termed "double stimulation." In their contribution to this volume, *Andreas Lund and Ingvill Rasmussen* extend that foundational concept from the micro-genetic level of Vygotsky's analysis of mediated cognition to the socio-genetic level, which has become increasingly focal in CSCL theory. As part of his critique of behaviorism, Vygotsky showed how higher human responses to a primary stimulus are mediated by a secondary stimulus, such as a symbol or tool. He also analyzed how mediating stimuli can be internalized in the individual's mind. When looking at collective behavior, like that in a school classroom, it is useful to broaden the conception of dual stimulation to include such phenomena as small-group tasks and institutional practices or technological media. This introduces concern with the complex relations that exist among agents, tasks and tools in CSCL settings. The tensions, affordances and constraints involved in the co-design of pedagogical tasks and collaboration media raise the need for social practices of appropriation, negotiation and adaptation by students, teachers and administrators at the levels of individual, small-group and community activities.

CSCL guidance and student self-efficacy

An enduring theme concerning CSCL practices is how to promote student interest and success in science and mathematics, particularly for low-achievers. A number of researchers have proposed adopting video-game technologies, but the verdict seems to be still out on that—perhaps because the surrounding practices have not been sufficiently taken into account. In their experimental study, *Brian Nelson and Diane Ketelhut* explore how students with different self-reported levels of self-efficacy in science succeed in a science curriculum presented in a video-game-like environment. Students collaborated online in groups of three, and could access guidance messages individually. As expected, access to the guidance hints helped to improve everyone's posttest scores. However, students with low self-efficacy—especially boys—viewed fewer guidance messages. So it is still necessary to change the self-defeating attitudes and behaviors of students with low self-efficacy feelings if their performance in these science environments is to have the beneficial results for which they are designed.

Informal gaming and formal learning

The next paper, by *Fengfeng Ke*, turns to the use of video-game environments for math education. Here, too, the central issue raised involves the design of classroom practices to support this approach to learning. The Astra Eagle games used emphasized drill and practice of fifth-grade math skills. Classroom procedures followed the Teams-Games-Tournament approach to collaborative learning, involving collaboration in teams followed by competition on the computer games by individuals in cross-team tournaments. Experimental results support the paper's claim that combining computer games with cooperative learning can improve math education and math attitudes. However, they also suggest that game-based outcomes are different for students who are economically disadvantaged.

Automated coding for research practice

Finally, to support the practices of CSCL researchers themselves, *Gijsbert Erkens and Jeroen Janssen* describe a system to help assign codes to utterances in chat logs. This paper continues the discussion by Rosé et al. (2008) in the previous issue of *ijCSCL*, although the new paper is based on a simpler linguistic theory and is, therefore, more limited in its application. It looks for keyword or key-phrase "markers" in single utterances in order to assign one of about 30 codes from a particular coding scheme that distinguishes argumentative, responsive, informative, elicitative and imperative utterances. The authors have developed a rule-production system of 300 rules for segmentation and 1,250 rules for selecting codes. The system is for chats in the Dutch language, and has been used in several CSCL projects in the Netherlands. The paper argues for the system's reliability and validity through three studies, while noting that the rules need to be constantly updated to cover new data and that the system's scope is restricted to research questions that involve the given codes for utterances of individuals. Issues of collaboration and group cognition that involve interaction cannot be well addressed, nor can issues of quality and depth of argumentation or reflection that involve the content of utterances.

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4(1): Yes we can!

CSCL in a more global context

As we begin to publish volume 4 of *ijCSCL*, the world has changed and the opportunities for CSCL have been transformed along with it. I am writing this introduction to our new journal volume in early November, immediately after the election of Barack Obama in the US and during a period of unprecedented economic volatility around the globe.

The recent events dramatically accentuate the rapid globalization of all aspects of life. In the US, we change from a parochial culture oriented toward America's rural past to a government led by someone with personal roots in Africa and Asia and with a respect for ideas and collaboration. The economic crisis forces nations around the world to work together in order to pursue their own self-interest in a complexly intertwined and interdependent globe.

The U.S. election—viewed by many as an election of international import—illustrates the importance of an educated population for democracy. Obama's support came from the most educated regions of the country. His campaign emphasized argumentation and reason over emotion and faith. To follow the election process, one had to comprehend polling, statistics, sampling and economics. It also helped to be conversant with e-mail, blogging and new computer interface displays. Just as John Dewey emphasized almost a century ago and as people in developing nations have seen repeatedly, education and democracy need to go forward together.

Despite the crushing pressure to address the economy, Obama still maintains his commitment to improving education in America. He wants to support schools, teachers and instructional technology in order to raise student test scores. This is where CSCL can provide new vision, tools and approaches. Research in the learning sciences confirms the importance of schools, teachers, technology and test scores, but demonstrates the need to go beyond these basic infrastructural elements. Students need to be engaged in constructing knowledge—for themselves and with their peers. They need to become involved in the cultures of knowledge building in various subject domains and to become conversant in the related media for expressing their own understandings.

CSCL offers innovative and powerful ways to take advantage of computer technology to provide new forms of learning. Too often, technology is viewed as a way of automating education and reducing costs, without changing the traditional view of education as the transfer of facts from an authoritative source to a relatively passive student's memory. CSCL proposes new media to support new experiences for students, in which they can interact with other students in structured environments with well-conceived tasks to learn through exploration and discussion.

Although most CSCL systems are still experimental prototypes, once fully developed with all the supports needed for deployment, they could provide effective learning environments to broad audiences of students. In doing so, they would even make it possible for students to collaborate across national borders, preparing them for an ever more global world.

Mature CSCL environments could be disseminated throughout the world, providing access for students inside and outside of schools to rich digital resources in productive interactional settings. The catch is that students, teachers, parents, schools, and politicians all have to transform how they think about education so that they can appreciate and support the profound kinds of learning that can take place in CSCL experiences.

Some countries have begun to commit to constructivist and collaborative learning as appropriate to our global knowledge-building economy. It is up to CSCL researchers to continue to provide persuasive evidence for transforming our educational institutions in this direction. The attempt to promote progressive education has been frustratingly slow since Dewey first called for it. We still need curriculum, technologies, theories, models, documented successes and reproducible interventions.

The US has fallen behind recently, with its policy of "no child left untested." At this juncture of history, it seems both hopeful and urgent to move in more collaborative directions. Can CSCL researchers make a difference and help education catch up to its historical mission internationally? Yes, we can!

A framework for distinguishing learning approaches

As we prepare for CSCL 2009 in Rhodes, we publish a keynote from CSCL 2007 in New Brunswick. In her paper based on her keynote address, *Diana Laurillard* provides a theoretical framework for distinguishing instructionist, social, constructionist and collaborative learning—whether computer-supported or not. Such a framework can guide the design of technologies driven by the pedagogical requirements of collaborative learning. As the paper points out, educational technologies are often commercially available systems that were designed for the business and leisure markets, not in response to the specific needs of learning. They are generic communication media, perhaps bundled with record-keeping facilities to aid school administration. In contrast, the presented framework stresses the communicative needs of collaborative learners to access explanations, pose questions, offer conceptual understandings, set learning goals, repeat practice, reflect, discuss, debate, articulate and document their ideas. By spelling out pedagogical needs, such a framework provides a welcome basis for evaluating and comparing CSCL systems in terms of the important issues. It may be a useful tool for arguing that popular systems like smart-boards or Blackboard, as usually applied in classrooms, do not support specific desirable aspects of robust collaborative learning. It may suggest new techniques—not only technological functionality but also classroom practices.

The paradox of productive failure

If you look at the sequence of models of instructionist, social, constructionist and collaborative learning it is striking how they become increasingly complicated. Common-sense conceptions of instructionist learning paint a simple picture: Students are given facts, and they store them for display on request; students either know the facts and can recall them in tests, or they have not learned them. Collaborative learning is much messier than that: There are group processes, which are driven by contributions from group members and which may affect future performances by the individuals. In their paper, *Manu Kapur & Charles Kinzer* explore an interesting twist in the interplay of group and individual problem-solving performance. They confirm their earlier finding that Indian high school students who were in groups that failed to solve ill-structured physics problems later outperformed students who had been in groups that succeeded in solving well-structured problems. Failure in collaborative group knowledge building had a paradoxically positive learning effect in the longer run. From a Vygotskian perspective, this is not so surprising. Challenging ill-structured problems carefully selected in the zone of proximal development of the students provided an opportunity for the groups to develop problem-solving skills that the individual group members could subsequently internalize, individualize, or make their own during posttests. The fact that these were purely peer groups—unlike in Vygotsky's examples—accounts for the fact that they did not fully succeed in the purposefully out-of-reach goal, but they nevertheless forged significant steps in working on the problem. The paper's authors engaged in extensive data analysis to confirm the experimental result of productive failure. However, as they point out, they did not conduct the kind of interaction analysis that might support their speculation about the microgenetic processes that mediated between the "failed" group knowledge-building practices and the subsequent superior individual learning.

"Do u wanna go 2 the moon?"

The process of learning is no more confined to individuals and small groups than politics is confined by national boundaries. The study of CSCL has to include research into how knowledge is diffused through communities of practice. The paper by *Deborah Fields & Yasmin Kafai* reports on a connective ethnography of how pre-teenage newcomers to a virtual community learn about a desirable virtual meeting place called "the moon" and then find out how to get there. To document how community members are socialized into community practices like meeting on the moon, the researchers had to "connect" data from diverse ethnographic sources: server log data, video recordings, field notes and interviews. One implication of the study is that learning is an important part of participation in virtual communities; another is that such learning ranges across many settings, requiring data analysis at multiple units of analysis. Accordingly, the paper contributes to the argument that popular virtual environments for gaming and socializing are relevant sites for CSCL research. To support such research, the paper extends and demonstrates the use of connective ethnography in an online setting.

Scripting, modeling and elaborating

In this final contribution to the original set of papers on the *ijCSCL* flash theme of scripting, *Nikol Rummel, Hans Spada & Sabine Hauser* compare scripting to other approaches for training students in effective collaboration skills. Working with dyads each consisting of a medical student and a psychology student, they teach the dyads how to share their complementary expertise in various ways and then they test to see which way produced the best collaboration practices. In the scripting condition, dyads are given a series of precise instructions to follow and the dyads step through this. Alternatively, dyads in the modeling condition are presented with a video-recorded model dialog of a medical student and a psychology student effectively coordinating their work, managing their time, and using their complementary knowledge for problem solving. Additional conditions were created where dyads using scripting or modeling were systematically prompted to engage in collaborative self-explanation. Along with a control condition without scripting, modeling or elaborating, this created five conditions to compare. The results raised doubts about scripting, and the paper discusses why this might be. One important consideration is that this experiment looked at the results after the scripted learning process, when the script supports were withdrawn; at that point it seemed that students had more lasting learning outcomes about how to collaborate by watching the video model—especially with prompted reflecting on it—than by being marched through a scripted process. Once more, we see that collaborative learning is a complicated interplay between individual and group learning processes, which may not follow common-sense assumptions and folk theories.

The agency of the CSCL system

In an insightful case study, *Annika Lantz-Andersson* shows how students working in a CSCL environment may attribute their problems to the technology rather than to their own work. The example nicely demonstrates the complexity of assigning agency when interacting with an educational software system. People have an understanding of the way that computers respond, requiring inputs in specific rigid formats. So if a computer rejects a student response, it may be because the answer is not in the precise format required. On the other hand, the computer programming is quite opaque, so that a user cannot tell what requirements have been set up. Furthermore, teachers design problems differently when computers will be mediating the problem solving. Consequently, the students' task of framing the problem context is quite complex. In a face-to-face situation with a teacher, a student simply has to guess what answer the teacher has in mind. If the student gives a partially correct response, the teacher is likely to indicate how the answer needs to be revised. In a computer-supported situation, the student not only has to guess at the teacher's expectation, but also has to take into account that the teacher's expectation is modified by the computer-supported context and that the computer response to a partially correct answer is likely to be inscrutable. In this case study, students collaborated—which allowed the researchers to observe their quandaries—but the software was not collaboration-support software. In a true CSCL context, the software would support the communication and collaboration, but would leave the assessment of the correctness of answers to people, avoiding the rigidity of simplistic testing, drilling or tutoring software.

4(2): Practice perspectives in CSCL

Conference on practices in CSCL

The theme of this year's CSCL conference is "CSCL Practices." It is concerned with practices relating to technology-based collaborative learning. According to the conference call, the CSCL community is not only concerned with studying and designing effective tools to support CSCL practices, but also with identifying specific educational and professional practices that are associated with their appropriate usages. In order to study practices in a reflective way, powerful theories and analytical approaches are required. The aim of CSCL research is to understand how learning emerges: on an individual level, on a group-cognition level, and at the community level. The articles in this issue of *ijCSCL* address this goal in specific ways.

The concept of *practice* is a complicated one. It comes from the Greek *praxis*—which may be why we are going to Rhodes this year, to connect to our philosophic roots—in contrast to *theoria*. Modern practice perspectives since Marx (1845/1967) argue for a unity of theory and practice. In common parlance, *practice* just refers to the things we do. Methodologically, *practice* indicates that we should be paying attention in our research to the ways in which people actually interact with one another, predominantly in dyads and small groups. According to Schatzki, Knorr Cetina, and Savigny (2001), for some researchers there has been a "practice turn" in contemporary theory, in which analytic focus has shifted from explicit knowledge and social structures to "practices as embodied, materially mediated arrays of human activity centrally organized around shared practical understanding" (p. 2).

The nascent CSCL field was influenced by Lave & Wenger's (1991) analysis of collaborative learning as social practices within communities of practice. A related inspiration, Scardamalia and Bereiter's (1996) proposal of CSCL technologies like their CSILE system, suggested introducing some of the practices of scientific research communities into classrooms as fledgling knowledge-building communities. As we shall see in this issue's articles, the practice perspective can be applied at the individual and group levels of description as well as at the community one. We shall also see investigations of how practices are embodied, mediated and shared within CSCL settings.

The proposal to adopt practice perspectives in CSCL is a substantive one. It contrasts starkly with the view of collaborative learning in terms of observing regularities based on pre-defined and controlled variables of interaction. While a regularity view of causation offers causal *descriptions* involving sets of manipulated variables, it is less suited to address finer *explanations* of how observed patterns of interaction unfold over time (Shadish, Cook, and Campbell 2002). Providing such explanations is the field where the study of practice comes into play. Practices are not commonly described in terms of regularity among controlled variables, nor are they usually measured with computations of statistical variance. This does not mean that studies from practice perspectives cannot include quantitative measurements, hypotheses for investigation, specific research questions, rigorous analyses and scientific results. Rather, the criteria for the most appropriate methods of research, analysis and reporting may be quite different from those for research efforts predicated upon statistical regularities among identifiable variables. For instance, contrast the studies in this issue with Kapur and Kinzer (2009) and Rummel, Spada, and Hauser (2009) in the previous issue.

Of course, *ijCSCL* is committed to publishing major contributions to CSCL from all scholarly perspectives. We plan to publish discussions of these methodological differences, their rationale and the possibilities for integration in future issues of the journal. At the CSCL 2009 conference, *ijCSCL* will sponsor a symposium on theory and practice approaches. In this issue, we present a set of papers analyzing the role of practices in CSCL.

Studying the group practices that support collaboration in CSCL

The first article in this issue, by *Murat Cakir, Alan Zemel, and Gerry Stahl*, investigates group practices: How does a small group of students organize its interaction within a particular CSCL online environment so that it can accomplish its knowledge-building and problem-solving goals? The paper identifies several characteristics of the group practices in a detailed case study and relates these to the design of the mediating software. The CSCL technology used was a dual-interaction environment combining text chat and a shared whiteboard. The multimodal nature of activity made salient for the students and for the researchers the need for coordination of meaning making. By focusing on coordination practices, the analysis reveals interactional methods that the student group used to organize its joint activity. Thereby, the researchers were able to make visible mechanisms of grounding, shedding theoretical light on issues of common ground and intersubjectivity that are fundamental to an understanding of collaborative learning from a practices perspective.

This work is part of the larger Virtual Math Teams (VMT) Project (Stahl, 2009). The analysis of group practices by the students using the VMT software provided the primary evaluation component of the project's design-based research process. The affordances (see below) of the technology were determined in terms of the ways in which the user groups enacted the designed features and adapted their interaction practices to the technical environment. The research project included development of pedagogy and problem design as much as of technology, and the analysis of student group practices provided feedback on the whole intervention.

Associate Editor Dan Suthers coordinated the review of this submission to maintain the journal's double-blind peer-review process.

Affordances of technology are enacted by user practices

Affordances are the features of an artifact or a communication medium that determine what one can do with them. For instance, an important affordance analyzed in the VMT environment was persistence. Unlike most audio and video media, the text- and graphics-based VMT components retained inscriptions for later viewing and reference. This was consequential for the ability of students to explain their postings and activities to each other, and thereby to establish a basis of collaborative activity. The chat, whiteboard and wiki components each had subtly different forms of persistence, as the analysis pointed out by describing how the group took advantage of these affordances.

The second article, by *Nina Bonderup Dohn*, reconsiders the nature of affordances, a contested term in CSCL and within the broader human-computer interaction (HCI) literature. She builds on early *ijCSCL* papers by Dwyer and Suthers (2006), Jones, Dirckinck-Holmfeld & Lindström (2006), and Suthers (2006), which emphasized the importance from a practice perspective of analyzing the affordances of CSCL technologies for group meaning making. She proposes that affordances not be considered objective properties of artifacts independent of the people who use them. Rather, affordances are relative to the "interaction potential" of the people who see and make use of the artifacts. The term "interaction potential" is not restricted to a person's current "knowledge in the head or in the world" (Norman, 1990). Rather, it is related to the analysis of "body schema" developed by the premier French phenomenologist, Merleau-Ponty (1945/2002).

The potential that someone—or some group or some community—has to interact with a given artifact is a function of their lifelong engaged being-in-the-world (Heidegger, 1927/1996). Here we note that these matters, which have traditionally been discussed in terms of individuals, apply as well to small groups or communities of practice. Interestingly, this article applies Merleau-Ponty's analysis of embodiment to the virtual world, in which actors are largely disembodied. For instance, students in a CSCL environment do not see each other as embodied presences and they do not touch or physically manipulate the objects that they share on their screens of pixels. Here the term "interaction potential" takes on a different sense. It is not a matter of Merleau-Ponty's embeddedness in the physical world, but of interaction in a new sense, whose affordances must now be analyzed. Space, time and causation in the virtual world are designed affordances, different from those in the physical world of bodily being.

Genres of practice adapt to new technologies

When people, groups, and communities move from the familiar physical and cultural world to brave new virtual realms, they carry with them their body schemas and other baggage that have defined their physical existence. The fit is not usually perfect, and a little dance takes place between their practices and the affordances of their new surrounds. In his article, *Norm Friesen* draws out some of the steps in this dance as it took place with the diffusion of email and threaded-discussion forums.

CSCL practitioners—teachers of online courses—have often looked to online media such as threaded discussion boards to support progressive knowledge building or critical inquiry. For instance, the widely used Blackboard learning management system for distance education features threaded discussion. When CSCL researchers analyze the results of student discourse in these media, they are often disappointed, as the early studies of Hakkarainen (see below) illustrate. Students tend to engage in informal socializing, sharing of unsubstantiated personal opinions, joking and posting statements of little intellectual depth. Why do students make such use of technology that was designed by researchers to support collaborative knowledge building and intended by teachers to promote critical inquiry practices? According to this article, it is because the students enact the affordances of the new technology in accordance with the communication genres of the past.

If one looks carefully at the genre of the student communication in threaded discussion forums, one sees the characteristics of the epistle or personal letter, rather than that of scholarly argumentation. While email is formatted along the lines of a business memo, brief postings in threaded discussion or SMS chat tend to adopt the genre of informal social conversation and personal letters. This is what students are used to, based on our cultural heritage. To change the practices of computer-mediated interaction to a form more akin to genres of logical deduction and scientific conjectures or refutations, requires training the students in new practices, not merely providing digital media. The affordances of the technologies are to be found not in the plans of the programmers or instructors, but in the practices of the users.

Exploring the metaskills needed for new practices

A discussion of current practice perspectives within CSCL would not be complete without contributions from the K-P Labs Project, a large European Union effort led by Scandinavian researchers. In this issue, we include a pair of papers from the lab in Helsinki, which recently merged the labs directed by Hakkarainen and Engeström. In a recent issue of *ijCSCL*, we published another article from the discussions in the K-P Labs Project by Lund & Rasmussen (2008), which emphasized the theoretical notion of object orientation. Here we have a paper by *Hanni Muukkonen and Minna Lakkala* that takes another approach to object orientation in knowledge-creation practices.

In thinking about collaborative learning theories, I often distinguish analysis at the individual, small-group and community levels of description (e.g., Stahl 2009, chap. 28). The "trialogical" framework of the K-P Labs Project instead distinguishes the individual, collaborative and object-oriented aspects. This shifts the focus for the third aspect from the agents—in any configuration—to the knowledge object. This emphasis is familiar from activity theory, where the activity system in a workplace is strongly oriented toward the goals to be achieved and artifacts to be produced. In a classroom setting, it calls for a focus of students, project groups and classes on the systematic improvement of ideas and other knowledge objects. Accordingly, collaborative learning pedagogies provide for student groups to engage in critical inquiry around open-ended questions so they will develop the skills needed to develop (locally) new knowledge about ill-structured problems.

Using a well developed coding scheme for analyzing knowledge-creation practices (or the lack thereof), this article explores the kinds of problems that students have when faced with enacting their own knowledge-creation practices. Just as seen in the previous article, students tend to stick with their accustomed genres of practice, sharing opinions more than building on shared knowledge objects. Becoming knowledge-creating learners requires the development of specific metaskills, as detailed in the article.

Theory of the knowledge-practice perspective

According to the conventional notion of theory, a statement of the theory of practice perspectives would be expected to introduce this issue. However, from a practice perspective, practices have the priority and theory comes later, as a reflection on the experiences—after the owl of Minerva has already flown, in Hegel's (1807/1967) classical metaphor. In the final article of this issue, *Kai Hakkarainen* reflects on issues of his research, dating back more than a decade to the start of his dissertation.

He wants to understand why it is so hard to promote knowledge-creation processes in classrooms, even using CSCL technologies. It is not enough, he argues, to facilitate sharing and building on ideas. A classroom has to develop a culture of knowledge-creation practices. As analyzed in the first article in this issue, the technology has to be iteratively developed in response to enacted student practices to take advantage of the subtle ways in which knowledge creation is supported by the materiality of externalizing ideas—for example, through forms of persistence, visibility, and integration. This is a matter of how the affordances of the technology in the sense of the second article are related to the interaction potential of the students, which is itself a moving target. The genres of social practices in the classroom—to use the terminology of the third article—must also gradually evolve. The possibilities of new practical genres rely upon the development of appropriate metaskills for engaging in knowledge-creation processes. All these factors must move in a coordinated and coherent unity of design-based research driving change in group practices, technology affordances, interaction genres, community metaskills and trialogical learning.

This defines a tall order for students, teachers and researchers to attain the potential of CSCL practices. The CSCL 2009 conference should provide an opportunity for us to take a step or two forward in this direction.

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4(3): Classical dialogs in CSCL

Ode on a Grecian conference

Upon the shore of the Aegean Sea, amidst the splendor of ancient Rhodes, the CSCL community convened in June to mix futuristic stabs at truth with classic vistas of natural beauty. Preceded by the first daylong retreat of ISLS, two-and-a-half days of pre-conference events brought together groups of researchers in 16 workshops, tutorials and seminars, including a doctoral consortium and an early-career workshop. The "Intro to CSCL" tutorial engaged over 30 newcomers to CSCL in a collaborative learning dialog with 18 members of the *ijCSCL* Editorial Board.

The three full days of the main conference included the whole variety of events typical of CSCL conferences: long and short papers, demos, interactive posters, panels, symposia and invited keynote talks. The conference concluded with a panel on the beginnings of CSCL 20 years ago in nearby Italy—highlighting both the growth of the field and the continuity of concerns. With perfect weather, an ocean beach, swimming pools and an open bar, the conference was pervaded by a particularly friendly and informal atmosphere. Scaffolded by good Greek food and drink, meals were always stimulating encounters, whether at the social events in the old towns of Rhodes and Lindos or in the hotel restaurants. Ideas about collaboration, learning and research flowed like wine from an ancient urn.

The interdisciplinary CSCL community has always valued a diversity of theories, methods, goals, disciplines and approaches. Whether because of the historical perspective of Greece, the intensity of the Mediterranean sun, or the growing maturity of the field, people were able to make pointed statements in favor of preferred perspectives—without denigrating the value of alternative opinions. The tension of diverse perspectives seemed to animate the community more than ever, stimulating new insights.

If you missed this conference, make plans for ICLS 2010 in Chicago (June 28-July 2; paper deadline October 30) and CSCL 2011 in Hong Kong.

Four years of *ijCSCL*

The *ijCSCL* Board met during the conference to review the journal's progress. To date, the journal has published 75 articles by 167 authors from 21 countries. Through subscriptions to ISLS members and distribution by Springer, *ijCSCL* is now available to more than 7,500 universities, research libraries, corporate and government institutions—i.e., about 15 million users worldwide. Electronic copies of all articles can be downloaded from http://www.springer.com/journal/11412 and free pre-print versions from http://*ijCSCL*.org/?go=contents. The number of downloads from each of these sites has more than doubled each year that *ijCSCL* has existed—now more than a thousand copies of articles are downloaded each month from each site.

The continued high quality of the articles published in *ijCSCL* is due to the selectivity and the feedback to authors from reviewers. The following people have contributed more than 500 reviews:

> Shaaron Ainsworth, Rick Alterman, Jerry Andriessen, Hans Christian Arnseth, Gerardo Ayala, Michael Baker, Maria Bannert, Liam Bannon, Sasha A. Barab, Brigid Barron, Phillip Bell, Daniel Bodemer, Jacqueline Bourdeau, Paul Brna, Bertram Bruce, Amy Bruckman, Juergen Buder, Murat Perit Cakir, John M. Carroll, Annamaria Carusi, Seth Chaiklin, Carol K.K. Chan, Tak-Wai Chan, Elizabeth Sandra Charles, Cesar Alberto Collazos, Ulrike Cress, Charles Crook, Lucilla Crosta, Harry Daniels, Ton de Jong, Sharon Derry, Pierre Dillenbourg, Angelique Dimitrakopoulou, Lone Dirckinck-Holmfeld, Paul Dourish, Alison Druin, Nathan Dwyer, Noel Enyedy, Michael A Evans, Martha D. Fewell, Frank Fischer, Brian Foley, Lachlan Forsyth, Andrea Forte, Hugo Fuks, Bill Gaver, Sean Goggins, Ricki Goldman, Jonathan Grudin, Frode Guribye, Joerg M. Haake, Kai Hakkarainen, Paivi Hakkinen, Rogers Hall, Andreas Harrer, Wu He, Thomas Herrmann, Friedrich W. Hesse, Cindy E. Hmelo-Silver, Christopher Hoadley, Ulrich Hoppe, Christine Joyce Howe, James M. Hudson, Sanna Jurvela, Patrick Jermann, Richard Joiner, Christopher Jones, Regina Jucks, Yasmin Kafai, Yael Kali, Victor Kaptelinin, Manu Kapur, Fengfeng Ke, Andrea Kienle, Joachim Kimmerle, Paul A. Kirschner, Lars Kobbe, Matthew J. Koehler, Timothy Koschmann, Ingeborg Krange, Kari Kuutti, Therese Laferrivre, Minna Helena Lakkala, Victor Lally, Mary Lamon, Johann Ari Larusson, Nancy Law, Erno Lehtinen, Lasse Lipponen, Jacques Lonchamp, Chee-Kit Looi, Rose Luckin, Sten R. Ludvigsen, Andreas Lund, Kristine Lund, Johan Lundin, Richard Medina, Naomi Miyake, Anders Morch, Joan K Moss, Daisy Mwanza-Simwami, Bonnie Nardi, Brian C. Nelson, Bernhard Nett, Matthias Nuckles, Angela O'Donnell, Hiroaki Ogata, Claire O'Malley, Jun Oshima, Roy Pea, Ruediger Pfister, Janet Read, Thomas C. Reeves, Peter Reimann, Ann Renninger, Jochen Rick, Tim Sean Roberts, Markus Rohde, Jeremy

Roschelle, Carolyn P. Rose, Liam Rourke, Nikol Rummel, Nadira Saab, Roger Saljo, Johann W Sarmiento, Marelene Scardamalia, Lynette Schaverien, Tammy Schellens, Gregg Schraw, Baruch Schwarz, Anna Sfard, David Williamson Shaffer, Wesley Shumar, Amy Soller, Nancy Songer, Hans Spada, Marc Stadtler, Gerry Stahl, Danae Stanton Fraser, Constance Steinkuehler, Jan-Willem Strijbos, Masanori Sugimoto, Daniel Suthers, Berthel Sutter, Gustav Taxon, Josie Taylor, Ramon Prudencio Toledo, Jan van Aalst, Ravi Kiran Vatrapu, Marjaana Veermans, Barbara Wasson, Jim Waters, Rupert Boudewijn Wegerif, Armin Weinberger, Gordon Wells, James Wertsch, Martin Wessner, Tobin Frye White, Volker Wulf, Fatos Xhafa, Ling Ling Yen, Joyce Yukawa, Nan Zhou.

Time is precious

The panoply of modern science has arisen in the two millennia since the golden age of Greece; the CSCL research community has evolved in the past two decades; school learning takes place in semesters and years; while a discussion can turn in a fraction of a minute. During these various periods, the nature of the variables of interest—like competence, development, interaction—may themselves vary. *Peter Reimann* proposes an event-centered approach as an alternative to conventional variable-centered methodologies for analyzing the processes that unfold over extended periods of time in CSCL settings. He argues that tracking events can be more responsive to changing circumstances than plotting values of presumably fixed variables. Furthermore, event-centered analysis can account for a richer range of causality and a broader spectrum of reporting, including narratives.

His paper reflects on the nature of multiple analytic methods in CSCL at a fundamental conceptual level, citing diverse efforts representative of current approaches. Although it mentions conversation analysis, uptake diagrams and thick descriptions, it does not clearly distinguish these as taking the participants' perspective on semantics, temporality or interaction generally. The mundane ways in which a question can elicit an answer within a unique CSCL situation, for instance, may not be reducible to a probability measure between events, but may require an understanding of the human semantics and interactional pragmatics in order to capture the essential processes of collaborative learning. Nevertheless, the article provides a rich and important contribution to the "timely" issue of multiple analytic approaches within CSCL.

Knowledge-creation discourses

Jan van Aalst extends the considerable discourse within CSCL related to Knowledge Forum as a technological support for knowledge building or knowledge creation. He first clarifies the often-confused terminology of alternative theories of learning, and then operationalizes his distinctions within a coding scheme, applied to the work of four groups in a classroom. He clearly distinguishes "knowledge creation"—as the community improvement of ideas—from a naïve-realist transmission model of "knowledge sharing" and a cognitive-psychology constructionist model of "knowledge construction." His coding scheme is able to distinguish the differential ability of the student groups to engage in knowledge creation through their work in Knowledge Forum. A look at the decisive codes is suggestive of pedagogical issues to consider in promoting knowledge creation.

Despite its extensive clarification, this article—like so much of the related literature—speaks ambiguously about the "sense of community," which it highlights as key to knowledge construction. Both the acquisition and the construction models focus on the individual student as the unit of description; knowledge construction differs decisively on this point. With its orientation to the progressive public refinement of ideas, theories and other knowledge artifacts, knowledge creation is a social activity. But the paper's case-study analysis is exclusively at the small-group level. Between-group differences are discussed in terms of social practices, sense of community and innovation ecology although all the groups were in the same classroom, school and world. In distinguishing knowledge creation from theories of individual learning, the paper fails to distinguish small-group from community processes. In fact, it shows how the theory of knowledge creation—derived from the practices of large scientific communities—can be applied to collaborative learning in small groups of students.

Collaborative learning in dual-interaction spaces

The contrast of fundamentally different approaches to analyzing interactions in CSCL settings pervaded the CSCL 2009 conference, from the workshop on multivocality the first day to the closing panel on 20 years of CSCL. In this issue, both Reimann's and von Aalst's articles explicitly contrast approaches based on incommensurable theories. *Jacques Lonchamp* takes the opposite tack, proposing a systematic integration of three analytic approaches. He describes three levels of analysis—dialog, knowledge and action—which he claims fit together like semantics, syntax and pragmatics to provide an integrated view of communication. Adding to the complexity, he considers dual-interaction environments built using his generic and customizable Omega+ model (Lonchamp, 2006). One can usefully compare his analysis of a case study of students constructing UML use-case diagrams with the detailed analysis by Cakir, et al. (2009) of students drawing and chatting about geometric patterns in another synchronous dual-interaction system. Such a comparison illustrates the difference between a designer perspective and a practice perspective.

Studying digital resources

In a complicated software tool like Microsoft Word, spell checking seems like a simple, well-defined and fully understood function. *Asta Cekaite*'s detailed analysis of several students using a spell checker shows, however, how this function can be enacted in surprisingly rich and creative ways in the situated practices of real users. As recently discussed by Dohn (2009), the "affordances" of an artifact are not fully predefined by the technology. Here we see that a spell checker can be used to support student writing through a variety of methods closely tied to the activity or interaction of the students. While both the spell-checking technology and the discourse of the students may seem trivial, the implication of this paper is that this kind of detailed case study can reveal the concrete affordances of designed technologies that go far beyond the intentions, affordances and assumptions of the designers.

The tensions of educational Web 2.0

In the new article by *Nina Bonderup Dohn*, we return to the theoretical tension between knowledge sharing (as an acquisitionist or transmission model of learning) and knowledge construction (as a participationist or social model). Building on her recently published analysis of affordances (Dohn, 2009), the author clearly lays out the challenges posed by trying to adopt Web 2.0 technologies (wikis, blogs, Wikipedia, Facebook, Flickr, YouTube, Second Life, etc.) for educational purposes in university courses. The affordances of these technologies depend on our established practices as consolidated in our body schemas (Merleau-Ponty) or habitus (Bourdieu). The conventional focus on educational outcomes of individual learners, systems of grading, traditions of instruction, and expectations of student development all militate against the Web 2.0 goal of collective wisdom and social networking. Once again, in the challenges of using recent forms of computer support we see the fundamental tension in collaborative learning: how to align and integrate learning at the individual, small-group and community levels.

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4(4): Paradigms of shared knowledge

Multiple paradigms for analyzing shared knowledge in collaboration

Collaborative learning is all about sharing knowledge. Without a shared base of knowledge (common ground), discourse itself is impossible, let alone collaborative interaction. Collaborators must share a means of communication (language), a joint focus (object-orientation) and a compatible orientation (perspective). In addition to being dependent upon the presence of existing shared knowledge, successful collaboration or collaborative learning involves the construction of new knowledge, created jointly and thereby shared by the participants. Knowledge can take many forms, not necessarily rational, propositional, explicit, factual knowledge. There is tacit and explicit knowledge, focal and background, propositional and procedural, personal and institutional, individual and group.

Studies of CSCL each tend to focus on a certain form of knowledge and assume a certain way of sharing this knowledge. These choices depend upon the theoretical position implicitly or explicitly adopted by the study. You may find it interesting to figure out which paradigm of shared knowledge corresponds to each of the articles in this issue.

The topic of paradigms of shared knowledge may seem abstrusely theoretical and remote from the practical concerns of CSCL. However, it strongly effects whether a given educational intervention—incorporating pedagogical resources, computer technologies, scripting, grouping of students, etc.—will foster effective collaborative learning. In fact, it may affect this even more when the teachers, researchers, or other CSCL designers are not explicitly aware of their assumptions about shared knowledge.

The four articles of this issue, which deal with computer support for shared knowledge, are all focused on the practical design of technologies to support collaborative learning: wikis, virtual reality, PowerPoint, and group formation software. They each presume a different paradigm of shared knowledge. The following paragraphs define four paradigms spanning a range:

The paradigm of sharing individual mental representations. Perhaps the most commonsensical view of shared knowledge in a small group is that the individual members of the group each possess the same knowledge. This can be elaborated theoretically by hypothesizing that each member has mental representations that are sufficiently similar to specific mental representations of each of the other members. The classic analysis of grounding (Clark & Brennan, 1991) that is often cited in CSCL research describes how two typical collaborators might establish shared knowledge by externalizing their ideas and explicitly comparing the propositional expressions of their mental representations. This paradigm assumes that individuals possess well-formed opinions and can unproblematically express them. Sharing is here taken to be a matter of transferring and comparing ideas in ways that typically do not change the ideas.

The paradigm of sharing an object. A quite different view conceives of shared knowledge as a natural consequence of a group being collaboratively involved with the object of their work together. They are all oriented in common toward the same object (an artifact, a problem, a goal) and thereby come to share knowledge of that object, in particular the knowledge about that object that arises from their work with it. The sharing of knowledge about a common object does not need special coordination, once the object is truly shared. A recent *ijCSCL* article (Çakır, Zemel & Stahl, 2009) described an example of how students in an online group worked to define and share multiple realizations of a mathematical object; once they could all "see" the same object, the construction of new shared knowledge (such as the formulation of an algebraic expression to solve their problem) proceeded quickly. Another recent article (Dohn, 2009) discussed how the affordances of an object must be enacted; in the collaborative case, this is accomplished interactively as the group comes to know and share the object. In both analyses, the shared knowledge is new knowledge for all the participants, arising out of their interactions with each other, with the shared object, and with other resources for communication and understanding, including available computer supports.

The paradigm of sharing a situation. If we broaden the notion that shared knowledge comes from a joint focus on an object of collaboration, we come to the idea that a group can share knowledge by being situated in a common context—e.g., a joint problem space (Roschelle & Teasley, 1995) or an indexical ground of reference (Hanks, 1992). The situation includes the shared object, but it also includes other resources and constraints, such as the affordances of a CSCL environment. Above all, it includes the past discourse of the group, which has created a complex network of shared concepts, interactions and experiences. According to (Duranti & Goodwin, 1992), the situation and the discourse "stand in a mutually constitutive relationship to each other, with talk, and the interpretive work it generates, shaping context as much as context shapes talk" (p. 31).

According to this paradigm, the engagement in collaborative discourse can automatically generate shared knowledge as an on-going process.

The paradigm of sharing a community. The social sciences generally take an even broader view. They argue that the shared knowledge that makes life together possible comes from belonging to the same communities, cultures, and societies. It is the understanding of the same historically accumulated knowledge, values, perspectives, artifacts and ways of life—largely encapsulated in language—that makes communication possible. In proposing that we broaden our thinking about computer support to include complex technological infrastructures, (Jones, Dirckinck-Holmfeld & Lindström, 2006) tried to show how the institutional macro-level could be related to the mezzo-level of collaboration and even to the micro-level of fine-grained interaction analysis.

The existence of multiple effective paradigms for understanding something like shared knowledge is not necessarily problematic. It may be possible to select the most appropriate paradigm for any given study. However, it does raise the question of how the paradigms might fit together—a topic for another time. Now we turn to four concrete proposals for supporting shared knowledge.

Intersubjectivity in collaborative learning

In the first article of this issue, *Johann Larusson* and *Richard Alterman* claim that wiki technology is particularly suited for enabling students to create an online intersubjective space that supports their collaboration. The wiki's malleable and easy-to-use interface, which contributes to its broad applicability, is, however, in need of specific kinds of additional functionality for collaborative-learning settings. The paper describes a Wiki Design Platform that provides a suite of awareness, navigation, communication and analysis components and scaffolds.

Two case studies demonstrate how different selections of components from the suite can help create an online intersubjective space for quite different forms of collaboration in a college classroom. In the first case study, student teams collaborate on HCI design projects. In the second, the students co-blog in the wiki about their course readings.

One might think that the design projects foster shared knowledge through the joint focus on the artifact being designed, while the co-blogging supported individuals externalizing their individual understandings. In fact, the paradigm of shared knowledge in this article is more complex because the authors refer to their theory of intersubjectivity (Alterman, 2007). For them, the intersubjective space is partially biological, but also social and cultural. In addition, it is related to the history of individual and group activities, and it provides a background for individuals to interpret each other's actions and (mental) motives. It is, therefore, not immediately clear which paradigm the presented concept of intersubjectivity falls into, or what form of shared knowledge is central to the suite of wiki tools or to the educational interventions in the case studies.

Collaborative learning in a mixed-reality classroom

The design of SMALLab, as presented by *David Birchfield*, pivots on three principles:

- Direct face-to-face interaction among co-located participants within the computationally mediated space should be cultivated.
- Thought and action should be distributed across multiple participants through an active, generative process that unfolds in real time.
- Immediate (spatial and temporal) consolidation of emergent conceptual models should follow the active learning process.

Each of these design principles supports shared knowledge. They provide the preconditions and mechanisms for knowledge to be shared among students in a classroom through their structured interaction.

In addition, the mixed-reality intervention involves the computer-supported projection of a virtual reality into the physical space of the classroom, interacting with the behaviors of students. This creates an environmental situation, embodying dramatic and interactive representations of otherwise abstract earth-sciences concepts. The reported study demonstrates that situating groups of students in such a mixed-reality setting can be highly motivating even for at-risk students, leading to their construction of scientific shared knowledge.

Together, the design principles, the mixed-reality technology and the whole-class activities may be considered to bring together the paradigms of individual, object-oriented, situated and community knowledge sharing.

Tools for presentation and critique in education

Architectural education traditionally employs extensive use of apprenticeship modes of sharing knowledge (Schön, 1983). In particular, design studios are scripted occasions for students to present designs and for professionals to publically reflect on them. Through careful conversation analysis of design-studio sessions, *Gustav Lymer, Jonas Ivarsson,* and *Oskar Lindwall* investigate the effects of different technologies—such as paper posters, PowerPoint slideshows and combinations thereof—for supporting presentation and critique in such sessions.

For knowledge to be shared, it is necessary that the participants can see the same thing in the same way. In the two previous articles, this was an important, but implicit principle. The wiki and the virtual reality were designed to create shared perceptual spaces, where salient objects could be seen by all. The previously referenced article, (Çakır et al., 2009), analyzed how students explicitly shared their ways of seeing in an online setting—much as (Goodwin, 1994) did for face-to-face settings. Here, the authors tease apart the ways in which presentation technologies mediate the sharing of ways of seeing, an important constituent of sharing knowledge.

Theory-driven group formation

In the previous articles, the authors design an interaction space or educational setting into which teachers can place groups of students. The question then arises as to how to form student groups that will engage in optimal collaborative learning processes within the given spaces. In the final article of *ijCSCL* volume four, *Seiji Isotani, Akiko Inaba, Mitsuru Ikeda*, and *Riichiro Mizoguchi* propose the reverse procedure. They start from the individual students' educational needs and goals to then form group activities that are responsive to those needs. Of course, to expect classroom teachers to match each of their students' needs to appropriate CSCL theories, technologies and pedagogies—and then to form compatible groupings of students in selected activities—without adequate support is not feasible.

The paper therefore presents a framework or ontology of categories for analyzing, specifying and coordinating student needs, theories, technologies and best practices. By starting from the needs of individual students, the authors hypothesize that it will be possible to group together students who can support one another and to select personally tuned collaborative-learning activities that can help the members of a group to achieve their goals as individuals and as a group. It is important to keep in mind when reading this technical paper that it is not trying to automate group formation, but to support teachers in their role as facilitators of collaboration and orchestrators of knowledge sharing.

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5(1): The CSCL field matures

The Web of Science

As it enters its fifth year of publication, *ijCSCL* has learned that it has been selected for coverage in Thomson Reuters products and services (formerly ISI). Beginning with Volume 3, Number 1, 2008, *ijCSCL* will be indexed and abstracted in the Web of Science under the following categories:

- Social Sciences Citation Index®/Social Scisearch®
- Journal Citation Reports/Social Sciences Edition
- Current Contents®/Social and Behavioral Sciences

Because the journal was accepted starting with 2008, the first Impact Factor will be calculated for 2010, which will be published in June 2011.

This is the most prestigious form of indexing for academic journals. Universities and other institutions in many countries consider journals indexed by ISI to be top-rank publications in matters of tenure and promotion. It is rare for new journals to be accepted for indexing so quickly. *ijCSCL* has been considered the logical place to publish major contributions to the field of CSCL ever since it was founded by the CSCL community in 2006. However, now, the decision by ISI should mean that scholars working in the broader field will—even more than in the past—consider *ijCSCL* to be a premier publication venue.

ISI's announcement is not only a tribute to the Editorial Board and many other reviewers who have worked hard to guide authors to meet high standards of academic publication. It is also due to the authors who took the risk to publish in a new journal and the readers who have subscribed through ISLS and supported the journal.

More than anything else, the journal's increased stature is a clear and direct reflection of the maturing of the field of CSCL. The history of the field can be traced to a workshop in Maratea, Italy, in 1989. The establishment of a regular biannual CSCL conference in 1995 defined a persistent research community. With the 2001 conference in Maastricht and the 2005 conference in Taipei, as well as the founding of ISLS as a supporting institution, the community became self-consciously international and permanent. The Springer CSCL book series and the

Springer *ijCSCL* journal provide crucial publication outlets specifically founded for this field. The decision by ISI is a further landmark in the growth of our field.

Volume 5, issue 1

The institutional maturation of the CSCL field is matched by developments in the field's research and theory. This issue of the journal illustrates some of the changes.

This issue sees the publication of some substantial contributions—as partially reflected in their length. As Executive Editors, we are often asked how long a journal article should be, as though the goal was to produce a certain quantity of words. The answer is that the main consideration is to have something important to say, a significant contribution to the field. The length should be just enough to clearly express and support the claims—and no longer. A quick scan through the past four volumes shows that most articles averaged about twenty formatted journal pages. However, we are open to shorter articles: book reviews, notes, reports on international developments in CSCL. We are also open to longer articles, as in this issue: The first paper presents a complex framework that requires lengthy motivation, presentation, and illustration and the second paper reviews, with impressive thoroughness, one of the most extensive realms of research in CSCL. Neither of these papers is likely to strike the interested reader as verbose; they are just long enough to convey their message.

The articles in this issue illustrate some ways in which the CSCL field is maturing. They demonstrate a continuing breadth of concern with theory, methodology, pedagogy, technology, sub-domains and empirical investigation. At the same time, they show a heightened level of self-reflection and a greater depth of analysis. In particular, they illustrate an intense and ongoing effort within this diverse multidisciplinary field to understand how research elaborated within incommensurate theoretical frameworks can contribute productively to a field with concerns in common.

This year's opening article addresses the central problem of sequentiality in CSCL discourse: How are we to analyze, represent and understand the ways in which one action takes up the contribution of a previous action in an online interaction? This temporal structure underlies the possibility of collaborative learning—of thought itself, whether individual or group—yet our theories and methods have not sufficiently focused on this fabric of interaction. *Daniel D. Suthers, Nathan Dwyer, Richard Medina*, and *Ravi Vatrapu* present the thinking of their lab in Hawaii over the past several years on this important theme.

One of the subareas of CSCL which has gotten perhaps the most attention is argumentation. A particularly clear way to look at collaborative learning is to study how people debate and argue about a claim. CSCL researchers have long and hard explored a variety of technologies for computer support of argumentation, looking both at helping students to learn to argue effectively and at using argumentation skills to learn collaboratively. *Oliver Scheuer, Frank Loll, Niels Pinkwart,* and *Bruce M. McLaren* have joined efforts from their AI labs in Germany and the US to undertake a comprehensive review of this extensive and productive effort by the CSCL community.

Structuring or scaffolding the sequential flow of student interactions has long been a central interest in CSCL, including supporting argumentation moves, scripting classroom discourse processes, or providing a selection of utterance categories (perhaps including labels, prompts, opening phrases). In their empirical analysis of the use of labeling under different conditions, *Eva Mary Bures, Philip C. Abrami,* and *Richard F.* Schmid of Canada argue that multiple forms of scaffolding may interfere with each other and that labeling should be designed flexibly so it can be tuned to the level of structure already existing in the educational activity.

On a theoretical and methodological level, the multidisciplinary field of CSCL has struggled with the substantial tensions, if not conflicts, between different approaches or even incommensurate paradigms in the work of different research groups. For instance, researchers in the cognitive science tradition favor quantitative studies aiming to measure the effects of mental representations of individuals, whereas researchers focused on situated interaction often opt for qualitative studies that reveal social practices, community participation, and group phenomena. There has been increasing discussion within the CSCL community about how to maintain a coherent and productive discourse with these diverse voices. *Marc Clarà* and *Teresa Mauri* of Spain close this issue of *ijCSCL* with the suggestion that multi-vocality in our field can be a healthy characteristic as long as we can find ways to bring the various findings into communication with each other. Focusing on content-analysis research, the authors identify three dimensions along which studies in this subfield of CSCL can be brought into dialectic relations with one another.

5(2): A prism of CSCL research

Our field of Computer-Supported Collaborative Learning necessarily struggles to integrate contributions and perspectives from a diverse set of disciplines, technologies, practices, methodologies and theories. First, based on its very name, CSCL must bridge the professional disparity between computer science and learning science. Then it has to function within the multiplicity of approaches to conducting research about computer-support technologies and collaborative-learning interactions. This presents an unavoidable challenge to people working in the field and to journals serving their needs. The current issue of *ijCSCL* presents an interdisciplinary prism of new CSCL research, illustrating multiple points across the spectrum of current work. Each of the papers investigates a distinctive CSCL-technology application, but does so in a way that emphasizes pedagogical aims and that investigates collaboration processes.

We start with a report on innovative computer support for K-12 science education by *Andri Ioannidou, Alexander Repenning, David Webb, Diane Keyser, Lisa Luhn and Christof Daetwyler*. A simulation of the human body's cardiovascular system of lungs and heart gives students a sense of the complexity of multiple organs working together. Based on a substantial extension of Agentsheets—a student-programmable simulation design environment—the Mr. Vetro simulation framework allows students to explore the effects of different variations of physiological parameters within an interdependent complex system. The students participate in highly engaging ways, interacting to collaboratively control the simulation of a complex organism under varying conditions by each simulating the role of individual organs or contextual parameters through handy mobile devices. The technology thereby addresses the currently popular theme of causality in complex systems in a way appropriate to K-12 science: It involves small groups of students in the complex interactions of collaboration, using an approach that the authors call "collective simulations." A basic assessment through user studies of the software in classrooms shows that it can be effective in making certain principles of human anatomy come alive for a classroom of students.

While the research on Mr. Vetro touches on a number of important issues about the representation of complex scientific phenomena in a necessarily simplified medium, implemented in computer graphics, the paper by *Göran Karlsson* explores a rather different set of science-education issues involving graphical representations, animations and conceptualizations. Rather than taking a conventional assessment approach using pre/post comparison of propositional domain knowledge, this case study delves into the discourse at a level of grammatical detail. It thereby opens up the black box of pedagogy to analyze what actually takes place as students follow task instructions. It avoids inferring student mental models as hypothetical causal agents for student behavior or learning. Instead, it takes a systematic look at how the students transform—at a linguistic level—the sentences they are given in a pedagogical setting into the sentences that they articulate. This methodological move provides an alternative to categorizing non-canonical responses as student misconceptions. In the study, students are asked to put "into their own words" descriptions of chemical reactions that are presented to them in animations. The analysis documents just how they approached their task and how they produced their responses. By documenting the processes that actually unfolded during the collaborative-learning interactions of the students with each other, with their task, and with the animations, the analysis provides a detailed description of the student collaborative behavior itself, with clear implications for rethinking the pedagogical design and implementation of the task and of the animation.

Another discussion of technology is related to the popular issue of scripting, which has been debated in this journal for several years. The contribution by *Joerg M. Haake and Hans-Rüdiger Pfister* offers analysis and reflections on the integration of scripting mechanisms in the CURE online platform for distance learning, which is extensively used at Germany's distance university. The effectiveness of scripting as a means of scaffolding student learning in CSCL settings is a highly contested matter. This study takes scripting out of the laboratory and tests it in a semester-long established computer-science college course. The scripting is implemented in the technology of the online collaboration environment. In the "unscripted" control group, students are told in text to go through phases of brainstorming, clustering related concepts and essay writing—but they are left free to self-organize how they collaborate on these tasks and they all see the same user interface. In the scripted condition, leadership for each phase is assigned by the technology, and only the selected leader sees the instructions for a given phase. Each student has access to a different interface and tools, depending upon that student's assigned role. Despite this significant difference in scripting, little difference in learning outcomes is measured, suggesting to the authors that the use of scripting is secondary to the way that tasks are defined, and that scripting is more appropriate to certain kinds of tasks rather than being a "silver bullet" for organizing collaboration.

The discussion of distributed leadership in our next article takes an alternative approach to scripting or scaffolding collaboration. It argues, in effect, that leadership is an emergent interactive group phenomenon and that—if allowed to interact without assigned roles—all group members generally participate in many core dimensions of group leadership. The paper by *Julia Gressick and Sharon J.*

Derry thus provides a striking contrast to research that assigns leadership roles to specific individuals in a group as a way to script the group interaction. Like the previous study, this one involves university students in a regular semester-long course, which largely takes place online. Rather than defining leadership by role assignments to individuals, this study adopts a reciprocal or interactive definition, in which leadership necessarily involves uptake or influence on followers; distributed leadership is a group-level phenomenon. By combining quantitative and qualitative analyses, the authors distinguish different specific forms of leadership, with different emergent patterns of distribution. It thereby extends the theory of group cognition by specifying forms of distributed leadership as a collaborative process at the group unit of analysis.

Finally, the paper by *Manoli Pifarre and Ruth Cobos* complements the discussion of distributed leadership by discussing how metacognitive skills can be promoted in a small group. Metacognition is taken to be the knowledge, skills, and practices of an individual or a group used to self-regulate their cognitive and affective learning activities. The Knowledge Catalyser discussion forum was designed to scaffold metacognition in a small discussion group by having students vote on, annotate, critique and revise each other's postings. As in the other papers of this issue, the technology is observed in a normal course, rather than in a laboratory trial. In this setting, the authors analyze the contributions of the students, looking in particular for postings that can be coded as metacognitive actions: planning, clarifying or monitoring. The use by students of these actions to help direct the work of the group and its members increased over time, indicating an increase in the employment of metacognitive skills using the tools designed into the collaboration technology.

Peering through the prism of this issue, different readers are likely to perceive different images and configurations of research. Some will be struck by the methodological diversity of the data analyses, reflecting seemingly incommensurate theoretical frameworks. Others will feel that the approaches are surprisingly similar—at once too applied to count as basic research or too experimental to be disseminated to classroom teachers. To this, one must respond that the sample in this issue is quite small and may reflect a quite limited range within the much broader spectrum of contemporary CSCL work. On the other hand, this issue may, indeed, say something about a current focal point within CSCL. Both *ijCSCL* and the related conferences welcome a diversity of ideas and analyses. See our past (and future) issues and join us at the conferences to see the broader universe of investigation. If you feel that your research team's work fits within the focal point or that it provides an important counterpoint, see http://*ijCSCL*.org/?go=procedures and submit a report on your work when it is ready for journal publication.

We look forward to seeing you at ICLS 2010 in Chicago!

5(3): Guiding group cognition in CSCL

Regardless of whether particular stakeholders are interested in individual learning outcomes or in the knowledge-building accomplishments of teams, the power of collaborative learning emanates from its potential to coalesce multiple people into the coherent cognitive effort of a group. The research goal of the field of CSCL is to understand how this synergy takes place and to design ways of supporting its fragile processes. The rigorous study of group cognition is elusive because successful collaborative learning is (a) currently rare and hard to identify, (b) complex in the structure of its constituent mechanisms and the factors influencing them, and (c) unique in each of its situated instances.

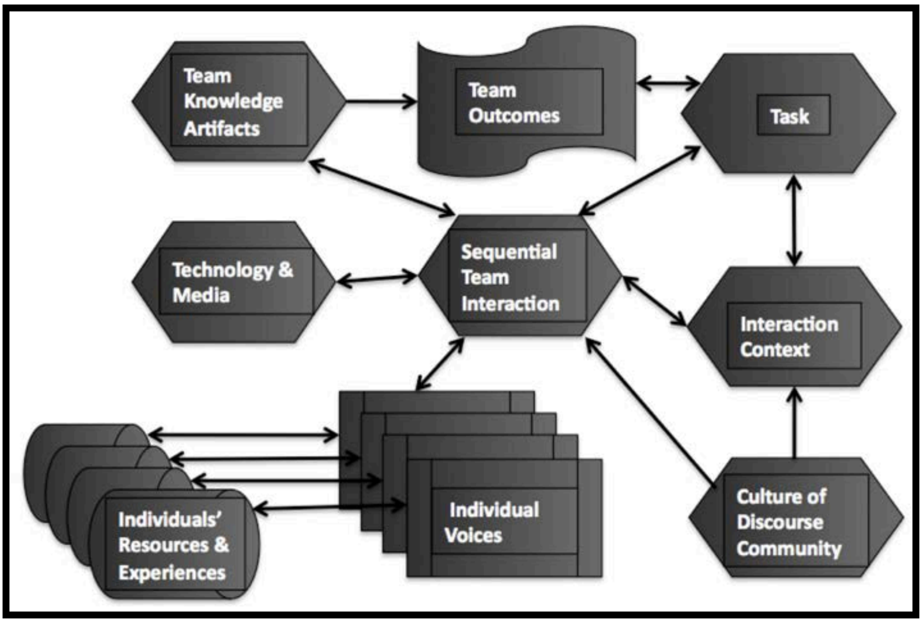

Figure 1. A diagram of major influences on group cognition.

There are now a number of theoretical frameworks available, which are influential in the CSCL research community, each, perhaps, with its own model of the influences on collaborative learning that must be taken into account. Figure 1 is an attempt to visualize major categories of these influences. It places at the center the dialogical interaction through which individual participants form into a collective knowledge-building agency.

The sequential nature of the interaction is what weaves contributions from the Bakhtinian voices of individuals into group processes of meaning making, as each responds to previous entries and elicits new ones. The meanings—shared by the group by virtue of their having been co-constructed in the collectively experienced sequential interaction—are embodied in team knowledge artifacts, whether linguistic phrases or physical objects. This collaborative knowledge building produces the team's outcomes, which are driven by the team's task.

A major thrust of the CSCL research agenda is to analyze the influences and constraints on the flow of knowledge building sketched in the preceding paragraph. Of course, a starting point is the determination of the individual voices of the participants: their background, perspectives and abilities. What experiences do they bring to the interaction and what resources can they each contribute? These factors at the individual unit of analysis are preconditions of the collaboration; they are of interest to education and psychology in general, but not specifically CSCL's concerns, which are more directed toward the group level of description.

By virtue of its name and its history, CSCL is especially oriented toward the computational technology and the digital media that support online group interaction. In addition, theories of situativity, activity, ethnomethodology, actor networks and distributed cognition highlight the essential influences on collaboration of the ongoing interactional context, the teleological object of the activity, available conceptual tools, established social practices, immutable-mobile mediators, the evolving joint problem space, and the larger socio-cultural horizon.

Because CSCL is an empirical science, researchers must capture data that lends itself to the analysis of these various dimensions of group interaction. To plausibly demonstrate the nature of particular influences, they must somehow focus on the phenomena they wish to study and determine the role they are playing. The authors of the papers in this issue do so in very different ways, illustrating once more the vigorous diversity, which is a core strength of the CSCL research field. The first four studies investigate how various forms of scaffolding can guide the group interaction in a pedagogically desirable direction, while the final reflection shows that the interaction also depends upon—and helps to construct—internal preconditions of productive collaboration, such as mutual trust.

The opening paper by *Christa S. C. Asterhan and Baruch B. Schwarz* starts with a useful literature review of the most basic form of scaffolding: that in which an instructor personally intervenes to guide synchronous small-group discussions. The paper then looks at four classes that are using an online environment to structure argumentation while a teacher is participating with each small group as a moderator, using various typical styles of facilitation. First, student self-reports from the students are compiled about what form of moderation seemed most effective to them, and then knowledge-building artifacts from the classes are analyzed to determine the effectiveness of the teacher intervention. Underlining the ways in which different factors interact with each other (and thereby complicating the task of modeling the dimensions of collaboration as though they were independent factors), the authors stress how different the moderation of synchronous computer-mediated interaction is from that of face-to-face or asynchronous interaction. Furthermore, they report that different approaches to moderation taken by different teachers exhibit very different characteristics and results.

The next contribution to this issue reviews the concept of scaffolding further and explores it in the context of medical-school training. Problem-based learning (PBL) has been a popular form of small-group collaborative learning in medical schools for decades. *Jingyan Lu, Susanne P. Lajoie, and Jeffrey Wiseman* have been exploring ways to extend the PBL model to overcome certain of its limitations. Here they report on changes to the effectiveness of teacher scaffolding due to two innovations: (a) an innovative form of medical case for role-playing called "the deteriorating patient" and (b) the use of interactive whiteboards. They analyze the changes in scaffolding strategies and discourse patterns in response to these innovations.

The contributions to group discourse made by a given individual are obviously influenced by the information and knowledge that the person has—or the experiences and resources available to them. Their contributions are likely to gradually introduce this information into the group knowledge-building or problem-solving process. In fact, much of the power of collaborative learning can come from the pooling of different knowledge and alternative perspectives distributed within the group. However, finding out who knows what can take time and delay the ultimate problem solving. The experiment reported by *Tanja Engelmann and Friedrich W. Hesse* investigates how information about what the group participants each know can be introduced into the shared group understanding through the use of CSCL technology. Specifically, they use the popular classroom tool of concept maps, having each participant within the experimental condition display for their collaborators a concept map representing their own knowledge. Triads with access to each other's concept maps proved to be more efficient in their collaborative problem solving.

The traditional concept of scaffolding, going back at least to Vygotsky, involved teachers or other students supporting collaboration and learning. Within CSCL, software tools (like argumentation environments, interactive whiteboards, or concept maps) have been used to support specific educational activities, and automated scripts have been used to guide students and teams through consecutive phases of a planned learning trajectory. CSCL researchers have found that the creation of one-off scripts is time consuming and hard to scale up for widespread classroom usage. For this reason, *Christof Wecker, et al.* discuss their effort to develop an infrastructure for scripts that can be ported to different collaboration environments. They do this by means of a browser plug-in, which can recognize inputs from different CSCL systems and provide responses in accordance with a cross-platform script definition. They illustrate its application in a realistic educational application setting.

CSCL researchers can become focused on trying to promote and control collaboration from outside the group itself. Taken too far, this can result in the fostering and administering of strategic communication and impression management, furthering external goals at the expense of the group's own autonomy, agency and sociability. Students can be influenced to engage in strategies designed to earn high grades rather than to build knowledge. For that reason, we close this reflection on guiding group cognition in CSCL by returning to the interpersonal resources of the group participants themselves. In the final paper of the issue, *Anne Gerdes* guides us in thinking about relations of trust among people: both how trust is required by collaborative undertakings as a spontaneous embodied experience of being-in-the-world-with-others and also how it may be engendered by the collaboration process itself. In contrast to journal articles that adopt an appearance of objectivity, this essay represents a new genre for *ijCSCL*: that of a brief, but deep reflection piece from a pointed perspective.

ijCSCL is now the #2 educational journal in the world. ISI Web of Science just released its report that *ijCSCL* has an impact factor of 2.692, the second highest impact factor of the 139 ISI-indexed journals in the category "Education and Educational Research."

Thanks to all our Editorial Board members, reviewers, authors and subscribers for your support! Thanks to the active CSCL research community, which reads and cites *ijCSCL*!

5(4): Beyond folk theories of CSCL

The role of theory in CSCL research is a complex matter, which has not been well worked out yet. The short caricature is this: There are three kinds of researchers in the field of CSCL,

1. People who conduct CSCL research and report on it as though there is no need for theory; they simply observe results of interventions.
2. People who conduct CSCL research and report on it by following a particular theory or theoretical framework that they accept as is.
3. People who conduct CSCL research in order to investigate theoretical issues and refine theoretical perspectives specific to CSCL.

The first group of people is naïve. The philosophy of science has shown convincingly that research is necessarily theory-laden. Those who do not reflect on their theoretical footing simply adopt the assumptions of common sense, known as ‘folk theories’. Folk theories are based on experiences of everyday life, on distinctions embedded in common language, and on simplifications of outmoded theories. For instance, folk theories might assume that what a subject says in an interview or a survey directly represents what the researcher was looking for, without worrying about how the imposed situation might influence the subject’s response or the researcher’s interpretation.

The second group may be much more sophisticated about research methodology, having learned from established sciences like psychology, education, linguistics or informatics. They are skilled at setting up survey instruments, research designs and statistical analyses. They are also adept at critically evaluating each other’s claims. Using the constructs of a given theoretical framework, researchers in this group like to test theoretical predictions, for instance to see if a specific educational intervention will increase student learning outcomes as measured by gains from pre-test to post-test. While findings from such an approach can be useful, the limitation is that the imposition of a theory that was not explicitly developed for CSCL may fail to identify phenomena that are characteristic of CSCL—and which could therefore be of particular interest to people involved in implementing CSCL in practice.

The third group may start from a stated theoretical framework or even from a commonsensical understanding—for all thought is necessarily grounded in everyday language and in the tacit pre-understandings that come from human activity in the world. However, their research aims at pushing the theories further and refining the conceptualizations through which collaborative learning is comprehended. The articles in this issue of *ijCSCL* exemplify such an approach.

The sciences in which many CSCL researchers were trained generally focus on the individual as the subject, who learns. Often, these sciences recognize the influence of cultural and historical influences, but these are generally conceived of at a broad societal level. In contrast, CSCL settings typically involve processes (cognitive, knowledge-building, interactional, or identity-forming) at the small-group and/or classroom level of description, as well as at the individual student level. Processes at these different levels interpenetrate with each other intimately, without being reducible to any one level. In addition, CSCL involves mediation of the learning, interaction and cognition by technological artifacts and computational media. To capture these processes and mediations, researchers need to develop more elaborated theories and methods. The articles below focus on these different levels and their special mediations, and propose new ways of viewing what takes place there.

Each of the following papers presents an individual case study. The point is not only (or even primarily) to argue that one should place students in similar circumstances to promote desired outcomes, but to present a persuasive example of how one might *view* collaborative learning taking place within such computer-supported contexts. In doing so, the authors propose intriguing extensions to theories that are important to CSCL, such as distributed cognition, discourse analysis, tacit knowledge, activity theory, and temporal analysis.

The study by *Ruth Kershner, Neil Mercer, Paul Warwick,* and *Judith Kleine Staarman* of elementary students' use of interactive whiteboards during small-group collaborative discussions builds on the theory of distributed cognition, in which people think collaboratively, mediated by physical and linguistic artifacts. It also applies Mercer's approach to discourse analysis—differentiating disputational, cumulative and exploratory forms of children's group talk—for looking closely at sequential interaction. The paper uses the discourse-analysis results to extend the theory of distributed cognition with the metaphor of a *shared dynamic dialogic space* as the focal point of the children's collective reasoning and co-construction of knowledge. The specific functions of the interactive whiteboard, combined with 'talk rules' instilled by the teacher, help to structure the dialogic space in which shared knowledge is co-constructed by the student groups.

The shared dynamic dialogic space—sometimes called the 'joint problem space'—could provide a new way of thinking about how the various critical dimensions of CSCL interactions come together. The interactive whiteboard, for instance, acting as a location for focusing shared attention on the group task, as a referential center for exploratory talk, as an external memory, common ground or indexical source for group cognition, and as a visual foundation for group identity demonstrates useful functionality for computer support of collaborative knowledge building.

Folk theories and rationalist philosophies assume that knowers can unproblematically state knowledge explicitly. Knowledge is conceived of as a possession of individuals' minds, much like propositions stored in a computer database. But much of our knowledge as people, groups and communities that carry out practical activities in the world is tacit, implicit, taken-for-granted, unstated. *Meng Yew Tee* and *Dennis Karney* investigate how tacit knowledge can be co-constructed, shared and developed in a CSCL context. They look at how tacit knowledge of corporate culture surfaces in an online discussion of business management and how tacit hands-on know-how is built through role playing and the use of simulation games. Their analysis of student discourse suggested four key processes: socialization, externalization, combination and internalization—consistent with Nonaka's model of knowledge creation. The authors stress the importance of viewing these processes in a situated way. The exploration of tacit knowledge as the oft over-looked foundation of collaborative learning provides an important corrective in post-cognitive theory to the concentration on explicit knowledge in rationalist, cognitivist and folk theories.

The paper by *Sinem Siyahhan, Sasha A. Barab,* and *Michael Downton* focuses on another dimension that is generally overlooked by folk theories: that of social norms, particularly their influence on how people position each other's roles during interaction. This study looks at parent-student dyads playing an educational video game together after school. The analysis is framed in terms of Activity Theory, which includes among the mediations of goal-directed activity the dimensions of social norms, community and the division of labor, in addition to mediation by artifacts (tools, symbols, technologies). The dialectic of roles was particularly interesting in this experimental context because the standard norms concerning parent-child relations interacted with the fact that the children were sometimes more expert at video-game operation and that the parents often positioned their children to take the lead during the 'educational' phases of the game. This opened up a space for productive exploration of the parent-child relationship by the participants.

The final paper of *ijCSCL* volume 5 addresses the temporal dimension of CSCL interaction. Folk theories of learning focus on the content and how it changes from some initial to some final state. However, to understand how collaborative learning takes place, we need to study how things gradually unfold during the period being studied. In particular, traditional theories conceive of time as an objective, smooth succession of moments. The Bakhtinian analysis by *Maria Beatrice Ligorio* and *Giuseppe Ritella*, however, treats the temporality experienced by the group in the classroom as a co-constructed encounter incorporating significant meaning and expression. Borrowing terminology from music—where the human experience of temporality is carefully orchestrated—the authors characterize phases of classroom interaction as proceeding with a tempo of adagio, andante or allegretto. They see the dimension of temporality and the pace of sequential interaction as constructed by the responses of students to each other under the specific conditions of the classroom and its technology. The three chronotypes correspond to different modes of collaboration, in coordination with the sense of space that is simultaneously established.

The articles in this issue move far beyond folk theory and push the existing theories that have been popular in CSCL literature to better reflect the characteristics of interaction in CSCL settings. They suggest that computer-supported collaborative learning opens up a multi-dimensional shared world in which participants interact with each other, situated within an evolving context that they co-create. Knowledge, roles, space and time are not simple givens whose characteristics can be assumed; they must be studied in each case through detailed analysis of the situated interaction. Of course, it is not necessary to address these theoretical frontiers of CSCL in every paper that claims to make significant and useful contributions to CSCL research; many research questions can be fully and rigorously pursued within the boundaries of established perspectives. *IjCSCL* welcomes both kinds of studies, those that make appropriate use of traditional frameworks and those that explore the boundaries of those frameworks.

* * *

As we close the fifth year of production of *ijCSCL*, we would like to extend our gratitude to the many people who have supported the journal as Editorial Board members, authors, subscribers and readers. In particular, we thank the following CSCL researchers who reviewed submissions to the journal; their committed and expert volunteer work is the single most important factor in maintaining the high quality of *ijCSCL* as a leading international journal and as the venue of choice for CSCL research:

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Start planning now for the up-coming CSCL 2011 conference in Hong Kong, July 4-8 (see: http://www.isls.org/cscl2011). Hong Kong is an exciting crossroads of the world, a bridge between East and West. It is easily accessible from Europe and the Americas by direct flights. The culinary capital of Canton, it offers hotels for every budget. The conference venue at the University of Hong Kong—one of

Asia's premier universities—is located within walking distance of the heart of Hong Kong. A former British colony, Hong Kong uses English widely. CSCL 2011 is designed to offer an affordable global experience, including a post-conference group tour of educational and tourist sites in mainland China July 10-15—bring your family and students. We look forward to seeing you there.

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6(1): CSCL in Asia

Shanghai competes in PISA

For the first time since 2000 when the Programme for International Student Assessment (PISA) tests started to be administered internationally by the OECD, Mainland China participated in 2009, represented by students from Shanghai. They took first place in all three major categories: reading, science and mathematics. The PISA tests are given every three years to a large sample of 15-year-old students in over sixty countries. In the recently released results from testing in 2009, generally 5 of the 6 top-placing countries were Asian (see Table 1). With the participating Asian countries all at the top, the United States and most of the European countries (except Finland) were way down in the mediocre world-average range.

Table 1. The top six countries in the PISA 2009 test scores.

Science	*Reading*	*Mathematics*
Shanghai	Shanghai	Shanghai
Finland	Korea	Singapore
Hong Kong	Finland	Hong Kong
Singapore	Hong Kong	Korea
Japan	Singapore	Taiwan
Korea	Canada	Finland

Of course, educational researchers may question the significance of standardized testing from many perspectives. In particular, CSCL researchers may wonder if high scores reflect an outmoded individualized drill-and-practice approach of memorizing facts rather than building knowledge collaboratively. Do winning scores result from an oriental Confucian philosophy that accepts traditional ways but will fail at creating innovation in a knowledge society?

Arguing against such suspicions, the OECD report and associated videos (http://www.oecd.org/document/13/0,3343,en_2649_35845621_46538637_1_1_1_1,00.html#Videos) indicate that Shanghai's success is the result of consciously forward-looking government policies. As quoted in the *New York Times*, OECD spokesman Andreas Schleicher summarized:

> In recent years, teaching has rapidly climbed up the ladder of preferred occupations in China, and salaries have risen. In Shanghai, the authorities have undertaken important curricular reforms, and educators have been given more freedom to experiment…. For me, the real significance of these results is that they refute the commonly held hypothesis that China just produces rote learning…. Large fractions of these students demonstrate their ability to extrapolate from what they know and apply their knowledge very creatively in novel situations. (Dillon, 2010)

Perhaps it is time for skeptical CSCL researchers to visit Shanghai and see what is going on there.

Another CSCL conference in Asia

The CSCL research community began largely in Western Europe and North America. It held its first conferences on those continents. Of course, there were always some Asian researchers involved, but most of them had academic ties to the West. In an effort to become more international, the CSCL community held its first Asian conference in Taipei in 2005, attracting many local scholars and students. Meanwhile, Asia-based conferences like ICCE and its sponsor, APSCE, have become active in presenting CSCL research, largely from Asian labs. This year, the international CSCL conference will return to Asia, hosted by the University of Hong Kong.

The theme of this year's conference ties CSCL research to policy and practice. There will be a variety of events related to educational policy before, during and after the conference. A special feature will be a chance-of-a-lifetime opportunity to tour Mainland China to learn about educational policy and practice there. From July 11-15, a group of CSCL conference attendees will go to Guangzhou, Shanghai and Beijing. This series of post-conference activities in Mainland China is an attempt to bring together researchers, practitioners and policy-makers within China and internationally to identify ways to better leverage the potentials that research on learning and learning technologies bring to educational change and improvement. It is a chance to meet with policy makers, researchers, educators and classroom teachers; to visit teacher-training universities and primary schools; and to not only observe, but also actually participate in the transformations underway there. See http://www.isls.org/cscl2011/call4post-conf.htm for details.

Asian educational policies

The irony, it seems, is that while educational policy in the US and many European countries seems increasingly confined to teaching to standardized tests, policies in places like Singapore and Hong Kong are explicitly aiming for "21st Century skills," which they recognize require transcending rote learning in favor of collaborative knowledge building, computer-supported analysis, and creative thinking. While much of the underlying theory, technology and research in CSCL originated in the West, current politics there resist the ideological and institutional transformations necessary for widespread implementation. For visionary political initiatives, we may have to look to Asia and to exceptional Western instances like Finland and Canada.

In preparation for the conference in Hong Kong, we feature a report on educational policy, CSCL research and classroom practice in Singapore in this issue of *ijCSCL*. In the next issue, we will feature a similar piece on policy, research and teacher training in Hong Kong.

This issue's opening presentation on the Singapore experience by *Chee Kit Looi, Hyo-Jeong So, Yancy Toh & Wenli Chen* is framed in terms of the need to integrate reform efforts at three scales. Building on the discussion of meso-level infrastructure in an early *ijCSCL* paper (Jones, Dirckinck-Holmfeld & Lindström, 2006), it distinguishes the micro level of student learning and interaction, the meso level of teacher professional development in the school, and the macro level of national policy and strategic planning. The authors report from the unique position of working within the Learning Sciences Lab of the National Institute of Education at Nanyang Technological University, established by the Singapore Ministry of Education specifically to transform educational practice based on the latest research in the learning sciences. In undertaking this mission, the authors discovered that the research does not provide a clear implementation path for preparing students for the world of the 21st Century. Rather, they realize that much of the needed educational philosophy was already clear in Dewey's vision of student-centered education for democracy, inquiry and innovation a century earlier, but that neither he nor his followers have had much effect on the rote-learning focus of an educational system tuned to the industrial age. Change must take place simultaneously on many levels, and this requires a carefully coordinated, phased, and iterative approach. The article chronicles a phased national policy of educational reform, a scalable approach to gradually working with increasing numbers of teachers, and an iterative design-based method of research in the classroom. A central illustration in the paper is the way that a particular CSCL technology, Group Scribbles, was introduced into some Singapore classrooms over several years. It discusses how embedded researchers worked closely with early-adopter teachers to tune the socio-technical system of this software's classroom role, based on analysis of situated student interaction mediated by the technology. A large chart in the article summarizes the coordination over time of design principles, curricular products, technology development, teacher professional development, and the spread of innovation among schools. While Singapore is a unique national system, its educational reform experience seems to offer lessons for other countries around the world.

CSCL research in Singapore

To complement the presentation on the macro-level effort of the Learning Sciences Lab in Singapore, we include two additional research reports from that lab. Then we publish two other papers on Asian CSCL research. These are not our first Asian papers. In fact, we started in the very first issue of *ijCSCL* with an article from Hong Kong (Lee, Chan & van Aalst, 2006) and have published papers from the Asia-Pacific region every year (Baghaei, Mitrovic & Irwin, 2007; Hung et al., 2008; Isotani et al., 2009; Kapur & Kinzer, 2009; Lu, Lajoie & Wiseman, 2010; Oshima et al., 2006; Reimann, 2009; Rourke & Kanuka, 2007; Tee & Karney, 2010; van Aalst, 2009). *IjCSCL* is an international journal and aims to publish a high-quality selection of world-class CSCL research from wherever groundbreaking work is taking place.

Manu Kapur's methodological proposal, "Temporality matters," responds to an earlier contribution arguing that "Time is precious" (Reimann, 2009) and that CSCL should adopt methods that analyze temporal processes of interaction. Of course, some varieties of interaction analysis do focus on the sequentiality and response structure of dialogical utterances (e.g., Çakır, Zemel & Stahl, 2009; Schegloff, 2007; Suthers et al., 2010). But Reimann and Kapur are not so much looking to qualitatively analyze individual interactions as to be able to quantitatively determine sequential patterns of interactions within a data corpus. Kapur proposes the adoption by CSCL researchers of Lag-sequential Analysis (LsA), a statistical technique used in other fields. This technique is similar to Hidden Markov Modeling (HMM) (Soller & Lesgold, 2003) in that it yields transition probabilities that one category of event will follow another category. The paper illustrates with a study of students in India how LsA can provide findings that would be lost to a traditional coding-and-counting approach, which aggregates events of each category and hides their respective ordering. Kapur's LsA temporal analysis revealed which groups ordered their problem-solving moves more effectively, providing insight into desirable group knowledge-building processes.

The illustrative study in Kapur's paper involved a phenomenon known as "productive failure." This phenomenon is one of the most interesting findings to come out of CSCL research (see Barron, 2003; Kapur & Kinzer, 2009; Schwartz, 1995). Productive failure is the finding that student groups who score lower on individual post-tests may have actually experienced deeper learning (such as developing more abstract conceptualizations) that could eventually lead to superior performance in the future. A team at the Singapore lab set out to investigate this phenomenon with a qualitative analysis of group processes among physics students. *Suneeta A. Pathak, Beumie Kim, Michael J. Jacobson, & Baohui Zhang* set up a situation of productive failure by initially giving some student groups well-structured problems, which tested for relatively rote learning of physics laws, and giving other groups ill-structured physics problems, which required more innovative thinking. Since the ill-structured problems were more challenging, the groups with them had lower rates of solution, but gained experiences that helped them with later problems. The authors manipulate the conditions systematically and analyze the resultant student interactions carefully. Previous studies of productive failure have focused on quantitative analysis to demonstrate the phenomenon, and have had to merely speculate on the mechanisms at work in the group interactions. This new study conducts qualitative analysis to see what the student groups are actually saying and what forms of shared understanding they are co-constructing. The authors then relate their findings to the notion of scripting in CSCL (Dillenbourg & Hong, 2008; Kobbe et al., 2007; Stegmann, Weinberger & Fischer, 2007), suggesting that scripting can be used to take advantage of the hidden learning that occurs with productive failure.

More Asian CSCL research

In *ijCSCL*'s first paper from Mainland China, *Zi-Gang Ge* explores issues of a field that is particularly important in Asia: English as a foreign language. This research explores peer review of writing assignments. It takes advantage of computer networking to have students review each other's essays anonymously. In particular, the use of asynchronous, anonymous online exchanges was hypothesized to lessen the Chinese cultural aversion to criticizing people face-to-face. An experiment was conducted with engineering students at a university in Beijing. Students were classified based on their English writing ability in order to see which level of student would be helped most by the collaborative intervention. Although there was generally a positive response to the peer-review process by the students, those with lower skills sensed that they were being reviewed by stronger students and often felt inferior, which sometimes increased their determination to improve. The better writers, on the other hand, felt that they were not learning as much from the process because the advice they received was not as good as what they gave. Perhaps engineering students in China are similar to those in the West, who resist collaboration based on their drive to excel as individuals (Rick & Guzdial, 2006).

The paper by *Michael Glassman & Min Ju Kang* presents the logic of inquiry—sometimes called "abduction" in contrast to deduction and induction—as discussed by Dewey and Peirce. Rather than arguing from some initial facts or ideas to a single prediction or conclusion, abduction involves exploring multiple possibilities suggested by an observation. The paper then proposes that computer-supported collaboration media like wikis and blogs could be further developed to support such multi-faceted inquiry in classrooms. The collaborative hypertext could provide an alternative to traditional linear and unilateral deductive thinking, such as when a teacher instructs about factual material or elicits predicted information. The technology can support complex networks of knowledge exploration and innovative thinking. The authors, one of whom is from Korea, review student experiences—including by students in the Philippines, Japan, Taiwan, and Korea—that take first steps in the kind of student-centered inquiry that Dewey proposed, but was not able to institute in his day. While the paper's ideas hearken back to classic hypertext notions of Engelbart and Nelson in the 1960s, they bring them together with the logic of inquiry as a foundation of Dewey's progressive education. It is not clear why blogs and wikis should be singled out, and not extensions of discussion forums like Knowledge Forum (Scardamalia, 2002) or WebGuide (Stahl, 2006, Ch. 6). Perhaps, Singapore's experiments with GroupScribbles (Looi, et al., this issue) also illustrate the kind of networking software that can support classroom abduction, while in addition indicating the design-based research that is needed to transform communication technologies into media for effective student knowledge creation (van Aalst, 2009).

Another perspective on research

We conclude this issue by returning most of the way to Europe with a contribution by *Baruch B. Schwarz, Yaron Schur, Haim Pensso, & Naama Tayer* about research in Israel as part of a European Union project. This work relates to themes from the preceding papers. In particular, it considers the effort within CSCL to reform education, and the barriers and complexities associated with this effort. Adopting a somewhat different take on the many factors involved, it explores issues involving the teacher role in mediating student collaborative knowledge building and conceptual change. This paper builds on previous studies in this journal by the same lab on computer support for argumentation (Asterhan & Schwarz, 2010; Schwarz & De Groot, 2007; Schwarz & Glassner, 2007). Engaging in multiple controversies within CSCL and using various means of intervention and of analysis, the paper raises issues about how to accomplish the CSCL vision in schools through the coordinated efforts of researchers, teachers, and other stakeholders through a design-based research process similar to that in Singapore.

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6(2): Let a hundred flowers bloom; let a hundred schools of thought contend

The title of this editorial is translated from a Chinese poem. The words have been adopted, adapted, reinterpreted, repurposed, proclaimed and misquoted repeatedly since 1956, when they were popularized in the context of the Chinese revolution and its international reception. In re-contextualizing the original spirit of the poetic line within the current situation of the CSCL research field, we strive to foster, articulate and support openness within our community to multiple schools of thought. In particular, *ijCSCL* provides a venue for exploration of alternative perspectives and for dialog among them.

While each CSCL researcher necessarily favors specific paradigms—more or less self-consciously—the field itself profits from a cacophony of voices: theoretical, methodological, pedagogical, technological, ideological, political, interdisciplinary and international. Scientific revolutions—like political revolutions—advance through the confrontation of viewpoints and the critique of established paradigms. We can see this in the academic progress of our field as clearly as on the battlefronts of the Middle East. While dominant positions may facilitate short-term ends, they restrict innovative thinking and practices; they are eventually surpassed and their rules overthrown.

Educational systems around the world are still striving to implement an industrial-era view of knowledge as factual content and learning as the testable transfer of knowledge from authoritative sources to individual students. CSCL is defined by alternative views, in which knowledge can be co-constructed by small groups and communities, particularly with the support of networked computers. Since its inception, CSCL research has built upon a wide variety of established and innovative approaches to pedagogy, theory, analysis and technology. Through this open-inquiry approach, the CSCL field itself adopts the attitude of letting many flowers bloom, which it projects as definitive of a stance toward learning that is appropriate to the contemporary post-industrial world.

The field of CSCL began as a multi-disciplinary effort, bringing together diverse concerns and approaches to the complex task of achieving the promise of computer-supported collaborative learning in actual school classrooms. Rather than converging on a single approach, the research community has increasingly recognized the need to incorporate more and more considerations. The goal of CSCL is inherently multifaceted. It must account for psychological, pedagogical, technological and community-based phenomena. It must design for individual, small-group and classroom interactions. It must overcome barriers involving entrenched beliefs and practices of students, parents, teachers, principals, school districts and governmental policies. Moreover, for each of these aspects, there are competing, apparently incommensurable ways of analyzing, understanding and responding. This is the nature of the CSCL mission; the journal of CSCL must provide a fertile ground in which a rich ecology of schools of thought can germinate and flourish.

In this issue, we offer a bouquet of diverse CSCL investigations, focused on promising approaches to educational practice, interactional theory, collaboration analysis and technology design. Each of these studies is grounded in traditional disciplinary foundations, but each also strains toward a future of innovative possibilities. Together, they foreshadow some of the presentations scheduled for the impending CSCL 2011 Conference.

A flower garden in Hong Kong

The conference—to take place in Hong Kong this July—has the theme, "Connecting computer-supported collaborative learning to policy and practice." As befitting this theme, our opening article by Carol K. K. Chan discusses the extended efforts of a group of researchers and teachers in Hong Kong to connect CSCL insights and approaches to the local educational policy and practice. This account complements the lead article last issue, reporting similar work in Singapore.

As noted by the video commentaries on the PISA results—cited in the introduction to the previous issue (Stahl & Hesse, 2011)—the most striking factor in leading educational systems such as those of Finland and Shanghai is the support given teachers by their peers. So it is particularly fortunate that the presentation here focuses on the Hong Kong Knowledge-Building Teachers Network (KBTN).

KBTN is a meeting place of forward-looking government policy initiatives, teacher peer support, CSCL researcher initiative, well-established CSCL theory, and the use of CSCL technology. KBTN has been funded continuously since 2006 by the Hong Kong Ministry of Education, in accordance with their educational reforms going back to 2000. As you can tell from its name, KBTN is based on the theory of knowledge building. This was a pioneering theory in the history of CSCL (Scardamalia & Bereiter, 1991), and involved the development of one of the first explicitly CSCL software environments, Knowledge Forum. The author, Carol Chan, conducted research in Scardamalia and Bereiter's Toronto lab before going to the University of Hong Kong. The KBTN is part of their broader effort to build an International Institute for Knowledge Innovation and Technology (IKIT).

Chan provides a stimulating and thoughtful reflection on the development of the KBTN. Recognizing the complexity and situatedness of the effort to support teachers in adopting a knowledge-building pedagogy and adapting it to the Hong Kong context, Chan parallels last issue's strategy by Looi et al. (2011) to analyze the macro, meso and micro levels of transformation as well as their mutual interactions, as already proposed in the first issue of this journal (Jones, Dirckinck-Holmfeld & Lindström, 2006). She provides an action researcher's perspective on the issues that arose and how they evolved over the years. Wisely, she refrains from any final evaluation or recommendation, recognizing that the effort is ongoing and that its lessons must be resituated in other settings.

Despite similarities in format of the reports from Singapore and Hong Kong, the differences are also striking. Especially if one considers them in the context of previous descriptions of teacher adoption of knowledge-building pedagogy, theory and technology in other countries like Canada, Finland or Italy, they appear as unique flowerings in a field of diversity. For instance, in Singapore the impetus came from the government, whereas in Hong Kong it was driven more by researchers and teachers. In Hong Kong, they introduced a relatively mature technology into the classrooms, while in Singapore they were more concerned with evolving the technology design. However, in both reports we find concerns that are familiar within CSCL research and seem to confront most efforts to transform traditional schooling into computer-supported collaborative learning.

Having contrasted a pair of studies of CSCL practice, we will continue in this issue with pairs of counter-poised papers on CSCL theory, analysis and technology.

An intersubjective dialogical space or an individual's cognitive conflict?

CSCL is distinctive within the learning sciences by virtue of its focus on collaboration, the process by which multiple people learn together. In this, it is inspired by: (a) the earlier work on cooperative learning, which determined the learning outcomes for individual students as a consequence of being involved with small groups (Johnson & Johnson, 1989); (b) Vygotsky's insight that individual cognition is derivative of intersubjective experiences (Vygotsky, 1930/1978); and (c) Lave's perspective on learning as participation in a community of practice

(Lave, 1991). Subsequent theories relevant to CSCL have accordingly fore-fronted (a) the individual, (b) the small group, or (c) the community level of analysis as the site of learning. Of course, a full analysis must take into account all three levels and their essential interpenetration, but any given analyst is usually well advised to focus on one level, in accordance with a specific research interest.

A prominent tendency within CSCL studies oriented to the small-group cognitive unit is that associated with dialogicality; the paper by *Manoli Pifarre* and *Judith Kleine Staarman* can be viewed in that vein. Analyzing an experiment conducted in Spain, the authors build on the theoretic and analytic work of their British colleagues Mercer (Kershner et al., 2010) and Wegerif (2006). They investigate how a wiki environment can provide a "dialogic space" for group knowledge building (see also Glassman & Kang, 2011; Larusson & Alterman, 2009). They note that the wiki gave voice to each participant, having them start by posting their own ideas; with the use of a "thinking together" approach based upon "exploratory talk," the wiki allowed the students to create a "dialogic space" to co-construct new understanding; the resulting wiki content served as a shared digital artifact as the product of their collaboration. The co-construction processes engaged in by the students involved them in taking into account each other's opinions, thereby reaching new intersubjective understandings and appreciations.

By contrast, the information-processing perspective developed by *Robert L. Jorczak* can be taken as representative of an approach that always traces the analysis to the level of individual cognition. This paper defends the view that was dominant in the beginnings of the CSCL field—influenced by artificial intelligence and cognitive science exploring the analogy between human thought and computer heuristic algorithms. While the information-processing model was originally focused on certain forms of problem solving by isolated individuals, it is here extended with the help of Piagetian concepts of cognitive conflict or internalization/externalization (Cress & Kimmerle, 2008; Mugny, Doise & Perret-Clermont, 1975) to account for the individual learning that can result from small-group interaction. With its Collaborative Information Processing model, this paper conceptualizes group processes as consisting of flows of information in and out of individual minds, through which individuals accept divergent ideas and potentially respond with convergent ideas. The productive tension of cognitive conflict at the group level is thereby reduced to individual processing of information via internalization and externalization.

Jorczak reviews a variety of theoretical approaches, including those that emphasize group-level, fundamentally interactional processing such as clarification, elaboration and conceptual-conflict resolution. He specifically interprets an early version of (Stahl, 2000) as a model of how group processes arise from and then feed into individual cognitive processes. But that model was intended to show how the individual processes contribute to the group processes—within which they must be conceptualized—as perhaps more clearly pictured in the republication (Stahl, 2006, Ch. 9, esp. pp. 210-11) and more recently in (Stahl, 2010, p. 256). The conceptualization of cognition as information processing may lead to the view that information processed by a group is simply an input into individual cognitive processing and learning. But the larger question is whether there are group processes that are central to collaborative learning but that are not reducible to aggregations of individual information processing. Is the dialogical space, for instance, as intersubjective, greater than the sum of the contributions to it? If a dialog context emerges from interaction of multiple subjects, do group phenomena or practices take place that should be attributed to or interpreted as group-cognitive processes? When Hutchins (1996) analyzes the information flows through a complex socio-technical system involving a skilled team, well established practices, historically developed navigational artifacts, and systematic training regimens, does the accomplishment of navigating the ship essentially exceed the sum of the individual-cognitive processes that contribute to it? The theoretical question may be an empirical one, requiring detailed case studies like Hutchins'. We now turn to such analysis.

A mental representation or a co-referential gesture?

The next two articles provide contrasting approaches to analyzing individual and group processes. First, we have a thorough quantitative experimental study of the effect of representational formats on individual and collaborative behaviors by *Bas Kolloffel, Tessa H. S. Eysink,* and *Ton de Jong*. Although the study was conducted in actual classrooms, the experiment was designed with the rigor of a lab study. Students were divided into individual and collaborative (dyad pair) settings, each of which was randomly divided into conditions using three different representational formats (concept maps, textual summaries, mathematical equations). A series of hypotheses based on previous studies was then systematically tested through statistical comparisons among conditions, using pre- and post-tests of individual student understanding. Although the study was intended to explore collaborative inquiry learning, the inquiry took place in a quite restrictive interface, in which mathematical problems with well-defined answers were presented and even analyzed for the students. The collaboration (in the dyad setting) was unstructured talk, which was not captured or analyzed. While some hypotheses were confirmed and others were not, the explanation of these results was left for speculation. Even though the effect of certain representations appeared to be different in the individual and dyadic settings, there was no way to know what role the representations may have played in dyad discussion or how the representations may have been differently understood by individuals and dyads.

Discussions of diversity in analysis methods often argue for the superiority of either "quantitative" or "qualitative" approaches. Increasingly, this has become recognized to be a false dichotomy. In general, methods have to be selected, adapted, or created depending on the nature of the data and the driving research interests. Additionally, a combination of "mixed methods" is becoming common. Often, a statistical analysis can suggest or even confirm a hypothesis, but then a close inspection of how an individual interaction took place may be needed to indicate underlying mechanisms or processes, as the authors of the representation study note and promise in future work. On the other hand, since analysis of a single case can raise questions of typicality or generalizability, a statistical result may be needed to motivate the significance of the detailed analysis.

The next paper, by *Michael Evans, Eliot Feenstra, Emily Ryon,* and *David McNeill*, seeks to provide the analytic tools needed to analyze the kinds of collaborative interactions that take place around external representations and other mathematical manipulatives. In doing so, it addresses many of the questions raised above. It hones in on a core phenomenon in the building of intersubjectivity or distributed cognition: what it calls "co-referencing." This involves multiple people referencing the same thing, whether through a deictic word, a pointing gesture, or any other verbal, physical, or virtual action that references something *as* intended by more than one person. Simply by paying attention to co-referential actions within a dyadic interaction, an analyst can get a qualitative sense of the co-construction process and the shared experience of collaborative meaning making. If, as these authors do, one also develops and applies a coding scheme for tracking co-references in discourse, then one can start to compile quantitative measures for possible comparison across cases. An important trend within Conversation Analysis—a prominent approach to the detailed analysis of interaction—has been to include the analysis of gesture along with talk, and McNeill's work on the coordination of gesture with word and thought (2006) has been influential there. In the paper here, a systematic typology of forms and levels of co-reference is sketched and a method of coding co-references in their temporality is proposed and illustrated.

Adapting technology to interaction or adapting interaction with technology?

Although many CSCL researchers specialize in collaborative-learning pedagogy, in analysis of interaction, or in the associated theory, for the field as a whole, the design of technology to provide the computer support for collaborative learning remains central. As the marketplace begins to offer media for collaboration, including Web 2.0 apps, CSCL designers still have to be concerned with how to adapt the generic media (discussion forums, chat, whiteboards, wikis, blogs, Facebook, etc.) to demanding educational goals and how to best structure the enactment of the technology in specific educational settings.

The report by *Erin Walker, Nikol Rummel,* and *Kenneth R. Koedinger* provides an insightful overview of some of the complexities involved in such adaptation. This work comes out of the Pittsburgh Science of Learning Center, home of the Cognitive Tutor Algebra. This paper takes that well-established technology for assisting individual students in learning algebra algorithms into the quite different realm of adapting such automated support to improve the quality of collaborative student interactions as two students take turns tutoring each other in mathematics. The reported attempt must be viewed as the start of several iterations. The authors recognize this. They have elaborated what they call an "in vivo" experimentation design process that combines design research with controlled experimentation to balance the tradeoffs between control and ecological validity. Similarly, they used mixed methods to get a full picture: without the qualitative data they would not understand why student use of conceptual help improved; but without the quantitative data they could not have determined how differences between isolated cases mapped to systematic contrasts between conditions.

The final article in the issue illustrates a social-psychology approach, adapted to CSCL and the design of interaction. Here, *Ulrike Cress, Katrin Wodzicki, Martina Bientzle,* and *Andreas Lingnau* were interested in supporting communication among intellectually disabled students. A group task was set up in a German special school and a set of rules was defined for subject behaviors. Two conditions were defined by manipulating one of the rules, and the results were compared. The researchers hypothesized that structuring the communication with a "floor-control" mechanism could have a substantial effect on facilitating communication among intellectually disabled people. They scripted the goal-directed behavior so that the participants had to discuss the transfer of the right to relocate items that were to be rearranged. The interesting result from a methodological perspective is that the quantitative results of the experiment were impossible to interpret on their own, perhaps even misleading. It was only through a mixed-methods approach of looking closely at the log of a typical interaction from each condition that one could make sense of the results.

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6(3): Tweets from #cscl2011

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Word of the CSCL 2011 conference in Hong Kong spread around the world instantaneously, thanks to computer support of this intensive community collaborative-learning effort. Tweets, blogs, Facebook postings, Flicker pictures, and video streaming accompanied the many face-to-face presentations and informal interactions during the pre-conference, main conference, and post-conferences in early July. The video feeds more than doubled the number of people able to participate in the conference. Check out the community memory on the conference site at isls.org/cscl2011 for links to the postings, pictures and videos.

The conference site also contains revised versions of the complete Proceedings. You can download searchable PDFs, incorporating recent corrections. The three volumes can also be printed on demand through Lulu.com. Like all CSCL and ICLS conference papers, the individual papers will be freely available on the ACM digital library.

The conference marked a significant increase in Asian participation in CSCL research, with many presentations from Hong Kong and Singapore researchers, but also from other Asia-Pacific universities. CSCL 2011 attracted over 400 registrants from more than 30 countries, including Singapore, Malaysia, Thailand, Japan, Australia, Mainland China, Taiwan, Macau and Hong Kong. The presentations were about evenly divided between Europe, Asia and North America. The impression of participants was one of high-quality research, strong scientific presentations and fluency in the conference language of English in almost all sessions.

The special theme of the conference was “Connecting computer-supported collaborative learning to policy and practice.” It reflected the long-standing tradition and priority in many of the Asian countries for education policy to support research that contributes to the improvement of educational practice (Chan, 2011; Looi et al., 2011). This theme was addressed through keynotes, paper presentations, workshops/tutorials as well as interactive, practitioner-oriented events to examine whether and how CSCL practices can bring deep changes to formal and informal educational practices at all levels, and contribute to education improvement at a system level by informing education policy. Dr. Gwang-Jo Kim, Director of UNESCO Regional Bureau for Education in Asia-Pacific, gave a keynote speech on "*Linking research and policy practice towards quality learning: Why and how?*" The other keynote speakers were Dr. Ed H. Chi, Research Scientist at Google Research, Prof. Erik Duval of the Katholieke Universiteit Leuven, and Prof. Roy Pea from Stanford University (watch their talks on video).

In conjunction with CSCL 2011, a Global Policy Forum on Learning was organized as a dialogue for about 20 prominent policy leaders, learning scientists and scholars to discuss challenges and possibilities for findings from learning-science research to have significant impacts on raising educational standards and nurturing 21st Century abilities. The vision of the Forum was to start a movement for learning to restore its central position in education policies, which was deemed to be core to the success of any reform that genuinely aims to enhance the quality of education. The Global Policy Forum held a public forum on *Back to Learning*, which attracted a large audience from the CSCL 2011 participants, the local community and the media (see its video).

After the Hong Kong main conference ended, post-conference activities were held in Guangzhou, Shanghai and Beijing during July 11-15, with the local organization led by teams from the South China Normal University, East China Normal University and Beijing Normal University, respectively. Education-policy makers involved in technology-enhanced learning at the local, municipal and national levels supported these post-conference events. This is the first time in the history of the CSCL conference that post-conference events were organized, and reflects the recognition given by researchers and education policy-makers in China to computer-supported collaborative learning as an important area of research and practice in education, and the reputation of the quality of the CSCL conference series. The post-conference events were integrated with local summer schools for PhD students and with the international Knowledge Building Summer Institute based in Toronto, Canada.

The success of the CSCL 2011 main conference and post-conferences in Hong Kong, Guangzhou, Shanghai and Beijing is a landmark indicative of the development of CSCL as a field of study in Asia and globally. We are now looking forward to ICLS 2012 in Sydney, Australia, and CSCL 2013 in Madison, WI, USA.

The Editorial Board of *ijCSCL* met during the conference and unanimously agreed to some changes in the journal in response to its great success. One change already instituted this year is to increase the number of articles published from an average of 5 per issue to 7. The ISI ranking continues to place *ijCSCL* among the top journals in educational technology and educational research based on impact factor. This has significantly increased the number of submissions to the journal, which should result in maintaining the high quality of the published articles. Clearly, *ijCSCL* continues to be read widely and to serve the CSCL community well.

In this issue

We present seven studies of CSCL processes—how they can be structured or scaffolded, and how the resultant interactions can be analyzed.

Facebook. In considering computer support for encouraging and aiding collaborative learning, it is tempting to look at popular Web 2.0 technologies as obvious available tools. They are not only already freely available, but many students enjoy using them, have incorporated them into daily life, have mastered their functionality, and employ them in maintaining social contact with other students. Often, students already re-purpose social networking tools like Facebook as "back-channels" for discussing academic courses outside of the formally sanctioned course media. In their sequence of two survey-based investigations, *Cliff Lampe, Donghee Yvette Wohn, Jessica Vitak, Nicole B. Ellison, and Rick Wash* provide a careful analysis of how the students they surveyed report their course-related use of Facebook. The results indicate nuanced correlations between the characteristics of the Facebook users and their reported propensity to engage in various forms of collaboration in their courses. Participation in college courses is a complex social process, with many important forms of student interaction outside the planning, control or purview of the instructors. This study provides a glimpse into the role that social networking media can introduce into that process. Further studies would be of interest to explore the differences that back-channel networking makes in actual course behavior or that incorporation of such media by instructors in course designs might engender.

Identity presence. Just as students engage in social networking outside of class, they also share their personal identities within the class discourse, for instance in an online discussion forum. *Fengfeng Ke, Alicia F. Chávez, Pei-Ni L. Causarano, and Antonio Causarano* focus on the role that displays of "identity presence" play in collaborative knowledge building. They document how disclosing personal histories related to course topics tends to lead to longer and deeper discussion threads, especially when such forms of presence are encouraged by instructors. Course designers often seek to elevate online student discourse from "off-topic" socializing to sharing of course-relevant examples, and then to generalized knowledge-building arguments. Expressions of personal identity can stimulate engaged discussion, but are unlikely to produce the "highest levels" of knowledge building by themselves according to this study.

Brainstorming. Concern for "process losses" frequently underlies arguments against collaborative learning. The claim is that the need to communicate, coordinate, negotiate, understand each other, and take each other's perspective into account introduce "cognitive loads" on the individuals who are collaborating. It is often simpler and hence more efficient to work on cognitive tasks individually.

Taking a collaborative approach introduces additional processes at the group unit of analysis, and this may add various costs of time, effort or complexity that outweigh the benefits. “Brainstorming”—the task of generating a list of a specified kind of idea in a given period of time—is a classic test of group-process losses in social psychology. In order to better understand the tradeoffs involved and the possibility of minimizing the costs of collaborative learning through computer support, *Hao-Chuan Wang, Carolyn P. Rosé, and Chun-Yen Chang* distinguish two operational definitions of learning: connection-based (socio-cognitive, see Cress & Kimmerle, 2008; Joczak, 2011) and multi-perspective learning (dialogic, see Kershner et al., 2010; Schwarz et al., 2011; Wegerif, 2006). As in recent studies of “productive failure” (Kapur & Kinzer, 2009; Pathak et al., 2011), it appears that long-term learning gains may be optimized in situations that display discouraging short-term process costs. Careful analysis is needed to design and manage effective CSCL approaches given these subtle trade-offs.

Technical writing. In the experiment conducted by *Shiou-Wen Yeh, Jia-Jiunn Lo, and Jeng-Jia Huang*, a software system for structuring and supporting collaborative writing featured brainstorming that led to outlining a paper to be written. Learning to write collaborative technical papers in English as a foreign language is particularly important in many regions of the world. Here, the brainstorming did not generate lists of new ideas, but provided sets of similarities and differences on a given topic—for instance, cultural contrasts between Chinese and Western societies. The experiment analyzed surveyed attitudes of participants, evaluated the documents that were drafted and compared the forms of the student interactions to demonstrate the benefits of software scaffolding for this complicated task of collaborative learning.

Mathematical elaboration. In yet another study that shows that broad, undifferentiated research questions—like whether collaborative learning is more effective than individual learning—obscure the important processes and distinctions, *Dejana Mullins, Nikol Rummel, and Hans Spada* explore collaborative mathematics. By differentiating math tasks involving reasoning from those stressing practice, they rigorously showed that collaboration aids in the learning of elaboration skills but not in the learning of procedural skills. Whereas individuals can more efficiently practice routine math procedures, unsurprisingly it helps to have dialogical partners to engage in reasoning about innovative problems and in elaborating mathematical arguments. As Vygotsky (1930/1978) suggested with his discussion of the zone of proximal development, collaboration can lead to long-term conceptual learning gains when the task is just beyond a person’s individual mastery level. This study indicates that in the domain of mathematics, conceptual learning tasks (at the right level) are more likely than procedural exercises to trigger effective collaborative-learning interactions. This explains why some studies of collaborative math have positive conclusions and others do not, depending on the nature of the task.

Sequential analysis. In order to model the group processes of knowledge construction taking place in a typical discussion forum, *Alyssa Friend Wise and Ming Ming Chiu* combine several analytic approaches from the CSCL literature. Most significantly, they avoid the loss of sequential interaction information that occurs when statistical analyses are computed on codes of postings (Kapur, 2011; Reimann, 2009; Stahl, 2002). They demonstrate ways of identifying sequential patterns in the interaction, including what types of postings follow each other (similar to the Hidden Markov Modeling approach of Soller & Lesgold, 2003) and where pivotal points occur (Wee & Looi, 2009). They then look at how different sequential patterns of posting types are contributed by participants playing different conversational roles. They also consider which roles contribute pivotal postings and when those occur in the overall discourse profile.

Role playing. In the concluding article of the issue, *Francesca Pozzi* explores the impact of a variety of roles on the interaction in a discussion forum and on the awareness of the participants of the role-based group discourse processes. This is a small-scale pilot study that looks at the flow of CSCL processes in participative, social, cognitive and teaching dimensions. This paper reflects nicely on the different ways in which role-playing is analyzed in CSCL research.

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6(4): Collaborating around the tabletop

In romantic visions of yesteryear, the idyllic nuclear family gathered around the kitchen table to share a bountiful dinner meal or the extended family came together around the dining-room table for a traditional holiday feast. These were occasions for lively and significant discussions, where consequential decisions emerged or were proclaimed and in which traditions were enacted and passed on. In such conversations, memorable interchanges took place spontaneously, without generally being planned or even in contrast to intentions brought to the table. How did the physical and social setting of the occasion open up a space across the tabletop in which discourses could form of their own volition? How did things come to word, which none of the participants had in mind beforehand or would have come up with on their own?

Several years ago in the introduction to an issue of this journal (Stahl, 2007), we imagined a group of people meeting around a primordial tribal fire (see Fig. 1). They discussed the dialectical relationship between the fire as a spiritual phenomenon and the individual logs that contributed to its continuing existence. Participants in the discussion exchanged questions and perspectives, building a multi-vocal network of utterances that reflected the complexity of the relationship.

Fig. 1 Tribal fires throughout human history.

The discussion of the emergence of the tribal fire from the burning logs served as a metaphor for the problem of the relationship of group cognition to individual thinking. The questions and reflections of the tribal members mirrored theories influential in CSCL research, from mental models to distributed cognition, activity theory and actor-network theory. The articles in that issue of the journal exemplified various positions within CSCL analogous to those in the mythical discourse of the tribe.

Conversation around the fire was paradigmatic of oral society. The answering of questions and the relating of narratives were knowledge-disseminating and knowledge-building mechanisms for unmediated verbal interaction. In literate society, texts like professional journals can open analogous “spaces” in which knowledge can be built and archived for communities such as research fields. In the digital age, technologies like wikis can play a similar role, at least in theory.

Imagine a mature Wikipedia page that presents a fairly coherent view, with a subtle intertwining of numerous thematic threads. Assume that the page has grown through a patchwork of edits by many, essentially anonymous contributions. When you read the page, you get a comprehensible impression of a complex idea that far exceeds what any of the individual contributors had in mind when they edited the page. Probably, most of the contributors tweaked details of specific sections that were in the wiki page at the time, and few if any contributors worried about the overall shape and impact of the page as a whole. The page emerged from this complex, unplanned, willy-nilly process of collaborative meaning making. The meaning of the final wiki page is a function of the interplay of the many words and sentences in the current version. While this web of meaning is the result of individual actions, it does not correspond to the thought of any one individual, nor is it a simple combination of such thoughts. It is the residue from a sequential interaction that was not planned but just happened. The wiki page—as a persistent, observable artifact—makes visible the nature of the group-generated meaning as a semantic web resulting from the unplanned, intentional, sequential interactions of individuals, which is not attributable to the agency of any individual contributor.

Recently, the availability of “tabletop” educational environments has raised the possibility of a digital technology that can serve as the center for small groups of learners to engage in a hybrid of oral, literate, and digital interaction: a multimedia tribal fire for the classroom, workplace, or social gathering. It seems that the tabletop can integrate physical and digital artifacts, spoken and written texts, and human and computational support to form a focal point, subject matter, and dynamic resource for collaborative knowledge building. However, if the field of CSCL has learned anything in the past two decades, it is that apparent technological possibilities require considerable interface design, user evaluation, pedagogical structuring, and collaborative culture in order to achieve desirable educational results.

This leads to the need for a flash theme of tabletop computing. A “flash theme” is a topic that has flared up in the current CSCL research community as an issue of timely importance and as a matter of viral concern. In previous years, we have featured articles on the flash themes of community-based learning, scripting in CSCL, argumentation in CSCL, and methods for evaluating CSCL. In this issue, we begin a flash theme on tabletop interfaces for CSCL. Like most of the earlier flash themes, this one flamed up at a workshop of CSCL researchers. The participants of the workshop and others have prepared scholarly presentations about the relevance of tabletop interfaces to the support of collaborative learning. We begin with several introductory papers in this issue. We anticipate more papers next year, and welcome additional submissions on this flash theme.

In this issue

We begin with an overview of the flash theme, interactive tabletops in education, by *Pierre Dillenbourg and Michael Evans*. This paper addresses in some detail the temptation to over-generalize the potential of the technology itself to produce educational gains and the tendency for inflated expectations based on the nature of the tabletop medium. The paper first provides a description of tabletop interfaces and their most common components, illustrating with examples of diverse research prototypes. It then discusses the primary characteristics of tabletops that lend them a socio-cultural flavor, at least potentially: they provide a hands-on multi-modal medium for co-located interaction within small groups. So tabletops tend to be small-group environments, in contrast both to the personal style of desktops, laptops, or mobile devices and to the public or classroom style of whiteboards. The role of small-group tool, mediating between individual cognition and classroom practices raises a number of issues for CSCL research on tabletop computing. The paper enumerates 33 such issues, clustered into the circles of: interaction with the individual student, support for small-group interaction, classroom orchestration, and institutional context. These dimensions highlight the complexity of tabletop interaction and militate against the tendency to assume that it is simply more "natural" than interaction with laptops because of its support for direct physical gestures. The paper provides a tentative catalog of central topics for analyzing tabletops in future articles of the flash theme.

The overview of research in tabletop environments for CSCL continues with a synthetic review of the literature by *Steven E. Higgins, Emma Mercier, Liz Burd, and Andrew Hatch*. They build on the preceding introduction and further develop the typology of issues for research, organizing over a hundred studies into categories related to the nature of the multi-touch interactive tabletop's surface, how it can be touched by its users, how it is networked with other devices, or how the tabletop is used to support collaborative learning. This review of the early literature on tabletops not only summarizes initial findings, but more importantly sketches the territory to be covered by needed future research. A central concern is how the tabletop design affords particular interaction patterns among the students using it together.

The next paper, by *Sara Price and Taciana Pontual Falcão*, takes up the task of analyzing interaction patterns that emerge during use of a tabletop interface in England. It focuses on the productive role of interference—for example, when two users simultaneously move tabletop objects in a way that interferes with each other. This seems related to recent *ijCSCL* discussions of "productive failure" (Kapur & Kinzer, 2009; Pathak et al., 2011; Wang, Rosé & Chang, 2011)—in which engagement with what Piaget might consider cognitive conflict leads to collaborative learning. Building on ideas developed in earlier flash-theme discussions of argumentation and scripting, this paper analyzes instances of interference in usage of tabletops for collaborative learning. The tabletop environment provides a rich space for several students to explore phenomena of physics collaboratively. The open, embodied, multi-touch micro-world allows for many forms of student-centered discovery and small-group interaction, as well as multiple opportunities for interference of both actions and conceptualizations. The paper systematically looks into the variety and consequences of such interference. While the tabletop interface affords multiple forms of interference, it is the nature of the small-group collaboration processes that primarily influences the learning that results. Productive argumentation involves the students in seriously considering each other's perspectives and resolving conflicts to allow a group solution. Determining how this takes place involves rather detailed analysis of the physical and verbal interactions around the tabletop.

Tabletop equipment is prohibitively expensive today for deployment beyond research settings. A group in Chile, including *Eyal Szewkis, Miguel Nussbaum, Tal Rosen, Jose Abalos, Fernanda Denardin, Daniela Caballero, Arturo Tagle and Christian Alcohoiado*, has been exploring a relatively inexpensive alternative: allowing a large group—a whole classroom—of students to share a projected computer display in common and each have access to interacting with it using multiple mice. A number of classroom practices are instituted, involving mouse-based interaction patterns; they implement what the authors call "silent collaboration" exchanges in which students work together on the assigned task without talking. The exchanges of computer icons by the student dyads using their mice are displayed for the dyads and for the whole class on a projection screen. In this way, all the students can be simultaneously actively involved in collaborative-learning activities within a large group, gathered around a shared display. The experimental results indicate significant collaborative-learning gains with this approach.

Telling stories is a fundamental form of interaction in oral societies; we learn how to create and narrate stories as young children (Bruner, 1990; Ong, 1998). In an experiment involving scripted collaboration and computer support, *Giulia Geimini-Hornsby, Shaaron Ainsworth, and Claire O'Malley* investigate how asking questions can help to drive the development of storytelling skills. They find the “guided-reciprocal-questioning script” to be effective in a number of ways. Interestingly, this is a very flexible kind of script, in contrast to many scripts investigated in CSCL research, allowing students to select what question to pose and even motivating them to formulate their own questions. Also, as a form of scaffolding, the use of this script seems to continue to exert a positive influence after the use of the script is withdrawn.

The next paper also explores the effect of scripted questioning. In a controlled experiment by *Inge Molenaar, Ming Ming Chiu, Peter Sleegers, and Carla van Boxtel*, triads of students engaged in collaborative learning in the Netherlands are periodically interrupted by questions on their computer. In the three conditions, they are shown either just a cartoon drawing of a teenage boy (the avatar), the drawing along with instructions on some action to take and suggestions on how to take it (the “suggestive” scaffold), or the drawing with a question about how to take some action and a text box for typing in a response (the “problematizing” scaffold). Analysis of the results indicates that the students shown the problematizing scaffolds learned the most domain knowledge. The questions were timed to correspond to points in the collaborative work when students would be thinking about their collaborative-learning process (engaging in metacognition). By prompting their metacognition in a timely manner, the scaffolds apparently aided the students in their reflections and interactions.

We close this issue and the volume with an exploration of community building by *Donatella Cesareni, Francesca Martini, and Ilaria Mancini*. They report on activities that took place in Italy during the second year of a European CSCL project—I happened to be involved in the system design phase in the first year in Germany (Stahl, 2006, chapters 7 & 8). In contrast to the carefully structured classrooms of young students in the preceding papers, here we have a reflection on a relatively free-flowing community of teachers, researchers, and university students: interacting online and face-to-face, synchronously and asynchronously, in text and through speech. For most participants, this was an initial involvement in what must be considered the early days of CSCL, given the state of computer support and experience in that setting. This helped to make visible the dialectic between expert and novice as the community matured.

Six years of *ijCSCL*

This issue completes six incredibly successful years of publication of the journal. The journal has attracted many important submissions and has served the CSCL research community by publishing a broad range of papers covering new ideas, rigorous studies, strong theoretical reflections, methodological innovations, and insightful reports. It not only serves as an archive for significant findings, but also as a venue for reflection upon the theories, methodologies, and agendas of the global CSCL research field, providing insights into the nature of collaborative learning as well as practical suggestions for implementing computer support. The quality of the published articles is due to the Board of Editors and other reviewers, who have not only selected the papers to be printed, but also provided key suggestions to the authors, which have resulted in substantial improvements to the final versions; they have kept the flames of this tribal fire burning brightly.

For next year, there will be some changes to the Board of Editors due to a substantial increase in the number of submissions to the journal. All Board members were asked if they wanted to renew their Board membership for another four years. Of 72 Board members, 82% committed to serving further and 13 decided to rotate off the Board to allow new members to join. In addition, the Associate Editor positions have rotated; the 6 new Associates will be taking on the supervision of reviews and the drafting of the meta-reviews, along with the Executive Editors. Nancy Law joins as an additional Executive Editor. Carol Chan, Ulrike Cress, Manu Kapur, Sten Ludvigsen, Carolyn Rosé, and Daniel Suthers take on the expanded Associate Editor roles.

At this time, the journal Executive Editors would like to express our sincere thanks to the people stepping off the Board, for their six years of support, helping to get the journal off the ground. We are also grateful to the former Associate Editors—who will all be continuing on the Board—for their leadership during this critical period. As always, we recognize the people who have contributed the decisive reviews, including the following:

Shaaron Ainsworth, Rick Alterman, Jerry Andriessen, Nancy Ares, Baharuddin Aris, Hans Christian Arnseth, Maarit Arvaja, Christa Asterhan, Maria Avgerinou, Gerardo Ayala, Michael Baker, Maria Bannert, Liam Bannon, Ulrika Bennerstedt, Johanna Bluemink, Daniel Bodemer, Jacqueline Bourdeau, Paul Brna, Bertram Bruce, Amy Bruckman, Jurgen Buder, Murat Cakir, Angela Carell, John Carroll, Carol Chan, Rosanna Chan, Tak-Wai Chan, Elizabeth Charles, Clement Chau, Fei-Ching Chen, Britte Cheng, Cesar Collazos, Ulrike Cress, Charles Crook, Lucilla Crosta, Ton de Jong, Anne Meier Deiglmeyer, Muhammet Demirbilek, Sharon Derry, Bram DeWever, Pierre Dillenbourg, Angelique Dimitrakopoulou, Lone Dirckinck-Holmfeld, Nina Dohn, Gilles Doiron, Paul Dourish, Nathan Dwyer, Anna Engel, Noel Enyedy, Gijsbert Erkens, Michael A Evans, Deller Ferreira, Frank Fischer, Brian Foley, Andrea Forte, Hugo Fuks, Andreas Gegenfurtner, Anne Gerdes, Sean Goggins, Ricki Goldman, Luisa Aleyda Gonzalez, Begoata Gros, Jonathan Grudin, Frode Guribye, Joerg Haake, Paivi Hakkinnen, Kai Hakkarainen, Raija Hamaalainen, Andreas Harrer, Wu He, Libby Hemphill, Thomas Herrmann, Friedrich Hesse, Steven Higgins, Cindy Hmelo-Silver, Christopher Hoadley, Ulrich Hoppe, Christine Howe, Tien-Chu Huang, James Hudson, Diane Hui, Chris Hundhausen, Liisa Ilomaki, Shahrinaz Ismail, Isa Jahnke, Sanna Jarvela, Patrick Jermann, Richard Joiner, Christopher Jones, Robert Jorczak, Regina Jucks, Yael Kali, Victor Kaptelinin, Manu

Kapur, Anastasios Karakostas, Fengfeng Ke, Diane Jass Ketelhut, Andrea Kienle, Joachim Kimmerle, Paul Kirschner, Lars Kobbe, Matthew Koehler, Timothy Koschmann, Ingeborg Krange, Eleni Kyza, Therese Laferriere, Minna Lakkala, Victor Lally, Niki Lambropoulos, Mary Lamon, Yu-Ju Lan, Johann Larusson, Nancy Law, Mark Lee, Erno Lehtinen, Maria Ligorio, Kenneth Lim, Robb Lindgren, Oskar Lindwall, Lasse Lipponen, Geoffrey Liu, Jia-Jiunn Lo, Jacques Lonchamp, Chee-Kit Looi, Jingyan Lu, Rose Luckin, Sten R. Ludvigsen, Andreas Lund, Kristine Lund, Johan Lundin, Kim MacKinnon, Alejandra Martinez, Richard Medina, Monika Mital, Naomi Miyake, Anders Morch, Johannes Moskaliuk, Daisy Mwanza-Simwami, Bonnie Nardi, Brian Nelson, Bernhard Nett, Matthias Nackles, E. Michael Nussbaum, Angela O'Donnell, John O'Donoghue, Claire O'Malley, Hiroaki Ogata, Javier Onrubia, Jun Oshima, Khaziyati Osman, Roy Pea, Ruediger Pfister, Manoli Pifarre, Sara Price, Mingzhu Qiu, Subba Rao, Ingvil Rasmussen, Janet Read, Peter Reimann, Ann Renninger, Jochen Rick, Alan Roberts, Tim Roberts, Jennifer Rode, Markus Rohde, Jeremy Roschelle, Carolyn Rose, Liam Rourke, Nikol Rummel, Nadira Saab, Roger Saljo, Johann Sarmiento-Klapper, Claudia Sassenrath, Tammy Schellens, Oliver Scheuer, Gregg Schraw, Baruch Schwarz, Anna Sfard, David Shaffer, Wesley Shumar, Amy Soller, Nancy Songer, Hans Spada, Marc Stadtler, Gerry Stahl, Karsten Stegmann, Constance Steinkuehler, Alan Stevenson, Jan-Willem Strijbos, Masanori Sugimoto, Daniel Suthers, Berthel Sutter, Seng-Chee Tan, Steven Tanimoto, Gustav Taxen, Pierre Tchounikine, Meng Yew Tee, Chris Teplovs, Ramon Prudencio Toledo, Stefan Trausan-Matu, Jan van Aalst, Ravi Vatrapu, Marjaana Veermans, Sarah Walter, Jim Waters, Christof Wecker, Rupert Wegerif, Armin Weinberger, Gordon Wells, Martin Wessner, Tobin White, Donghee Wohn, Volker Wulf, Fatos Xhafa, Ling Ling Yen, Jennifer Yeo, Fu-Yun Yu, Nicola Yuill, Joyce Yukawa, Coco Zhao, Nan Zhou.

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7(1): Ethnomethodologically informed

The research field of CSCL is ethnomethodologically informed, or at least ethnomethodologically influenced. This has not always been the case, although there is a logic to this growing tendency.

Ethnomethodology (EM) is an approach to conducting research in the human sciences founded by Harold Garfinkel (1917-2011) and largely defined by his *Studies in Ethnomethodology* (Garfinkel 1967; Garfinkel & Rawls 2012).[1] EM addresses the 'methods' that people within a given linguistic community use to establish and maintain intersubjective understanding. Since CSCL can be characterized as being focused on joint meaning making,[2] the analysis of prevalent meaning-making methods seems particularly relevant to the methodological quandaries of CSCL research.

Ethnomethodology has been slow to catch on in CSCL, in contrast to its role in allied fields like CSCW, where it seems to be a dominant research paradigm (e.g., see Crabtree 2003). There are a number of theoretical and historical reasons for this. For instance, as discussed below, practitioners of EM eschew research questions and theoretical framings because these could obscure the meaning-making perspective of the people whose interactions are under investigation. This injunction against guiding theory makes it difficult to integrate EM studies into the educational and design agendas of CSCL investigators. In addition, the case-study approach of EM to analyzing naturally occurring events is at odds with the traditional emphasis in educational and psychological research on controlled experiments and statistical generalizations.

On the other hand, there are strong arguments for viewing the ethnomethodological approach as especially appropriate for analyzing computer-supported collaborative learning. In particular, a major stream of research within EM has been conversation

[1] Garfinkel died in April 2011. Michael Lynch (2011) wrote an obituary reflecting on his life. His work is outlined in his Wikipedia entry (2012). This issue of *ijCSCL* is dedicated to his vision.

[2] Timothy Koschmann (2002) presented a programmatic description of CSCL in his keynote at CSCL 2002: "CSCL is a field of study centrally concerned with meaning and the practices of meaning making in the context of joint activity, and the ways in which these practices are mediated through designed artifacts."

analysis. This is the analysis of talk-in-interaction, as pioneered by Harvey Sacks (1962/1995) and other colleagues of Garfinkel. An early finding of conversation analysis was the system of turn taking in face-to-face informal conversation. While this system does not apply directly to such CSCL interactions as online text chat about an academic topic (Zemel & Çakir 2009), the underlying techniques of sequential analysis (systematized in Schegloff 2007) seem highly applicable to the analysis of meaning making in CSCL settings (for an example, see Stahl 2011). Such sequential analysis explicates the evidence embodied in instances of discourse that reveal meaning-making processes taking place in small groups. It looks at the semantic, syntactic and pragmatic details of how utterances respond to each other and elicit new responses in the flow of group cognition.

The historical traditions of CSCL research

To paint a simplistic picture of the development of CSCL research, let us say that early investigators turned from inspirations in computer science and artificial intelligence to the fields of educational psychology and sociology to find methods of studying the effects of using CSCL systems in classrooms or in laboratories. The theories and research paradigms that they brought in from these established fields focused on either the individual student or the larger society as the unit of analysis. Educational theory operationalizes learning as a hidden change in mental state of student knowledge from before an intervention to after, as measured by pre- and post-tests of individual students. At the other extreme, social science approaches hypothesized societal forces that could not be observed directly, but could be inferred and measured by controlled experiments using statistically significant numbers of randomly selected subjects.

Ethnomethodology—drawing on philosophical influences from phenomenology and reacting against functional approaches to sociology—takes a different tack, centered on what is made visible in the interactions between people. EM argues that one can observe the meaning-making processes at work by carefully studying the discourse between people; one does not have to make inferences about hidden changes in mental models or invisible social structures. Furthermore, EM studies can focus on the small-group unit of analysis, which seems most appropriate to analyzing collaborative learning. While other areas of education and of sociology may seem centrally concerned with individual or societal units of analysis and while collaborative learning may also involve processes and phenomena at those levels, the meaning making in contexts of joint activity which is definitive of CSCL takes place primarily at the small-group level, even if a complete understanding will need to tie all the levels together (Stahl 2012).

The ability to conduct microanalysis of interaction was historically made possible by recording technologies. Conversation analysis arose in the age of the tape recorder. That technology made it possible to hear exactly what was said and how it was articulated. It allowed the production of detailed transcripts, which encoded intonation, pauses, emphasis, restarts and overlaps so that the mechanisms of verbal interaction could be studied. Subsequent development of video recording led to analysis of gesture, facial expression, gaze and bodily posture as important but generally unnoticed aspects of interpersonal interaction. For online communication typical of CSCL, computer logs and even the ability to replay synchronous interaction can provide adequate data sources necessary for the study of how students actually engage in computer-supported collaborative learning.

Applied to CSCL, the approach of EM implies that we can observe and report on the ability of given technologies and pedagogies to mediate collaborative interactions between students in concrete case studies. EM suggests ways to do this systematically, with intersubjective validity, and to generalize the findings. Insights from this can be used to critique the designs of interventions and to suggest redesign criteria. To make these claims about EM plausible, we will need to review some of the principles of EM (see also, Stahl 2006, Chapter 18).

The theoretical framing of CSCL research

As mentioned above, there is a prevailing notion that EM is atheoretical or even anti-theoretical, that it rejects all theorizing. Yet Garfinkel and Sacks (1970) were highly theoretical thinkers, influenced by philosophy, sociology and communication theory. In fact, EM represents a strong theoretical position about the nature of human reality and the possibilities of comprehending it. EM claims that human social behavior is structured by a large catalog of 'member methods'—patterned ways of making intersubjective sense with other members of one's linguistic community. Furthermore, these member methods are 'accountable' in the sense that they provide an observable account of their own character. People's actions are designed so that the meaning of the actions will be recognizable by others within the given discourse situation. This accountability is necessary for intersubjective understanding among members. But it has the secondary consequence that researchers can understand the methods as well (given certain conditions). The theory of EM thereby explains how EM is possible as a scientific enterprise.

The member methods of a linguistic community contribute significantly to the social order of activities within the community. The social structure is enacted in the very interactions of the members by virtue of their use of these methods; the accountability of the methods, as they are realized, reveals to the other participants (and potentially to researchers) evidences of what is being enacted. As Garfinkel put it, "any social setting [should] be viewed as self-organizing with respect to the intelligible character of its own appearances as either representations of or as evidences-of-a-social-order" (Garfinkel 1967, p. 33). There is reflexivity at work between the meaning of an elemental interaction (e.g., an utterance response pair) and the local context of the on-going discourse, in which the utterances are situated within a context whose significance they interpret in a continuously emergent way. The theory of EM is formulated in its concepts of member methods, accountability, reflexivity, etc.

The reason that EM is often considered atheoretical is that it systematically rejects the kind of theoretical framing that is associated with many other research approaches. For instance, in other paradigms an experiment and its analysis are motivated and structured by a theory or conceptualization of the phenomena to be studied. There may be a specific research question that the researchers have in mind. There may even be hypotheses about how the experiment will turn out based on preconceptions. While scientific researchers must remain open to their hypotheses being disproven by the evidence, the posing of research questions and hypotheses define a research perspective within which the evidence is interpreted. For instance, CSCL discourse data might be coded according to a set of codes designed to make distinctions relevant to this perspective, experimental conditions will be structured to test these distinctions and coders will be trained to categorize their data from this perspective.

EM, in explicit contrast, wants to understand the data from the perspective of the participants in the study (e.g., students). Because the analysis of discourse is a human science, it must take into account what the discourse means for the speakers and audience. The participants are viewed as people engaged in meaning making, and EM researchers want to understand the meaning that the participants are making. EM researchers do not want to impose a perspective on the data analysis that is based on their own preconceived theories about the interaction. Rather, they want to engage in 'thick description' (Ryle 1949) of the discourse to explicate the meaning making that is taking place in the discourse and that is displayed in the accountability of how it is formulated. The fact that the discourse is accountably intersubjectively understandable allows the researcher to analyze the meaning that is implicit in the discourse as it sequentially unfolds.

This is the sense in which EM rejects theory: that it adopts the participant perspective on understanding the meaning in the data, rather than imposing a perspective based on a theoretical research framing. There has been considerable debate within CSCW about how EM analysis can be used to guide design of collaboration systems if it cannot be directed toward theoretical issues (e.g., see

Crabtree 2003). But the stricture against theory in EM is only against imposing an a priori analysis framework, not against drawing theoretical consequences from case studies. So one can, for instance, study the discourse of students embedded in a computer-supported interaction, and analyze the nature of the methods they use—which they enact, adapt or create—for achieving their collaborative tasks. The details of these methods can have design implications, such as addressing technical barriers that resulted in unnecessarily cumbersome behaviors. Thus, EM can contribute to the analysis phase of design-based research (Design-Based Research Collective 2003), which is a widespread approach in CSCL to the design of effective collaboration technologies.

The ubiquity of methods

Ethnomethodology posits the existence of member methods pervading all of social life. EM research for the past fifty years has documented many such methods, for instance in informal conversation, in doctor-patient discussion, in mathematical proof, in criminal interviewing and in workplace communication (Lynch & Sharrock 2003). These methods are often sedimented in the traditional design of the tools we use and in the clichéd turns of speech within our vernacular. They constitute our myriad overlapping cultures.

Sacks (1962/1995) argued that the pervasiveness of member methods meant that one could profitably study almost any interaction and learn from it about the nature of social existence. He argued that the universal application of these methods was necessary if people were to understand each other. In the CSCL literature, one often talks about the establishment and maintenance of 'common ground' (Clark & Brennan 1991) as providing the foundation for intersubjective understanding. But, according to EM, it is not a matter of the participants having corresponding mental models of propositional knowledge; rather, intersubjectivity is founded on sharing a world through using shared methods of communication (see also Stahl et al. 2011). These methods provide 'resources' for engaging in specific domains of the social world. According to the EM viewpoint, collaborative learning does not consist in the storing of propositional knowledge as mental contents in individual minds, but in the increasing ability to enact relevant resources or shared practices in interactions with others.

By looking carefully at interactions in CSCL settings, we can analyze the methods being applied. Because the acceptance of these methods is widespread within a culture, the results of a single case study can have quite general ramifications. Of course, to accept the implications of a single case study—or even a small catalog of case studies analyzing variations on a method—as valid and of general applicability, we need to ensure lack of bias or idiosyncrasy. This is usually addressed in EM by 'data sessions' and other mechanisms to involve multiple analysts (Jordan & Henderson 1995). If discourse under analysis displays an account of itself, then a group of experienced analysts who share the relevant cultural understanding with the discourse participants should be able to reach a consensus about the meaning being created in the discourse. EM case-study publications frequently include very detailed transcripts of the relevant discourse excerpts to enable readers to confirm the analysis based on their own cultural understanding. Because meaning and meaning-making methods are always situated in unique, evolving, emergent contexts, the case study is the preferred genre of presentation for EM studies of CSCL.

In previous issues of *ijCSCL* there have only been a couple of explicitly ethnomethodological case studies, such as those of Lymer, Ivarsson & Lindwall (2009) or Cakir, Zemel & Stahl (2009). The following contributions to CSCL research all also adopt case-study approaches. They identify with EM to varying degrees, suggesting a range of approaches to informing CSCL with the EM influence. It is perhaps noteworthy that even though EM originally developed in the US and despite the fact that it spread primarily through personal teacher-student or mentoring relationships, none of the articles in this issue are from the US. In particular, the most strongly EM-informed of these studies are from the UK and Scandinavia (Sweden, Denmark and Finland). A similar geographic pattern seems to be present in CSCW research, despite notable exceptions in both fields.

Case studies of ethnomethodology in CSCL

In this issue, we open with an EM case study by *Christian Greiffenhagen* that looks at the teacher's role in CSCL. While previous CSCL research has shown the dramatic difference that the teacher role can play in a CSCL classroom through statistical contrasts, this study looks at what the teacher actually does and says in interaction with the students.

This paper highlights the ways in which the teacher repeatedly guides the students in ways that realize the goal of the day's lesson. These methods of interaction while making classroom rounds are primarily taken-for-granted actions that are neither premeditated by the teacher nor surprises to the students. They are natural responses to the situation, where the teacher acts intuitively to make the lesson more effective. Anyone who has been a teacher making these kinds of rounds in a classroom where students are working in collaborative small groups—or any researcher who has observed such rounds—will probably feel that the author has articulated the sorts of actions that one had experienced without putting them into words. The actions were natural for the students as well; the students in the study not only responded to the teacher's actions, but they actually anticipated them and even looked out for them.

The paper assembles a catalog of examples of different kinds of typical moves that the teacher made in this session. We can imagine that very similar interactional moves—or communication methods—take place everyday in classrooms around the world. Yet, the specifics of these interaction excerpts are completely situated in their unique setting. Not just the pedagogy of the lesson, the characteristics of the technology, the concern about the future test, but even the details of the posture of the student and the path of the teacher contribute to what is said, to whom it is said and how it is said.

What takes place and what is stated is full of meaning. It is significant in terms of the life of the teacher, the students and the school. Despite its situated, indexical and fragmentary articulation, what is said displays for all concerned its accountable meaning. The meaning of the day's lesson could not be fully articulated in an initial statement; it had to be worked out as the lesson unfolded. That was the role of the rounds. The teacher had to reorient the students to the important aspects of the lesson and limit their distraction by other aspects. The need to do this was not clear from the outset, but emerged through the reflexive process in which the students enacted the lesson and the teacher responded to signs that the experienced teacher could see to be problematic.

The EM analysis was accomplished by analyzing the meaning-making processes that took place in the classroom during the rounding. There was no need to impose criteria for judging the actions or utterances of the teacher, the students or the schoolwork. Yet, one could derive many useful suggestions for redesigning the pedagogy and/or technology of the lesson. One could take away insights into the role of the teacher during small-group sessions and the nature of a collaborative-learning classroom—all from a single case study.

Against generalization

In the next article, *Ulrika Bennerstedt*, *Jonas Ivarsson* and *Jonas Linderoth* address the idea of educational gaming. As they document, there are two dominant and diametrically opposed positions about the educational potential of videogames. On the one hand, some CSCL researchers wonder if we can harness for educational aims the motivational power that videogames exert over many students; some of these researchers even claim that gamers learn important collaboration and learning skills by playing massively multiplayer online games. At the other extreme, parents are worried that the games primarily teach violent behaviors. The paper authors propose that one should refrain from prejudging this issue and conduct an ethnomethodologically informed examination of how gamers actually manage their collaborative gameplay activities. In EM terms, this involves describing the ways in which gamers display skills and produce the social order of the multiuser game.

The paper takes a sequential-analysis approach by following key interaction sequences step by step. Doing so requires an understanding of gameplay. That is, the researcher must become acculturated in the gaming community of the particular game (Lord of the Rings Online) in order to make sense of possibilities, actions and consequences from the perspective of a player. The analysis even adopts some of the terminology used by players to describe their actions. Without this, it would not even be possible to understand how characters in the game collaborate or what their motivations are.

The authors argue against generalizing from the collaborative or violent aspects of the behavior they analyzed. The form of collaboration in the game is quite sophisticated, but totally specialized to the technical details of the game environment. Furthermore, it is entangled in the issue of violence. While on a superficial visual level the game involves players in violent interactions with various kinds of monsters, the portrayed aggression is highly mediated by strategic considerations in the face of complex game rules and definitions. The arousal that players feel probably has much more to do with the challenge of competing against the complex rule system, presented in terms of imaginative representations, and interacting socially in a fantasy world. The detailed look at what actually transpires in the game suggests little basis for generalizing the skills involved either to learning in school or to violence in the streets.

Resources for learning

The notion that learning centrally involves the acquisition of knowledge structures, mental models or mental faculties that can be applied generally, across diverse contexts is far removed from an ethnomethodological approach. Instead, EM analysts look for ‘resources’ that people skillfully adopt in concrete interactional situations. Rather than trying to infer ‘transfer’ of knowledge, they look for the uses of resources that may display the take-up of issues from beyond the current local situation. In this manner, *Kenneth Silseth*, in his case study, explores the role of resources from outside the classroom—both from global politics as portrayed on television and from gaming experiences or personal hobbies—on a student’s learning trajectory in a school lesson.

Here, we see the impact of gaming on a student and on his interactions and inscriptions—not as a generalized influence, but as a resource that can be brought to bear in specific ways. Similarly, the violence of televised global conflicts can enter into the student's meaning making as a displayed resource rather than as a general structure or hidden societal force. Relatedly, the learning trajectory of the student is observable in sequences of utterances (in discourse with other students as well as in successive writings submitted to the teacher), rather than being a measurable but unseen change of mental contents or state. The paper analyzes in some detail how the student's interactions in gameplay become constituted as resources for academic discussion of a social studies topic.

This paper takes a dialogic approach. This is in certain significant ways similar to EM, in that it focuses on close analysis of the meaning making and discourse of dyads and small groups. The context of on-going interaction provides the context for situated analysis. Building on the writings of Bakhtin, dialogism stresses the inter-animation of perspectives and the dialectic between self and other (see references in the paper). As Koschmann (2002) argued, both dialogism and EM are potentially productive for CSCL analysis of meaning making.

Interestingly, this article demonstrates the role of the teacher in guiding the students. The detailed analysis of teacher interventions and interactions with the student show how the teacher supported the student to adopt a multifaceted perspective on the topic. It thereby makes visible the way in which collaborative learning among students can involve technology and teacher scaffolding in the situated process of bringing in resources from outside the classroom situation. In turn, the dialogic perspective on the Israeli-Palestinian conflict, which emerged in the student's learning trajectory, will presumably provide a resource for his subsequent meaning making around issues of global politics.

The personal as resource

The concept of resources for learning as developed in the next contribution provides a nice corrective to a long-standing issue in CSCL. *Arvaja Maarit* analyses the use of personal and shared experiences as resources for online discussion. Many CSCL studies of the use of threaded-discussion forums for school-based knowledge building have complained that students post too many statements of their personal opinions, based on their past experiences. Researchers often code discussions in terms of a presumed hierarchy of knowledge-building moves—a pre-existing theoretical framework for measuring how student interactions meet an ideal of what they "should" be doing from the researcher's perspective (Chi 1997). Posted descriptions of someone's personal experience are often coded as 'off topic'. The researchers then wonder why it is so hard to get students to build knowledge collaboratively in a discussion forum.

By analyzing the ways in which students in a particular case study make sense of the topic for themselves and for each other, the paper not only provides insight into this student behavior, but also suggests why it is desirable. Rather than viewing the postings as expressions of rationally calculating individual minds deducing knowledge, the EM or dialogic approach is to look at how potential resources available in the larger contexts of one's life are made actual and relevant within a current discourse, such as a threaded discussion. Potential resources include semiotic, material, social, cognitive and cultural resources, such as past personal experiences that one has had in school, on a job, playing a game or watching television.

In this paper, we see how students discussing philosophic texts that are hard to understand succeed in making sense of the various philosophic positions by connecting them to their own or their peers' past experiences, which they already understand. In particular, the analysis of the students' meaning-making moves highlighted several methods for connecting the philosophic claims with the students' understanding of phenomena in their own professional field: applying, supporting or forming conceptions and critiquing. By engaging in these forms of sense making in discourse with one another, students learned from each other. Dialogic learning involves learning to see from the perspectives of others, rather than necessarily building knowledge together as researchers have often assumed in the past.

Intersubjectivity amidst disagreement

Sarah Pollack and *Yifat Ben-David Kolikant* return us to classroom discussion of the Israeli-Palestinian conflict, but his time involving students whose personal perspectives are already strongly influenced by this conflict. In fact, the two dyads of students bring such opposed perspectives to this discussion that the teachers turn to CSCL technology to mediate the discussion, providing an environment in which the students can feel safe expressing their views and can hope to have some kind of productive interchange.

As in the previous paper, the analysis shows that each perspective evolved as a result of their discourse together, even though they did not build knowledge within a joint perspective. The agents (in this case not individuals but dyads) were able to use the perspective of the other as a resource for their own reflection, without denying the continuing opposition between their perspectives (rooted in strong cultures and long histories). In the analysis, we can see the larger societal context made active and relevant through specific resources brought into the local discourse.

Interestingly, the students establish an intersubjective understanding of their discussion topic through an inter-animation of persistently opposed perspectives. There is no convergence or overlap of mental models or common ground. Just as Israelis and Palestinians share a geographic world without giving up their differences, so the students establish intersubjectivity amidst deep-seated disagreement.

How teachers guide collaborative learning

The final two papers in this issue are not strictly speaking ethnomethodologically informed, but they return to the opening paper's theme of teacher guidance in CSCL settings. The contribution by *Yangjie Song* and *Chee-Kit Looi* is a comparative study of two teachers teaching the same lesson. It reports on research in Singapore (Looi et al. 2011) using the Group Scribbles collaboration software.

Like an EM case study, this paper conducts a fine-grained analysis of moment-by-moment teacher practices. This analysis is oriented to discover the connections among teacher beliefs, teacher practices and student learning. The authors recognize the complexity in these connections. They emphasize that innovative educational interventions—such as inquiry-based CSCL lessons—are not simply implemented, but are enacted through the practices of specific, situated teachers and students. How teachers enact the lessons and orchestrate classroom interactions has a significant impact on the outcomes of student collaborative learning.

The paper by *Javier Onrubia* and *Anna Engel* undertakes a similar analysis of the connection of teacher practices to student outcomes, particularly the relationship of patterns of teacher assistance, forms of collaborative work in student groups and level of performance of the groups. Here, the pedagogical intervention is structured by a macro-script—see the *ijCSCL* flash theme on scripting in CSCL (Dillenbourg & Hong 2008; Kobbe et al. 2007).

While this analysis employs coding and frequency counts, the aim is not to draw statistical generalizations, but to support the exploratory case study in revealing patterns of teacher practices. The role of these teacher practices leads to the conclusion that what is important is not simply the design of a macro-script, but the teacher's classroom orchestration that enacts and supports the use of the script in particular, unique and unpredictable teaching and learning situations. Something like skillfully making rounds is needed.

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7(2): Cognizing mediating: Unpacking the entanglement of artifacts with collective minds

The age of simple objects like well-designed artifacts, minds confined inside of skulls, and cultures cloistered in the tacit background has been left in the fading past according to current socio-cultural theory. We are now enmeshed in dialectical processes of social enactment, whereby designed objects continue to evolve well after they enter into the structuring of our thought patterns.

Biological human evolution has long since transformed itself into cultural evolution, proceeding at an exponential pace. Along the way, thought overcame the limits of individual minds to expand with the power of discourses, inscriptions, digital memories, computational devices, technological infrastructures, computer-supported group cognition, and virtual communities. Both human cognition and its mediation by technological artifacts morph from fixed nouns into process verbs, like "cognizing mediating"—where human cognition and technological media shape each other in ways we are just beginning to conceptualize.

The owl of Minerva flies only at night, according to Hegel's (1807/1967) metaphor: theory—which is one's time grasped in concepts—lags behind the continuous unfolding of practice. As today's viral software successes rapidly outstrip our design theories, we must try to understand the ways in which new generations of users adopt and adapt their digital tools, thereby defining and redefining their conceptual, social, and pragmatic ties to their worlds. Hegel theorized the dialectic between subject and object, proposing that the identity of the human subject is formed when a subject subjects an object to goal-oriented design (Stahl, 2006, p. 333f), creating an artifact within the effort to forge intersubjectivity and its spin-off, the individual's self.

Vygotsky (1930/1978) recognized the role of double stimulation in mediated cognizing: that the subject's access to an object is mediated by tools such as hammers, names, and physical-symbolic inscriptions, so that in higher-order human cognizing we are stimulated by both an intentional object and a cognizing-mediating tool. It is this mediation of cognition by artifacts and via other people that opens the zone of proximal development, allowing the individual mind to first exceed and then later extend its limits. Engeström's (1987) concept of expansive learning added the cultural dimensions from Marx' social theory to Vygotsky's simple triangle of subject-artifact-object. Henceforth, socio-technical understandings of artifacts have to situate them culturally, historically, politically.

We have considered the labyrinthine nature of the artifact's affordances previously within theories of human-computer interaction (Hutchins, 1999; Norman, 1991), cognitive science (Gibson, 1979; Hutchins, 1996) and CSCL (Bonderup Dohn, 2009; Dwyer & Suthers, 2006; Jones, Dirckinck-Holmfeld & Lindstrom, 2006; Suthers, 2006; van der Pol, Admiraal & Simons, 2006). In particular, based on Merleau-Ponty's (1945/2002) philosophy, Bonderup Dohn argued that the affordances of an artifact were potentials realized in response to human behaviors.

* * *

In this issue's opening essay, *Maarten Overdijk, Wouter van Diggelen, Paul A. Kirschner & Michael Baker* explore the nature of artifacts by comparing the theory of affordances with the theories of structuration and of instrumental genesis. Structuration (Giddens, 1984; Orlikowski, 2008) is a well known theory developed to account for the dialectic between social structures and the local interactions which are both constrained by these structures and reproduce them. Instrumental genesis is a recent theory developed in France by Pierre Rabardel and his colleagues. This issue of *ijCSCL* introduces the theory of instrumental genesis to the CSCL community and explores how the theory might impact work in CSCL, at methodological, technological, and theoretical levels.

Our first article compares the three major recent theories about the interaction between artifacts and people, using a concrete case study of a typical CSCL setting. It argues in favor of the general approach of instrumental genesis as an analysis of the micro-genesis of artifacts and as the best available description of the nature of tools, particularly for CSCL. The theory of affordances tends to focus on the individual, for instance with Gibson's biological perspective or Norman's use of mental models, or Piaget's schemas in individual minds. In contrast, the sociological theory of structuration focuses on the societal or cultural level. The theory of instrumental genesis can more naturally be applied to the small-group collective level central to CSCL, as the first article does in discussing how triads of students enacted a feature of an argumentation-support software system.

The paper presents a "theoretically grounded" conception of the artifact-agent connection. A next step would be to explore an empirically grounded analysis of the connection. While the article referred to data from a CSCL experiment, it simply used high-level descriptions of the data to illustrate aspects of the theories being described. It will be important in the future to analyze such data in detail to see if the connections of groups of students to computer-support systems follow the contours of one or more of the three theories, or whether they display different lines of development. Furthermore, it will be useful to consider more complex technologies, whole meso-level infrastructures (Jones, Dirckinck-Holmfeld & Lindstrom, 2006) rather than isolated functions. For instance, in an online course, small groups may have to negotiate the coordinated use of hundreds of functions in Blackboard, Google search, Wikipedia, Facebook, Google Docs, iChat, Gmail, Word, and PowerPoint in order to produce a one-week assignment. Such an undertaking invokes the use of individual experience or expertise, established social practices in the school culture, consideration of course requirements and project goals, as well as collaborative discourse and trials by the small groups. The resultant computer-supported effort assembles and interprets a complex technical infrastructure, increases the expertise of the group participants, and provides a medium for group knowledge building. The connection of the collaborative group with the technical infrastructure continuously evolves through use during a term.

* * *

Having glimpsed the potential relevance of the theory of instrumental genesis to CSCL, we turn next to a discussion of that theory within the context of CSCL system design. *Jacques Lonchamp* returns to these pages after having presented his analyses of CSCL design options (Lonchamp, 2006; 2009). He now argues for applying Rabardel's theory by expanding Engeström's (1987) Activity Theory triangle of mediations, to explicitly represent both the processes of mutual shaping of agent and artifact and the specific role of the teacher in CSCL classrooms: He pictures the various mediated interconnections among tool, designer, teacher, student, peer, and tutor. Furthermore, he discusses how the agent-artifact connection—embodied in Rabardel's conception of the instrument—evolves over time through usage and re-design.

The paper concludes with a review of CSCL system design approaches to supporting "instrumentalization" by teachers and students. Although it comes close to describing design-based research (Brown, 1992; Design-Based Research Collective, 2003), this review does not name it. Design-based research is a dominant approach within CSCL research to integrating system design, usage analysis, educational research, and practical classroom interventions. It was developed in response to the need to conduct user-centered design of innovative educational software for collaborative groups—a realm lacking in detailed theories, specific analysis methods, adequate software, or design guidelines. Perhaps an explicit combination of Rabardel's theory with data from design-based research projects could provide empirically grounded insights into the mutual shaping of CSCL software and group cognition in on-going design and usage processes.

* * *

The third paper, by *Giuseppe Ritella & Kai Hakkarainen*, situates Rabardel's theory within the context of knowledge-building practices, as these are conceptualized in recent work at the Scandinavian-led Knowledge Practices Laboratory (KP-Lab). This context is populated with social practices grounded in knowledge-building artifacts (Hakkarainen, 2009) and structured in space and time by chronotypes (Ligorio & Ritella, 2010). The knowledge-building artifacts are instruments in Rabardel's sense; they provide for advanced forms of Vygotskian double stimulation (Lund & Rasmussen, 2008). The whole context is the result of the cultural evolution (Donald, 1991; 2001) that led up to our involvement with digital information and communication technologies in an increasingly powerful, distributed, and mediated cognitive universe.

From prehistoric times to the present, the proliferation of forms of inscription (Latour, 1990) transformed the human cognitive architecture as profoundly as earlier leaps in biological evolution, allowing radical externalization and collectivization of cognition. In a sense, CSCL aims to push this further, designing collaboration media to foster group cognition that can lead to new forms of individual learning, team knowledge building, and community social practices. To the extent that this is true, we need to design new tasks for computer-supported teams, aiming for cognitive achievements beyond the reach of individual team members without computer supports. The goal of CSCL research should not be to simply demonstrate repeatedly that individuals learn better in online groups, but to design and investigate tasks that go beyond traditional instruction. Recent findings concerning "productive failure" (Kapur & Kinzer, 2009; Pathak et al., 2011) illustrate how groups with challenging tasks may be learning in ways that defy standard testing indicators, but that contribute to increased problem-solving skills of the groups and ultimately of their members.

The analysis of instrumental genesis within the framework of knowledge building points to both the potentials of CSCL and the barriers to widespread dissemination. The historical evolution of tools as "epistemic artifacts" can itself be seen as a knowledge-building accomplishment of the greatest cognitive consequence, related to Vygotsky's—perhaps misleadingly named—notion of "internalization" by individuals of skills germinated in intersubjective circumstances. On the other hand, the complexity involved in successful instrumental genesis translates into severe barriers when, for instance, one tries to promote adoption of CSCL technologies, pedagogies, chronotypes, and educational philosophies in established school communities and institutions. Parallel to the difficulties of the students struggling to enact the technological affordances are the difficulties of the researchers, trying to document, analyze, and conceptualize the tortuous paths of instrumental genesis in CSCL.

* * *

This issue of *ijCSCL* balances its featured discussion of CSCL theory with important presentations of CSCL pedagogy, CSCL technology, and CSCL analysis. The paper by *Carmen G. Zahn, Karsten Krauskopf, Friedrich W. Hesse & Roy Pea* investigates the provision of pedagogical guidance oriented to social interaction versus that oriented to cognitive tasks. An experiment with groups of 16-year-old students using video tools for history lessons indicates that support for their collaborative interactions was more effective than guidance directly related to their assigned tasks. This demonstrates the centrality of issues of adopting and exercising interaction practices in collaborative learning, and has implications for scripting group tasks, orchestrating group work, and guiding group collaboration.

* * *

Imagine trying to analyze a large corpus of online collaborative discussion to see how often groups under different conditions articulated specific components of scientific argumentation, such as claims, evidence, critique, etc. The contribution by *Jin Mu, Karsten Stegmann, Elijah Mayfield, Carolyn Rosé & Frank Fischer* describes a promising approach to automating such analysis utilizing current and innovative techniques of natural-language processing. The first step—not previously fully automated—is to segment the corpus into utterances (whether phrases, clauses, sentences, or paragraphs) that each expresses a specific component of argumentation. Until this can be automatically accomplished reliably and with generality, the dream of automating the coding of micro-argumentation will remain out of reach. To overcome typical over-generalization to specific training sets, the approach tested here replaces the context-specific terms in a corpus with syntactic descriptors and replaces the nouns with entity categories—e.g., substituting "location" or "city" for "Sydney." This pre-processing allows the software analysis to compute rules that are less context dependent.

* * *

Collaborative learning can be much more complex to support and to analyze than individual learning. For instance, computer-based cognitive tutors have been effective in supporting individual learning of traditional school mathematics for years and are used widely in classrooms, but they have rarely been applied successfully to collaborative learning. In the empirical study reported here by *Nikol Rummel, Dejana Mullins & Hans Spada*, algebra tutoring technology is combined with scripting to explore potential benefits for small-group learning. As described by the theory of instrumental genesis, the use of new technologies by student groups must be enacted by the students. This means that a comparison of conditions with and without computer supports involves significant differences in the tasks faced by the students, including learning to use the tools and negotiating how to take advantage of them. Different enactments by different teams can obscure statistical measures of learning that average across the cases. As seen in this study, narrative analysis of specific cases can provide incisive insight into how the technologies are being used and how they are actually affecting the group knowledge-building processes. Rigorous research into the effectiveness of CSCL tools can require multiple coordinated methods, responsive to the complexities of the collaborative-learning issues involved, as discussed in this article.

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7(3): An international research community

Gerry Stahl * Nancy Law * Friedrich Hesse

The Editors are pleased to announce that the *International Journal of Computer-Supported Collaborative Learning* was again highly ranked by ISI's annual "Impact Factor" report released several days ago. *IjCSCL* ranks #11 of the 203 journals ranked by ISI in the field of Education and Educational Research and it ranks #6 of the 83 journals ranked by ISI in the field of Information Science & Library Science. *IjCSCL* is the #1 journal published by Springer and ranked by ISI in each of these categories.

IjCSCL has an impact factor of 2.243 for last year and a 5-year impact factor of 3.000. The impact factor for 2011 is the number of citations of the journal's 2009 and 2010 articles cited during 2011 in ISI-ranked journals, divided by the number of the journal's 2009 and 2010 articles. That is, articles printed in *ijCSCL* during 2009 or 2010 were cited in ISI-ranked journals on average 2¼ times during 2011. The ISI impact factor (published annually by the Institute for Scientific Information at Thomson Reuters) is widely considered the most important ranking of academic journals. In many universities, it is considered in evaluating authors for tenure and promotion.

IjCSCL supports an international research community. It receives submissions from 53 countries. About 7,000 universities and research institutions around the world subscribe to it, making its content available to millions of people through the Springer website. We also maintain the *ijCSCL*.org website with the full text of all articles freely available to the whole world; there have been two million hits to this site so far. Several thousand articles are downloaded every month from the Springer.com and *ijCSCL*.org websites. This indicates that *ijCSCL* continues to be read and cited by many researchers in the active computer-supported collaborative learning (CSCL) and learning sciences research community, in addition to being an archival venue for significant research findings.

The articles most frequently cited (in ISI Web of Science and Google Scholar) and most often downloaded (from http://*ijCSCL*.org/?go=contents and http://www.springerlink.com/content/120055) have been:

- “Technology affordances for intersubjective meaning making: A research agenda for CSCL” (Suthers, 2006)
- “Specifying computer-supported collaboration scripts” (Kobbe et al., 2007)
- “Analyzing collaborative learning processes automatically: Exploiting the advances of computational linguistics in computer-supported collaborative learning” (Rosé et al., 2008)
- “A systemic and cognitive view on collaborative knowledge building with wikis” (Cress & Kimmerle, 2008)
- “Productive failure in CSCL groups” (Kapur & Kinzer, 2009)
- “Time is precious: Variable- and event-centred approaches to process analysis in CSCL research” (Reimann, 2009)
- “The joint organization of interaction within a multimodal CSCL medium” (Çakir, Zemel & Stahl, 2009)
- “The pedagogical challenges to collaborative technologies” (Laurillard, 2009)
- “Learning to collaborate while being scripted or by observing a model” (Rummel, Spada & Hauser, 2009)
- “Web 2.0: Inherent tensions and evident challenges for education” (Bonderup Dohn, 2009)
- “Approaching institutional contexts: Systemic versus dialogic research in CSCL” (Arnseth & Ludvigsen, 2006)

This list reflects the journal’s broad diversity of contributions to CSCL theory, technology, methodology, pedagogy, and analysis. These articles are written in a range of creative presentation styles, by authors trained in various fields and traditions. Such interdisciplinarity and multivocality are essential for the growth of knowledge in CSCL.

The CSCL and learning sciences research community continues to expand its international reach, as interest in the field spreads around the world. The International Conference of the Learning Sciences (ICLS 2012) was just held in Australia, marking the first time this conference series was located in the Asia-Pacific hemisphere. The previous year, the CSCL conference (CSCL 2011) was held in Hong Kong, with post-conference events at three Mainland China universities. As a result, *ijCSCL* is receiving more submissions from Hong Kong, Singapore, Mainland China, Japan, Korea, Thailand, Malaysia, Taiwan, Australia, and New Zealand. In fact, about a third of *ijCSCL* submissions now come from Asia-Pacific, a third from Europe and a third from the Americas. We hope that people from around the world will continue to attend the ICLS and CSCL conferences. CSCL 2013 will be in Madison, Wisconsin, USA (near Chicago); paper submissions are due November 2, 2012 (see http://isls.org/cscl2013).

IjCSCL recently published reports on systematic educational reform programs in Singapore (Looi et al., 2011) and Hong Kong (Chan, 2011). We welcome brief descriptions of efforts to introduce CSCL approaches in other areas of the world—such as the Middle East, Africa, or Latin America.

Although competition is increasing for publication in *ijCSCL* (21% acceptance rate in 2011), we are now able to publish about 40% more articles than in the past, providing expanded opportunities for new ideas and significant contributions to the CSCL literature. Generally, authors should develop their papers through a series of preliminary presentations—such as local research talks, posters, workshop contributions, conference papers, book chapters—in order to receive peer feedback and successively expand and refine their arguments. Submissions to *ijCSCL* should report on mature research that explores processes of collaborative learning and mechanisms of its computer support in considerable depth. For instance, surveys of student self-perceptions and beliefs are considered preliminary explorations, not ready for journal publication. Submissions should be grounded in solid understanding of current CSCL research, methods, pedagogy, and theory.

The on-going success of *ijCSCL* is attributable to the authors, reviewers, and readers of the journal. Many of the authors are established leaders of the CSCL and learning sciences research community; others are newcomers or researchers in allied fields, contributing stimulating perspectives and novel findings. The Board of Editors—about 80 researchers from around the world—and other reviewers provide the incisive feedback to authors, generally pointing the way for improvements to the papers, which greatly increase their import. Finally, the readers take up the published ideas and build our knowledge further, realizing the impact in reality, which ISI's numbers only roughly model.

In this issue

The following articles analyze the complex interplay of digital technologies with collaborative learning in a variety of intriguing situations.

In the first article, *Noel Enyedy, Joshua A. Danish, Girlie Delacruz,* and *Melissa Kumar* analyze in subtle detail the results initially reported in their quantitative study (Enyedy et al., 2011), which won the best-paper award at CSCL 2011. Toddlers develop body-centered understandings of the physics of the world as they bump into objects, manipulate their bodies, and interact with the objects and people around them. As they proceed through schooling up to high school or college physics courses, they gradually transform this tacit embodied cognition into explicit discourses about forces and motion, ultimately, perhaps representing these concepts, for instance in the symbolism and calculus of Newton's laws. In their analysis of a sensitive combination of computer support (augmented reality) and collaborative learning (socio-dramatic play), the authors show how young children (6-8 years old) in a CSCL classroom can already make significant progress along this cognitive trajectory, so important for comprehending our scientific world.

Most CSCL research—like that in the preceding paper—is design-based, exploring how to effectively support collaborative learning by engaging in iterative cycles of technology design, trial in concrete situations, analysis, and re-design. While this often seems like the best or even the only practical approach to increasing our understanding of how to design educational technologies and how to employ them pedagogically, design-based research seems problematic to many researchers trained in other research traditions. For instance, there is no specified methodology for analyzing the collaborative student usage of CSCL technologies. Furthermore, there are rarely direct implications of the analysis for technology re-design. Perhaps most challenging is the attempt to generalize implications from a single case-study context. Particularly, as we have increasingly come to recognize how much context matters, it becomes important to identify the nature of a case-study's context in order to judge its broader relevance. In her article, *Kim MacKinnon* draws on Cognitive Work Analysis to address this issue. She illustrates the application of this technique from engineering fields to analyzing the socio-technical context of an educational research setting.

In the popular press and in many parents' opinions, computers can exert an anti-social effect, particularly on young children's development. The knowledge-building benefits of CSCL are often assumed to apply only to older students and adults. The study by *Eun Mee Lim* shows that this can be a misconception and that technology can promote important cognitive results even among kindergarten students, if properly structured. Through quantitative and qualitative analysis, this paper demonstrates a variety of cognitive accomplishments arising from computer-supported collaborative interactions among students in the computer area of their kindergarten in Korea.

At the opposite extreme of graduate students building knowledge in a discussion environment like Knowledge Forum, other misconceptions prevail. For instance, college administrators may envision a potential to use online courses to teach large courses with few faculty members. As the contribution by *Mingzhu Qiu*, *Jim Hewitt,* and *Clare Brett* shows, effective collaborative learning in a discussion forum requires relatively small group sizes; students cannot relate deeply to discussions involving too many participants. This careful study refines our understanding of the parameters affecting the use of now rather established discussion-forum technologies. The paper concludes with useful research-based recommendations for practitioners.

The final article by *Mar Pérez-Sanagustín, Patricia Santos, Davinia Hernández-Leo*, and *Josep Blat* proposes and illustrates a scripting approach focused on four factors: the space, the pedagogical method, the participants, and the history. The emphasis on space is related to the domain of the blended learning course: geography; the course uses mobile and other technologies to support teams of students exploring the urban environment in Barcelona.

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7(4): Traversing planes of learning

Planes of learning in CSCL

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. One can identify and analyze important processes taking place at each of these levels of description. This tri-partite distinction is grounded in the practices 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 classroom context by providing some initial time for individual activities (such as background reading or homework drill), 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 positions 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 tends to be 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 planes are actualized in CSCL practice, and the matter of their relative roles and connections becomes subsequently problematic for CSCL theory (Dillenbourg et al., 1996; Rogoff, 1995; Stahl, 2006).

While these different units, levels, dimensions or planes are intrinsically intertwined, research efforts generally focus on only one of them and current analytic methodologies are designed for only one. Furthermore, there is little theoretical understanding of how the different planes are connected. To the extent that researchers discuss the connections among levels, they rely upon commonsensical notions of socialization and enculturation—popularizations of traditional social science. There are few explicit empirical analyses of the connections, and—as we discovered at a workshop on this issue at ICLS 2012—it is even hard to find data that would lend itself to conducting such analyses.

The individual unit of analysis is the traditional default. This assumed approach is supported by widespread training of researchers in the standard methods of psychology and education. In the era of cognitive science, analysis made heavy usage of mental models and representations in the minds of individuals (Gardner, 1985). With the "turn to practice" (Lave & Wenger, 1991; Schatzki, Knorr Cetina & Savigny, 2001), the focus shifted to processes within communities-of-practice. Group cognition lies in the less-well-charted middle ground. It involves the semantics, syntactics and pragmatics of natural language, gestures, inscriptions, etc. The meaning-making processes of small-group interaction 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.

Computer technologies play a central role in mediating the multi-level, intertwined problem-solving, content-acquiring 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 design process of collaboration environments how to prepare groups, individuals and communities to take advantage of the designed functionality and to promote learning on all planes—e.g., through the provision of resources for teacher professional development, scripted collaboration activities and student curriculum.

The theory of interconnected planes

How are the major planes of learning connected; how can we connect investigations at different units of analysis? In Figure 1, we see highway ramps or bridges used as resources for connecting road levels or landmasses. While we are more interested in conceptual connections between levels of learning, it may be helpful to consider the more intuitive physical case initially. A highway ramp or bridge often creates a possibility that did not otherwise exist for going from one level to another at a given point. To traverse from a local road to a limited-access expressway, 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 ramp or the bridge "affords" connecting the levels (Bonderup Dohn, 2009).

Figure 1. Connecting ramps for the I-90 bridge across the Hudson River. Photo: G. Stahl, Albany, NY, 2012.

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. In his early work, Heidegger 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, he 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 artifacts 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 places and resources for meaningful discourse and action.

This transformation of perspective away from a human-centered or individual-mind-centered approach became characteristic for innovative theories in the second half of the 20th Century. 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. 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*)—such as the Alte Brücke of Heidelberg shown in Figure 2—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 (Stahl, 2006, Ch. 18). In distributed cognition, Hutchins (1996) analyzed the encapsulation of historical cognition in technological instruments. In actor-network theory, Latour (1990) uncovered the agency of various kinds of objects in how they move across levels in enacting social transformations. Vygotsky (1930/1978) used the term “artifact” to refer to both tools and language as mediators of human cognition. The broader term “resource” is frequently used in sociocultural analysis (Furberg, Kluge & Ludvigsen, 2013; Linell, 2001; Suchman, 1987) for entities referenced in discourse. Such artifacts or resources are identifiable units of the physical world (including speech and gesture) that are involved in meaning-making practices—bridging the classical mind/body divide.

Figure 2. The bridge across the Neckar River connecting the town with the residential hillside, as discussed by Heidegger (1950/1967). Photo: G. Stahl, Heidelberg, Germany, 2012.

A central research issue for CSCL is how collaborative knowledge building takes place. The main problem seems to be to understand the role of individual cognition and of societal institutions in small-group meaning-making processes. Figure 3 indicates (without claiming to explain or model) some typical processes on each of the primary planes of learning in CSCL and suggests possible paths of influence or connection, as events unfolding on the different planes interpenetrate each other.

This figure is not meant to reify different levels or activities, but to sketch some of the constraints between different phenomena and possible flows of influence. The distinctions represented by boxes and arrows in the chart are intended to operationalize an infinitely complex and subtle matter for purposes of concrete analytic work by CSCL researchers.

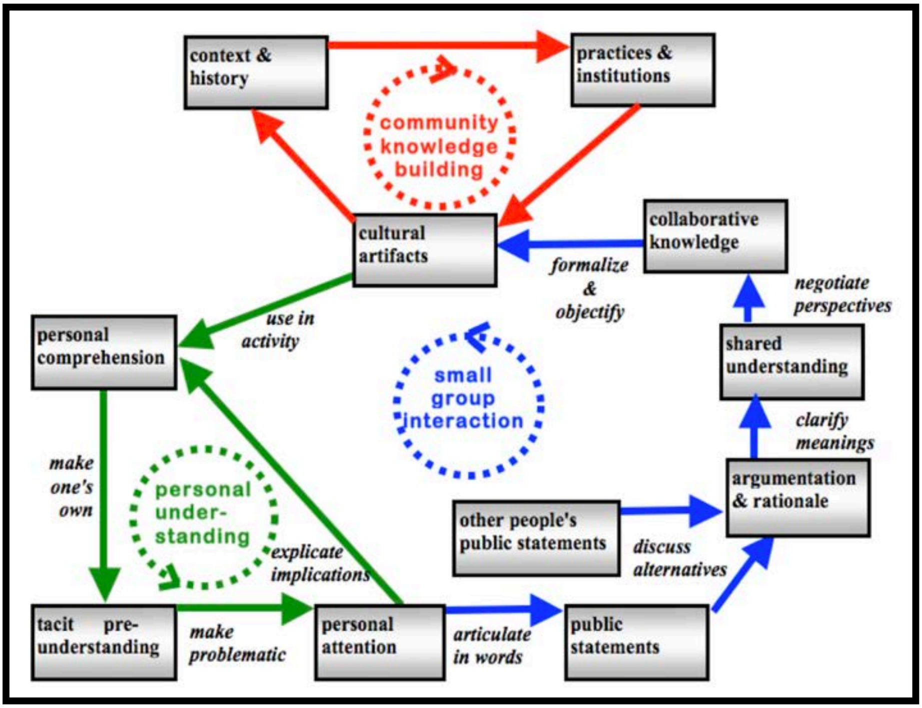

Figure 3. A model of collaborative knowledge building. Adapted from (Stahl, 2006, Ch. 9).

Some researchers, such as many ethnomethodologists, argue against distinguishing levels. For instance, in their description of Conversation Analysis, Goodwin and Heritage (1990, p. 283) open their presentation 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." Social interaction typically takes place in dyads and small groups, so interaction analysis is considered to be oriented to the small-group unit of analysis. However, CSCL researchers also want to analyze the levels of the individual and the culture as such—e.g., the individual identities and learning changes or the social practices and institutional forces: How do the identities of participants get affirmed or denied as a result of social interaction? How are cultures transmitted, renewed and modified through social interaction?

In general, the sequential small-group interaction brings in 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. Such a process may result in generating new or modified resources, which can 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 sedimented elements of language. We would like to study how this all happens concretely within data collected in CSCL settings.

Analyses of connected planes

This issue of *ijCSCL* presents several studies that can be read in part within this problematic of traversing planes of learning. Each of the contributions offers some data from a CSCL setting, which can be analyzed in terms of the interpenetration of multiple planes of learning. In each case, a specific form of interactional resource is identified, which plays a mediating role in traversing the planes. Of course, these articles were drafted and submitted to the journal without any expectation that they would be read within this analytic problematic. So please appreciate each on its own terms, in relation to the framing content area and the stated findings. But it might also be interesting to consider them as case studies for understanding the relations among CSCL's three primary planes of learning.

In the first presentation, *Jacques Lonchamp* harkens back to the inaugural issue of *ijCSCL*, where Kienle and Wessner (2006) studied the evolution of the CSCL community through an analysis of conference papers. Lonchamp has previously appeared in this journal with theoretical contributions about mediating CSCL technologies, most recently applying the new theory of the instrumental genesis of technological artifacts to CSCL (Lonchamp, 2006; 2009; 2012). Now, he tries to construct an account of this journal itself, as it has evolved over seven years. As we have argued, the journal has served as an important pillar of the CSCL research community (Stahl & Hesse, 2006; Stahl, Law & Hesse, 2012). As such, the journal solicits the work of individual researchers—expressions of their personal investigations and thought. These ideas of individuals are inseparable from the group contexts within which they emerge and to which they are heavily targeted: the research labs, circles of corresponding specialists, traditions of shared paradigms. As analyses of journal and conference papers inevitably document, research thrives within an active and rapidly changing community or else it shrivels to irrelevance. As Latour and Woolgar (1979) showed some time ago, research is essentially mediated by concrete inscriptions; in *ijCSCL*, these take the form of published papers, with their references to other published papers. The journal paper is a key resource that traverses the planes of knowledge building in the CSCL community, and it can be analyzed and mapped as such.

The next paper shifts to another professional field, a medical specialty. *Markus Nivala, Hans Rystedt, Roger Säljö, Pauliina Kronqvist and Erno Lehtinen* provide a careful analysis of how certain resources in this world of work mediate collaborative reasoning. In particular, they are concerned with how innovative technical artifacts support the kind of co-attention in multi-modal settings that we have seen in other CSCL settings to be necessary to sustain collaboration (Çakir, Zemel & Stahl, 2009; Evans et al., 2011). The authors stress that their analysis must span the three planes of mental processes, the activity system and social interaction of the learning situation. They focus on "the interaction between individuals and how this interaction is mediated by language, referential practices and technology, which also constitute the unit of analysis." That is to say, they are concerned with how the small-group level of the interaction is mediated by the practices and artifacts that draw upon and simultaneously transform the personal skills and the medical institutions. Their analytic approach to referential practices as resources that span levels is ethnomethodologically informed (Stahl, 2012).

The analysis of learning in a science museum by *Susan A. Yoon, Karen Elinich, Joyce Wang, Christopher Steinmeier and Sean Tucker* takes a quite different approach to studying the connection among levels. The learning domain is science, a community concerned with canonical theories. The learning intervention involves the use of augmented-reality tools and knowledge-building scaffolds within small groups of students visiting a museum. Here, the analytic focus of the experiment is on individual understanding: "CSCL environments are designed to be influenced by group interactions and we intentionally designed the conditions to understand how working in groups as a knowledge-building scaffold can impact understanding." This is typical for educational studies, which are concerned with learning outcomes of individual students. One can see in the analysis how community-level science content is mediated by the resources introduced at the small-group level to produce an effect at the individual level.

Similarly, the study by *Chia-Ching Lin and Chin-Chung Tsai* starts at a community level in order to investigate effects at the individual level. Rather than using group interaction to benefit individual outcomes, this intervention drew upon the collective intelligence of social media—specifically bookmarking—to benefit individual cognition. The experiment is in the area of information search. Traditional investigations of search focus on individual information behavior, while recent social informatics enquiries use Web 2.0 technologies to support search at the community level. Support for small-group search has unfortunately been under-researched (Stahl, 2006, Ch. 7; Twidale & Nichols, 1998). The bookmarks served as resources that bridged the collective and individual. The behaviors of the students in participating in the social activity were coded and correlated with the cognitive engagements of the students at the individual level.

The closing article of the 2012 volume of *ijCSCL* considers CSCL scripting technology for orchestrating effective mixes of pedagogical activities at the individual, small-group and classroom planes. An important theme in the journal has been the definition of scripts for structuring interactions across levels. Here, *Pericles Sobreira and Pierre Tchounikine* explore an approach to supporting the efforts of teachers to adapt CSCL scripts to their particular classrooms. Scripts are resources for teachers, which operationalize catalogs of techniques for forming and using small groups and other classroom-organization approaches, such as a jig-saw script. Abstract technical discussions of scripting, including formalization and automation, can distance these potential resources from the practical world of the embedded teacher. The approach described here provides a clear representation of the design structure and envisioned effects of the script resource, so teachers can flexibly plan sequences of activities that traverse planes of learning

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8(1): Learning across levels

The theme of this year's CSCL 2013 conference—"To see the world *and* a grain of sand: Learning across levels of space, time and scale"—targets a provocative challenge for CSCL, namely that the interactions of collaborative learning be understood, supported and analyzed at multiple levels. As the conference call puts it, "the attention to the theoretical, methodological and technological issues of addressing research at multiple levels is highly relevant to current research in CSCL, as well as to developing an emerging understanding of the epistemological and methodological issues that will shape our intellectual efforts well into the future" (http://isls.org/cscl2013).

The attempt to bridge across levels of analysis—in CSCL theory, analysis and practice—stands at the forefront of CSCL research today. CSCL research typically investigates processes at the individual, small-group and community units of analysis. However, individual CSCL studies generally each focus on only one of these units. 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 and orchestrating learning in CSCL settings. The introduction to the last issue of *ijCSCL* (Stahl, 2012b) proposed that the levels of individual learning, group cognition and community knowledge building may be connected by emergent *interactional resources*, which can mediate between the levels.

Resources across levels in CSCL

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 many ways these connections across levels take place, and it is likely that they often involve mechanisms that are not apparent to participants. In the following, we explore one way of thinking about how such connections can occur: thanks to interactional resources.

In his study of how social institutions can both effect and be effected by small-group interactions, Sawyer (2005, p. 210f) argues that we can conceptualize the interactions between processes at different levels as forms of "collaborative emergence": "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." The frames that emerge from small-group interactions can take on institutional or cultural-level powers to influence actions at the individual unit. This interplay among levels involves both *ephemeral* emergents and *stable* emergents. Sawyer's theory of emergents suggests a relationship among different kinds of resources along the lines pictured in Figure 1.

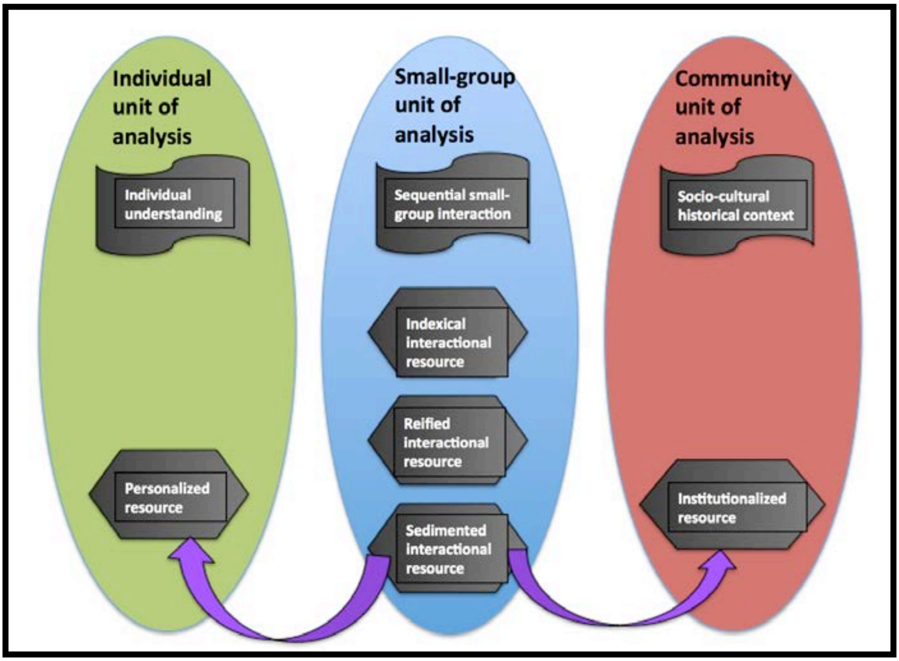

Fig. 1 *A diagram of emergent interactional resources bridging levels of analysis*

While Sawyer's analysis addresses a broad "sociology of social emergence," it can be confined and adapted 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. He thereby rejects the relevance of most popular theories of emergence for CSCL and shifts the focus to the discourse at the small-group unit of analysis. 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. Analysis focused on these emergent artifacts can deconstruct the reifying processes of emergence that span the group level to both the individual and the social.

The small-group interaction represented in the center of Figure 1 can be theorized 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. The coherence of the interaction and its comprehensibility to the group participants is supported by a network of references, each of which is defined indexically, that is by a pointing within the on-going discourse context ("here," "it," "now," "that point"). Interactional resources, which can be indexically referenced in the interaction, can typically only be understood within their discourse context, but they facilitate meaning making within that context.

Interactional resources can undergo a process like Rabardel's instrumental genesis (Lonchamp, 2012; Overdijk et al., 2012; Ritella & Hakkarainen, 2012). 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. Through repetition within a group discussion, a term or the use of an object might take on a settled significance within the group's current work. Over time, continued usage can result in a *sedimented resource*, something whose existence has settled into a longer-term "stable-emergent" form, which retains its meaning across multiple group interactions.

A sedimented resource is 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. Thus, the institutional resource not only references the social context, but also partially reproduces it in a dialectical relationship of mutual constitution by contributing a new element or revitalizing an old set of resources.

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 progressively emergent character of resources can be seen even in fields of mathematics and science, as documented in the papers in this issue.

The term "reification" goes back to Hegel's dialectical philosophy of mediation (Hegel, 1807/1967). Sfard (Sfard, 2000; 2008; Sfard & Linchevski, 1994) has applied it to the formation of mathematical concepts. 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 and reified) vocabulary to 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 of 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.

Among the theories influential in CSCL—such as activity theory, distributed cognition and actor-network theory—artifacts play a central role as resources for thought and action. In the foundations of activity theory, Vygotsky (1930/1978) conceives of artifacts as including language as well as tools. In the seminal study of distributed cognition, Hutchins (1996) analyzes how the complex of navigational tools, naval procedures for trained teams of people and specialized language work together to accomplish cognitive tasks like ship navigation. He even analyzes data to show how an indexical phrase becomes reified within a dyad's interaction to take on significance that could have led to intra-personal and/or institutional usage. In a witty essay, Latour (1992) shows how a common mechanical door-closer artifact can act to fill the role of an individual person (a doorman), to participate in the politics of a group and to enforce institutional rules. He also argues (Latour, 1990) that an inscription artifact like a map on paper—a stable emergent that he refers to as an immutable mobile—can traverse levels from a local discussion in ancient Asia to the social niveau of imperial Europe. However, studies like these have not often been duplicated in the CSCL literature.

Reviews of CSCL research show that few papers in our field 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 a theory 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. The contributions in this issue can be read as beginning such an undertaking. They present examples of interactional resources in small-group discussions and indicate how the resources can be seen as bridging levels of analysis.

Resources for collaboration and for mathematics

The idea of viewing interactional resources as central to mathematical discourse around dynamic geometry is proposed in the article by *Diler Öner*. Building on an earlier analysis of mathematical learning published in *ijCSCL*, she argues that rather than focusing on the "coordination of interaction" (Çakir, Zemel & Stahl, 2009), collaborative activity should be analyzed in terms of the "coordinated use of resources." Participants rely on two major categories of resources when working on a geometry problem within a computer-based dynamic-geometry environment: (1) mathematical and tool-enabled resources (math-content-related) and (2) collaboration resources (relational or social). She proposes a focus on the coordination of these resources—which characterize collaborative dynamic-geometry problem solving—for understanding what goes on in such productive math learning.

The combination of social and content resources brought to bear on geometric problem solving often bridges levels. Social resources—such as greetings, invitations to speak, checks on discourse direction—function to cohere the group out of its individual members, drawing upon community standards and institutional routines. Uses of math resources—such as manipulating visual representations, referencing recent findings, expressing relationships symbolically—move fluidly between individual perceptual behavior, group problem-solving sequences and the cultural stockpile of mathematical knowledge. Perhaps the incessant traversal of levels is particularly visible in collaborative math discourse because of its explicit use of multiple layers of reality: a physical drawing, the intended figure, a narrative description, a symbolic expression, the conceptualization, the mathematical object.

Öner's methodological proposal is to track both the math-content-related and the social/collaborative/relational resources used by students solving dynamic-geometry problems. Math resources may come from graphical, narrative and symbolic representations or expressions of the math problem or from previous math knowledge of culturally transmitted concepts, theorems, procedures, symbolisms, etc. Social resources include communication practices, such as the rules of conversational discourse (transactivity, sequentiality, shared attention, argumentation, turn taking, repair, etc.).

Öner's paper cites a number of distinctions drawn in the CSCL literature for contrasting social/collaborative/relational resources with content-related resources:

- An inter-personal-relations space versus a content space (Barron, 2000);
- Building a joint problem space (JPS) versus solving a problem (Roschelle & Teasley, 1995);
- Temporal dimensions of the JPS versus diachronic content (Sarmiento & Stahl, 2008);
- Text chat versus shared-whiteboard graphics (Çakir, Zemel & Stahl, 2009);
- Project discourse versus mathematical discourse (Evans et al., 2011);
- Spatio-graphical observation (SG) versus technical reflection (T) (Laborde, 2004).

The "space" that a group builds up and shares is a structured set of resources gathered by the group (JPS, indexical field, common ground). The resources are "indexical" in the sense that they are only defined within (and thanks to) this constructed space of the specific problem context. Through their discourse, the group compiles these resources as potentially relevant to the problem. In turn, the resources help to define the emergent problem, dialectically, as we will see in the next papers.

Öner generated data to explore the interaction of the contrasting dimensions by having two people work together face-to-face in front of a shared computer on a particular dynamic-geometry problem, whose solution required a mix of spatio-graphical observation and technical reflection involving mathematical theory—a mix of SG and T resources, to use the distinction she adopts from Laborde. She uses this distinction among resources to structure her analysis. In doing so, she shows how these various resources bridge the different units of analysis. Resources of *individual* perception (during dragging of geometric objects on the computer screen) feed into the *group* problem solving, just as do references to classical theorems passed down through *cultural* institutions. They make possible and stimulate the group interaction. This analysis and the others collected in this issue of *ijCSCL* provide examples of interactional resources at work in CSCL settings.

By analyzing both social and content resources, Öner shows how interrelated these can be. For instance, on line 48 of Excerpt 4, one student says, "now two isosceles, oops, equilateral triangles are formed here." This utterance is deeply indexical. It is pointing to the "here" and "now" of the geometric construction. The student is narrating his work, intersecting two circles to locate the vertices of the desired equilateral triangle (see Figure 2). The method he is using refers back over 2,500 years to Euclid's first proposition, which teaches this construction. It also notes that one could use either of two potential intersections to construct alternative triangles. This leads his partner to see first one of the intersection points and then the other. Öner notes that the two students collaboratively accomplished this construction; they collectively recalled the procedure in the doing of it, which they had performed in the past but forgotten. She also emphasizes that this utterance includes a self-repair, in which the speaker substitutes a correct term ("equilateral") for an incorrect one—a move she considers social. Repairs are conversational moves aimed at avoiding or correcting potential misunderstandings.

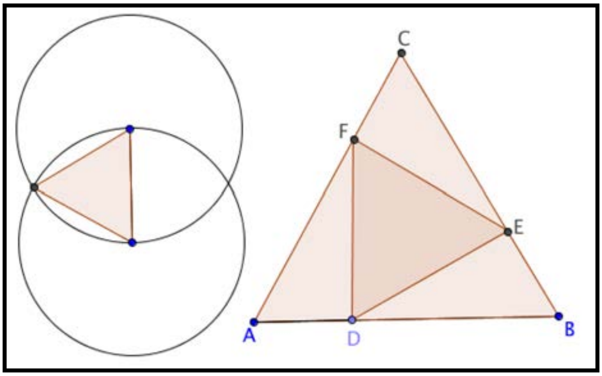

Fig 2 Constructing an equilateral triangle

This raises a key theoretical point. Should this utterance be analyzed, categorized or coded as a social resource or as a mathematical one? What is the resource here? Is it the generic conversational resource of self-repair as a "member method" (Garfinkel, 1967), or is it the word "equilateral" in the shared language, or is it the geometric concept of equilateral polygon? I.e., is it a conversational move, a linguistic term or a mathematical concept? This is a matter of level of analysis, because one could characterize it in any of these ways. Alternatively, one could argue that the interactional resource that exists here spans multiple levels of analysis, providing an object for analysis at the conversational, linguistic and mathematical levels of the interacting group, the speaking individual and the cultural conceptualization. In other words, such a resource can serve as a boundary object (Star, 1989), which can be discussed from different perspectives, focused on different units of analysis.

Öner succeeds in analyzing how her students collaborated on their geometry problem by focusing consistently on the interplay between social and content resources. It may be that we can often follow the movement of discourses across different levels by keeping our eyes on consequential resources. However, other CSCL researchers interpret the theme of resources differently from Öner. This leads them to different insights about their data. It may be that we can use the concept of resource as a boundary object to bring together the disparate theoretical voices. Too often, they seem to talk at cross-purposes, emphasizing differences when they might well be seeing the same phenomenon from different angles.

Scientific representations across levels

Even if analysts agree in identifying a certain object as a pivotal interactional resource, that does not mean that the nature or meaning of that resource is self-evident to students using it for collaborative learning, as the discussion by *Anniken Furberg*, *Anders Klug* and *Sten Ludvigsen* makes clear. They turn to look at how students make sense of scientific diagrams to support their collaborative learning of physics. The implications of a diagram of a photoelectric cell only emerge gradually for a group of students striving to understand and explain the scientific processes represented there.

The central case study of this paper illustrates how the students gradually produce the meaning of the scientific representation. It is the sense-making process—mediated by the representational resource—that spans levels: The individuals, each with their own approaches and each bringing in different other resources, contribute to the group's collaborative effort, resulting in a group understanding, expressed however awkwardly and partially in their written report. The representation—first from their textbook and then complemented with a second diagram from the Internet—is a contribution from the larger scientific or science-education community.

The paper characterizes the science diagram as a *structuring resource*. It argues that the representation, as it becomes meaningful to the students, structures the group's sense-making work. The structuring takes place on various levels: Interactionally, the group uses the diagram as a deictic resource, pointing to its features either gesturally or linguistically to support the verbal accounts.

Individually, the students refer to the diagrams to monitor their own understanding. At the level of science norms, the students attempt to use canonical language to express the sense they are making of the diagram.

Student discourse generally halts in articulation of an idea at the point when everyone seems to understand each other adequately for all practical purposes of the conversation. Even adding a third person to the discourse can extend the discussion somewhat, because the third person brings new questions and needs for understanding. However, when students go to write up a point, they must attain a much higher standard of articulation. They must make their written statement comprehensible and persuasive for a general audience or for people not present to indicate their understanding or agreement. This audience might, for instance, include the teacher, other students in the class or even an audience of unknown potential readers. The audience might require a scientific formulation, using the vocabulary and stylistic genre of physics. Furthermore, since the reading audience is not co-present with the speakers, physical gestures and deictic references to times, places, people and objects present are no longer effective. While the diagram still helps to structure their articulation of the description, the description can no longer rely so heavily on the diagram to help convey their meaning.

It is always true that there is a dialectical circularity or recursive character to the relationship of the discourse context and the utterances that are made within that context; this becomes even clearer in the relationship of the diagram as a structuring and interactional resource to the students' understanding of this resource. The (tentatively understood) diagram helps to structure the students' (increasing) understanding of the diagram itself. The paper nicely shows how the introduction of a second diagram enriches the dialectic by shedding light on the first diagram's meaning through the tension created by the differences between the two representations.

Referential resources for a math problem

In the third paper, *Alan Zemel* and *Timothy Koschmann* take an ethnomethodological (Stahl, 2012a) look at the role of resources, representations, referential practices and indexical properties in the mathematical problem-solving interactions of students within a CSCL setting. Viewed in the context of this issue of *ijCSCL*, they develop further some of the central themes of the previous two papers. They concur with the first paper on the importance of tracking the use of resources, and they further emphasize that it is the on-going specification-in-use that determines the significance of a given resource. They concur with the second, in adopting a concern with representations, and they make even more explicit the extent to which the representational practices—how the representation was built and worked with—contribute to the problem clarification and problem solution.

In theoretical terms, this paper develops the discussion of *indexical reference resources* by Hanks (1992). It considers two groups of students who were presented with the same problem statement involving combinatorics. The two groups identified completely different sets of "indexical properties," which allowed them to formulate implicitly, share collaboratively and solve mathematically the "same" problem, which, however, had been specified quite differently. In the first team, Bwang8 specified the stair-step pattern of squares in terms of two symmetric sets of lines. Each set of lines followed the pattern: 1, 2, 3, …, n, n. In the second team, Davidcyl specified the problem initially as: "the n^{th} pattern has n more squares than the $(n-1)^{th}$ pattern."

Ethnomethodologists are keen to observe the work that people do to accomplish what they do. Both teams engaged in intricate coordination of text understanding, sequential drawing, retroactive narrative and symbolic manipulation to make sense of the problem statement they faced and to arrive at a mathematical solution. The work involved in this can be characterized as discovering, proposing and negotiating successive determinations of indexical properties of the problem they were working on. The indexical properties are ways in which the team members can reference aspects of the problem, such as in terms of sets of lines arrayed in specific identifiable patterns. These indexical properties are tied to the local problem-solving context of the respective team. They specify the problem for the team in practical terms, which allow the team to make progress in both understanding and solving the problem.

This approach is appropriate for what Rittel (Rittel & Webber, 1984) called "wicked problems." These are non-standard problems, for which the approach to problem solving is not obvious and turns out to be a matter of coming to understand the problem itself. One can imagine Bwang8 entering a completely unknown territory. He was not familiar with the online environment, had never seen the kind of problem statement that was displayed, did not know the other team members and was unclear about what was expected of him. He spotted (visually) an interesting symmetry in the problem and started by stating it as an initial specification about how to view (perceptually and conceptually) the problem. Then he started to draw the problem, so specified, on the shared whiteboard. Davidcyl entered a similarly unknown territory. He started drawing the pattern for N=4, as suggested in the text. In so doing, he developed some copy-and-paste practices, which he presented (in the sequentiality of his drawing process as well as in his accompanying description) as tentatively mathematically relevant.

Starting from *individual* suggestions of indexical properties (by Bwang8 or Davidcyl, respectively), each group developed a growing shared indexical ground of deictic reference. The work of building that space of possible references led the *group* to make sense of a problem and to discover a path to a solution in mathematical terms. The ground itself is a set of shared interactional resources that allows the team to refer to their object of concern in mutually intelligible ways. By gradually moving from purely deictic terms like “it” or “this,” to mathematical terms or abstract symbols, the indexical resources incorporated cultural knowledge and contributed to a less locally situated store of understanding that could be relevant in a larger classroom or *culture* of school mathematics (including standardized tests). The analysis of how these groups successively and collaboratively re-specify their referential resources suggests approaches to studying how groups make sense of problems and artifacts whose indexical properties are initially unknown or underspecified. This is a foundational concern for CSCL, as “a field of study centrally concerned with meaning and the practices of meaning making in the context of joint activity, and the ways in which these practices are mediated through designed artifacts” (Koschmann, 2002).

Coincidentally, in parallel with the publication of this paper, Medina and Suthers (2013) analyzed the same data of Bwang8’s virtual math team, showing how the student group re-used over time a set of indexical resources that they developed for co-constructing, co-attending to and collaboratively making sense of graphical representations useful for their problem solving. This analysis connected the local unit of analysis to a larger temporal level.

Roles as interactional resources for community meaning making

If the previous studies take interactional approaches, the paper by *Magnus Hontvedt* and *Hans Christian Arnseth* can be considered to be largely at the community-of-practice level. Like the apprenticeship cases of Lave and Wenger (1991), this one is concerned with how novices take on the practices of a professional community. Situated in a simulator for training Norwegian sailors, the apprentices role-play at navigating a ship. To bring a ship up the fjord to Oslo, they must bring aboard a local expert. This master pilot helps to establish the professional navigational practices with the apprentices. Interestingly, the pilot insists on using the international language of shipping, English. At times, the trainees slip into Norwegian to reflect on their role-playing, thus marking linguistically the duality of their realities. On the one hand, they are playing the roles of professional sailors interacting in English on the bridge with the local pilot; on the other, they are Norwegian students discussing their educational activities.

Through their role-playing, the participants—whether newcomers or established members of the sailing community—co-create interactionally the context of their learning. Much of the learning consists in this subtle process, which includes integrating interpersonal relations, language constructs, physical artifacts, a designed setting and nautical tasks. Together, this constitutes what the authors call an *activity context*. Building on the theoretical framework of activity theory, an activity context is closely related to Goffman's concept of frame, discussed above.

The roles taken on by the students are resources for their apprenticeship meaning making. Like roles in a play on stage, they require a willing suspension of disbelief. The analysis in the paper nicely shows how the students fluidly move in and out of their roles and negotiate when to do so, often through code switching between the languages of the two cultures. Never taking the simulation fiction too seriously—as though it were an immutable reality—the analysis reveals how the participants themselves achieve the tenuous existence of the activity context interactionally.

The interactional resources of this learning community are ephemeral emergents—which also means they can collapse. The action can call for a role or an artifact that is missing from the simulation, resulting in improvisation, chaos, laughter. This carries a lesson for all of us: an assemblage of resources for learning cannot foresee all uses. Even the most rehearsed experiment in complex learning is likely to run afoul of glitches. In the best cases, the participants laugh off the troubles … and the analysts discover insights in the breakdowns.

Annotations as resources for individual learning

In our final paper of this issue, *Evren Eryilmaz, Jakko van der Pol, Terry Ryan, Philip Martin Clark* and *Justin Mary* take a controlled-experiment approach to evaluate the effect of a promising annotation-support tool as a resource for individual learning. While learning is conceptualized as a process that primarily takes place in individual heads, it is enhanced by the interactional level of individuals formulating ideas as posted text and receiving feedback as posted responses from others. Asynchronous discussion forums seem like good media for supporting such enhancement, except that their use causes excessive "cognitive load," reducing the ability to engage in the cognitive processes required for deep learning and therefore counteracting the potential benefits of social interaction.

To make it easier to establish joint reference, the authors of this study provided students with a software indexing function, which graphically connects annotations with relevant selections in the provided educational text. The treatment group uses this software tool as an *interactional resource*, which is not made available to the control group. The authors study the effect of the resource on learning. They show that the treatment group produces more posts coded as "assertions" and "conflicts." The treatment group also does better than the control on the post-test, confirming experimental hypotheses. The conclusion is that the software resource reduced the cognitive load needed to co-construct effective shared interactional resources, like indexical descriptions of target text passages. This allowed the students more cognitive ability to engage in interactive assertions and conflicts. So the focus on the individual unit of analysis allowed this study to evaluate interactions between individual learning, group interaction and socio-technical setting.

The approach and conclusions of this paper can be contrasted with the recent findings in CSCL research about "productive failure" (Kapur & Bielaczyck, 2012; Kapur & Kinzer, 2009; Pathak et al., 2011). Positive findings about productive failure suggest that group processes can underlie individual-level learning in ways that may not show up immediately. The effort to build a joint problem space about a text through interpersonal interaction may confer learning benefits that are not achieved when that task is delegated to software. The interactions among individual learning, group process and institutionally mandated assessments may look quite different depending upon how the research methodology treats the relationships among the levels.

This final paper, taken together with the preceding four, illustrates how different methodologies can be adopted for analyzing resources and their relations to different levels of analysis. What can be taken as a resource for purposes of CSCL research is open to a broad range of approaches and theoretical frameworks. One can find resources for individuals, groups and communities. Often, those resources can be seen as traversing across or mediating between levels. Analysts can fruitfully focus on one aspect or another of this; or they can strive to follow resources across multiple levels.

The CSCL agenda on levels of analysis

The time has come for CSCL to address the problem of traversing levels of analysis with exacting research. Attempts to research a given level in isolation have run into fundamental limitations. Although it is clear to most researchers that the levels of individual, small-group and community phenomena are inextricably intertwined, opinions differ on how to respond analytically. Religious wars between adherents of different methodological faiths are often based on misunderstandings: people agree on the need to comprehend the levels together, but articulate that need in incommensurate-seeming locutions.

Multiple-method approaches, multi-level statistics and multi-vocal analyses are limited, because they do not explicitly address the complexity of interrelationships among different levels. Some researchers claim that the apparent levels are all reducible to one fundamental level—whether individual cognition, group interaction or the social—while others assume that they can be studied independently. Some say that there is no such thing as different levels, but only different kinds of analysis, although they generally end up talking of individual understandings, group interactions and community practices. There are vague theories that one level is emergent from another or dialectically coupled with it, but these ties are not well worked out or evidenced with CSCL data.

The contributions in this issue provide examples of the kinds of studies and analyses that are needed. In order to comply with one or another standard of rigor, most research focuses on specific relationships within a single unit of analysis. We now also need to generate, compile and analyze data that sheds light on relationships across levels. The idea of tracking *interactional resources* as they mediate across levels offers one suggestive approach. The different papers discussed here and other referenced theories show that there are many ways to conceptualize, analyze and theorize resources. One can conceive of the resources as interactional resources, indexical-reference resources, ephemeral emergents, immutable mobiles, social and content resources, structuring resources, representational resources, framing resources, role-playing resources, cognitive resources, level-traversing or boundary-spanning resources. This journal issue is not meant to define or defend a particular tack, but to suggest interactional resources as a candidate boundary object for discussion across competing approaches. The editorial introduction has not tried to propose a consistent position, but rather to raise some questions about what can be meant by resources for computer-supported collaborative learning, in the hope of stimulating thinking for the CSCL 2013 conference.

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8(2): Transactive discourse in CSCL

The previous two issues of *ijCSCL* explored the multiple levels of analysis characteristic of CSCL research. In this issue, we look at multiple levels in four more papers. Two of them explicitly discuss the notion of 'transactivity' in this context. They all consider how students—from kindergarten to college—build on each other's reasoning through the shared use of computer media—synchronously or asynchronously—and how this can be measured and supported.

The concept of transactivity connotes a spanning of activity across multiple actors. Defining transactivity as the reasoning of one utterance building on another utterance's reasoning suggests two ways of looking at transactions: in terms of the distinct utterances of the individuals or the unified interaction in the dyad, small group or community.

The first approach reduces the description to the individual unit of analysis. An individual A expresses his or her individual cognition (mental model, internal representation, thought, reasoning) in an utterance P, and then individual B observes utterance P, interprets P in terms of B's mental model of A's intentions and formulates a transactive utterance Q in response. The sequence P-Q may build knowledge or express a logical argument. The sequence would not have occurred through the mental activity of A or B alone, but results from the interaction of A and B, in which B builds on A. Yet, the entire transaction has been analyzed in terms of mental states of the individuals A and B. One can, for instance, go on to ask about the extent to which A and B had similar individual understandings of P and Q.

Alternatively, it is possible to analyze the transaction P-Q at the group unit of analysis. One can say, we know nothing about internal states of A and B other than what is implicit in what they say aloud in order to make their meanings clear to each other. As observers or analysts, we can understand what they say in the same ways that they understand each other—on the basis of how they make themselves clear to each other—assuming that we have a similar cultural background and understand their language. In this approach, the meaning of the transaction is located in the pair of utterances, P-Q, rather than in the minds of A or B. P may be understood in terms of its elicitation of a response such as Q; P opens the possibility of such a response and this possibility is an essential aspect of its meaning. Q responds to P; the meaning of Q is highly dependent upon P. It may be better to say that the meaning does not lie partially in P taken on its own and partially in Q by itself, but in the unity P-Q. The meaning may involve semantic, syntactic and pragmatic references between P and Q, which only make sense when P and Q are taken together. An analyst of transaction P-Q must understand the meaning of the pair of utterances taken together, situated in their on-going discourse. Such an analysis is at the group level of analysis of the discourse between people. It consists of linguistic analysis of the transactive utterances, not of the mental states of the individual speakers.

As CSCL researchers, we understand the meanings of transactions between subjects in our data because we are members of the same broad community as our subjects. We can give "thick descriptions" of their utterances in terms of what they mean. The term "thick description" comes from the philosopher Austin and the anthropologist Geertz (see the following papers for references). Austin distinguished a thin description of someone's eye twitching vs. a thick description of someone winking. An objective description of the physiology or movement of an eyelid might be the same for a twitch or a wink. However, a wink is part of a meaningful transaction between people and must be understood and described as such. This requires subtle cultural knowledge, which is why Geertz was concerned with how one makes reliable thick descriptions in anthropological contexts involving exotic cultures.

A transactive pair of utterances can serve as a boundary object between CSCL analyses at the individual and small-group unit of analysis. Not only can we relate the different analyses of a specific pair of utterances, but we can also extend the analysis of the transactive utterances to conceptions of individual or group background knowledge, common ground and transactive memory systems.

It is important to note that the original conception of transactivity by Wegner and others in the 1980s was significantly different from more recent theories of distributed and group cognition. It was a psychological theory focused on situations in which individuals hold different knowledge and members of the group engage in transactions to assist in recall of the stored information, largely through meta-knowledge about what each other knows. Thus, transactivity analyzed group phenomena at the individual unit, as contrasted to theories of intersubjective shared understanding, where knowledge is spread across multiple people and their artifacts or where a group is engaged in building and maintaining a joint problem space, which is co-experienced.

The articles in this issue address many of these matters of building knowledge together, each in a quite different way. They each grapple with the issue of units of analysis. They also discuss the ways in which computers can support collaborative knowledge building despite the fact that computers cannot formulate or understand thick descriptions of discourse moves. What is interesting about this collection of CSCL research reports is not so much their commonality in considering levels of analysis, as the rich diversity of their approaches to doing so.

In the first paper, *Richard Alterman and Johann Ari Larusson* undertake an extended theoretical and empirical analysis of knowledge creation in loosely coordinated learning activities—specifically in student blogging—in contrast to meaning making in a tightly coupled joint problem space, as is more commonly analyzed in CSCL research. While blogging is a predominantly individual writing and reading experience, it also provides for transactive building on the reasoning of other students and, over time, in the emergence of common knowledge from participation in the persistent and growing community blogosphere.

The next article raises the question of how to support transactivity with scripting. *Omid Noroozi, Stephanie D. Teasley, Harm J. A. Biemans, Armin Weinberger and Martin Mulder* report on a laboratory experiment in which interactions of dyads with different expertise are scripted in ways hypothesized to increase transactivity. One script prompts for building awareness about a learning partner's expertise, assigning and accepting task responsibility, and forming a collaboratively shared system for retrieving information based on the partner's specialized expertise. The other script prompts for analyzing arguments put forward by learning partners and constructing arguments that relate to already externalized arguments. The study examines the individual and combined effects of these two kinds of scripts on the quality of both joint and individual problem solutions. Interestingly, each of the scripts—designed to support one aspect of transactivity—seems to be beneficial, but when combined the scripts apparently get in each other's way.

Florencia Gómez, Miguel Nussbaum, Juan F. Weitz, Ximena Lopez, Javiera Mena and Alex Torres explore a situation in which triads of kindergarten children work together on a single computer with three mice and three distinct areas of the screen. In keeping with the theory of transactivity, the participants have different but interdependent roles or tasks. The authors argue that interacting on a single computer increases shared attention, and hence the tendency to build transactively. The children engage in group processes in order to achieve a common goal on the shared screen. Thereby, they develop social skills. Experimental results show that this combination of individual roles and group interaction—typical of transactivity—are effective in enhancing the social skills of the young children, as measured individually by standardized psychological tests. Given the inexperience of the kindergarteners, a teacher must mediate, analogously to the scripted prompts for the college students in the previous study.

The final paper, by *Gahgene Gweon, Mahaveer Jain, John McDonough, Bhiksha Raj and Carolyn Rosé*, addresses the task of automatically assessing the level of transactivity in a spoken-discourse corpus. Perhaps because computers cannot engage in thick descriptions of the meaning of interactions, an indirect approach is taken here. Data-mining algorithms have become proficient at identifying patterns in thin descriptions of data, such as acoustical features of speech. The authors argue that insights from the social psychology and sociolinguistics of speech style imply that a measure of speech-style accommodation should positively correlate with a prevalence of other-oriented transactions in conversation. That is, people tend to accommodate certain acoustic characteristics of their speech—such as variation and average levels of pitch, intensity of speech or the amount of silence and duration of speech—to that of their partner to roughly the same extent that they engage in building on their partner's reasoning. Thus, an analysis of the acoustics of speech can predict a level of transactive reasoning.

8(3): Collaborative learning at CSCL 2013

Gerry Stahl, Nancy Law & Friedrich Hesse

In Madison, Wisconsin, USA, with its Northern European heritage, collaborative learning is fueled by brats and beer. At the international CSCL conference in June, there were many formal and informal opportunities to build knowledge about our field with colleagues from around the world while sipping drinks on the shores of the sunny lakes, along the vibrant college-town avenues, or in the university halls.

The intense week of interaction began—at least for some—with a daylong retreat of the ISLS Board. Discussion focused on plans for increasing the impact of the CSCL and Learning Sciences research community globally. A more interactive website is imminent and increased outreach to communities that are just discovering CSCL is planned. Efforts to increase access to the contents of the journals—*ijCSCL* and *JLS*—as well as conference papers and the CSCL book series are underway.

The pre-conference began the next day with a variety of well-attended workshops. One was on interactional resources spanning multiple levels of analysis in CSCL settings—as discussed in the three preceding issues of *ijCSCL*. Another of especially general interest was a workshop on creating a cyber-infrastructure that can support engagement by multiple researchers in working toward answers to important theory-driven research questions for design-based research. As always, the doctoral consortium and early career workshops were valuable for the many mentors as well as the participants.

The following day began with half-day workshops. We three attended one that seemed particularly promising for the field of CSCL. The international PISA test—which rates student math, science, and reading skills in over 70 countries around the world—is planning to introduce measures of collaborative problem-solving skills in 2015. This could mean that students, parents, teachers, schools, and policy makers in many countries will urgently want to know about collaborative learning. In fact, the test will be computer supported, having students tested through interacting with a computer system. This workshop was the first time that the framework for measuring collaborative problem solving in the PISA tests was made public. Fortunately, a number of CSCL and Learning Sciences researchers are closely involved in this effort and are committed to making the process as public as possible. The debates and discussion during the workshop raised important theoretical and methodological challenges to measuring collaborative problem solving, and there is general agreement that such open communication between the CSCL and the psychometric communities is beneficial to advances in both large-scale assessment methodologies as well as in our understanding of collaborative learning and problem solving. We welcome submissions to *ijCSCL* on the PISA approach and its implications for CSCL.

Highlights of the conference included three keynote presentations, each of which broadened the discussions of CSCL. They presented insights into behaviors related to collaborative learning among chimpanzees who live in the present only, teenagers who build rapport by insulting each other, and young girls who express themselves in amateur videos. Another highlight was the invited presidential symposium, organized by ISLS current president, Frank Fischer, in-coming president, Cindy Hmelo-Silver, and former president, Susan Goldman. Because of its potential interest to the *ijCSCL* readership, we present a summary of the symposium presentations below.

Of course, the heart of the conference was the presentation of lecture papers, interactive papers, posters, demos, symposia, etc.—too many for anyone to attend all of them. We hope to publish extended journal versions of some of this important research next year. For this issue, we present a mix of empirical, pedagogical and theoretical papers addressing current topics in CSCL.

Looking back and looking ahead: Twenty international years of CSCL

The Presidential Symposium presenters analyzed the research and the development of the CSCL community in their respective regions of the world. Gerry Stahl presented a brief history of CSCL in North America; Paul Kirschner presented his view on CSCL research and communities in Europe; Peter Reimann analyzed CSCL research in Australia; and Nancy Law contributed her perspective on CSCL in Asia. In the role of the discussant, conference program co-chair Nikol Rummel provided a synthesizing perspective on historical and future trends.

Almost two decades after the first conference on computer support for collaborative learning, four contributors analyzed the research and the development of the CSCL community in their respective regions of the world. Questions they addressed included the following: What were the origins and early stages of CSCL in this area of the world? What have been important research questions, concepts, and methods? Which unique contributions to CSCL research have there been from this area of the world? What have been the role and the relation of different disciplines within CSCL research, e.g., computer science, psychology, and educational sciences? Looking ahead, what future trajectories can be expected and what would be desirable futures of CSCL research? The discussant reflected on the presence in the current conference of the trends presented in this symposium.

For many of the leading early North American CSCL researchers, the goal was to use CSCL innovations as levers to transform education by promoting collaborative learning. They investigated the interaction within the group and the group processes related to social dynamics as well as to knowledge building. Research addressed aspects like design of technology, analysis of collaborative learning, and the evaluation of collaborative-learning outcomes. A major contribution of North America to CSCL research has been the emphasis on design-based research, in which iterative cycles of trials in realistic settings are used to drive design of technology and pedagogy. Future trends in CSCL research are toward increasing international collaborations and projects.

The hallmark of European CSCL is its diversity. Across Europe, research groups are designing tools for CSCL and studying their implementation in terms of duration, scripting, and social dynamics. Aided by national, transnational and European programs, Europeans regularly work with and meet with each other, learning from each other in Networks of Excellence and European schools. The future promises continued cross-national efforts.

The main “driving” discipline behind CSCL research in Australia is applied computer science, in particular in the form of technology developments in higher education. Australia’s innovative contributions to CSCL currently include tabletop computing in support of co-located, synchronous group work and group learning, collaborative web-based video annotation, and collaborative (academic) writing as a form of CSCL. Likely trajectories for future research are those focused on media-rich (synchronous) collaboration, including video conferencing and collaboration in immersive environments; increasing use of learning analytics in the context of CSCL studies, and studies into collaboration processes in design teams and virtual design studios.

CSCL research in Asia was stimulated in the 1990s by the formulation of IT master-plans in a number of countries and focused on improving education system-wide and preparing citizens for the 21st century. There is strong interest in linking research and practice and an orientation toward collaborative knowledge building. The CSCL research conducted in Asia has a strong emphasis on pedagogy and assessment, bringing with it the challenge of integrating CSCL into the daily instructional milieu. A second emphasis in Asia is on teacher learning and professional teacher networks for knowledge building. Looking to the future, CSCL in Asia needs to take up the challenges inherent in research on CSCL at individual, group, and community levels.

Two themes emerge from considering the perspectives presented from the different regions of the world on the past and future of the field of CSCL: diversity and unity. On the one hand, we see a lot of diversity in the ways CSCL research has developed and is currently enacted. Differences concern, for instance, research foci (i.e., which letter of the CSCL acronym research focuses on), research methodology, overarching goals of the research, and the extent to which various stakeholder groups (e.g., learners, teachers, policy makers) guide the work or are considered. On the other hand, it is evident that there is unity in the diversity: The joint goal of the international community of CSCL is to make an impact on the way collaborative learning is implemented, both in terms of educational practice and policy. Developing the CSCL community as part of the larger umbrella of ISLS will be instrumental to enabling the CSCL community to have a say in international developments, such as the planned inclusion of the area of collaborative problem solving in PISA 2015.

8(4): Reigniting CSCL flash themes

Gerry Stahl, Nancy Law & Friedrich Hesse

This journal promised six years ago to publish studies on what it termed “CSCL and its flash themes” (Stahl, 2007). Rather than devoting single issues to specific topics of timely prominence, we decided to welcome submissions about selected emerging themes of CSCL research on an on-going basis. Accordingly, we set aflame again in the current issue discussion of the topics of argumentation, scripting, and tabletop interfaces. These three areas of computer support for collaborative learning continue to be active foci of CSCL research. To begin the issue, we spark a new theme with a paper on the use of eye-tracking technology to support and to research collaboration, an approach that has not previously been discussed in this journal but has been gathering attention at the ISLS conferences recently. It is noteworthy that research in these flash themes is still not merely a matter of refining the details of well-established findings, but continues to raise fundamental and controversial theoretical and methodological issues from a CSCL perspective.

In introducing their study of gaze perception among dyads of students, *Bertrand Schneider and Roy Pea* begin with an extended discussion of joint attention. As they document, joint attention is foundational to collaborative interaction and, indeed, to human sociality. From infancy on, people learn to take advantage of different forms and media of joint attention to make intersubjective sense. Any mode of intentionality (whether individual, group, or collective) involves an orientation to some subject matter; communication accordingly requires a coordinated orientation to a shared object, with the understanding that this orientation is shared and with a shared sense of the object’s meaning. For two people to solve a problem together—e.g., in a CSCL setting like answering questions about diagrams—the participants must take (or enact) the problem as the same problem and they must see (and describe) the object as the same object (Stahl, 2013, Ch 8; Zemel & Koschmann, 2013). This requirement of successful collaboration is complex, multi-modal, subtle, and learned over a lifetime. It involves discourse, gesture, gaze, cognition, social skills, tacit practices, etc. In the experiment reported here, the joint attention is investigated in terms of technological support for coordinating the eye gazes of pairs of students. In the experimental condition, students can see where the eyes of their partners are gazing at a computer screen like their own screen. The knowledge of where their partner is looking can then be used as an information source in addition to their audio connection for discourse. Thereby, the fact that they are staring in a similar direction can be elaborated into a sense that they are making shared meaning concerning the jointly intended object. Data collected on gaze was computed into four different quantifiable measures, which were then correlated—for both the experimental and control conditions—with independent measures designed to operationalize learning gains, joint attention, and quality of collaboration (based on Meier, Spada & Rummel, 2007). A small-scale qualitative analysis provides additional insight into the different experiences of the two conditions. This investigation demonstrates how eye-tracking technology can be applied to the long-standing interest within CSCL theory in studying joint attention, common ground, intersubjectivity, shared understanding, co-construction of meaning, group cognition, and joint problem space. However, this requires that objective data on gaze be tied to intersubjective meaning making if gaze is to be used as an indicator of joint attention.

One of the most explored topics in CSCL has been the computer support of argumentation (Andriessen, Baker & Suthers, 2003; Asterhan & Schwarz, 2010; Falcao & Price, 2011; Scheuer et al., 2010; Schwarz et al., 2011). The paper by *Esra Alagoz* combines this focus with the analysis of learning during videogame playing, another important theme for *ijCSCL* (Bennerstedt, Ivarsson & Linderoth, 2012; Silseth, 2012). She conducts an ethnographic study of 22 teenage boys who were identified as “disengaged” at school and school-related work. The investigation concludes that in contrast to their performance in school and contrary to expectations based on earlier publications on argumentation, when the subjects chatted in the fantasy multiuser videogame of *World of Warfare* (*WoW*) they “engaged in quality argumentation in 81% of their argumentative exchanges.” Thus, the paper contributes to a line of academic argumentation that says educators should learn from game designers how to motivate students or even that they should incorporate computer games in the classroom to teach cognitive skills like arguing logically. It claims that the quality of the argumentative performance of the students is higher in the “informal” context of *WoW* because the students have a higher sense of control (e.g., in selecting parameters for their digital avatars). It characterizes the digital context as a less alienating, more authentic setting than school for the students to “establish an emotional attachment to the activity and reflect their personal trajectories.” Considering that the *WoW* scenario is the product of an immense corporate design effort and marketing strategy, is highly formally structured, and is intentionally about as removed from the students’ physical lives as possible, this seems to be a curious claim. Furthermore, the reportedly “quality” argumentation is rather different from what the theoreticians of argument cited in the literature review had in mind. They envisioned articulate discourses consisting of multiple propositions tightly linked together. The first counter-argument we are presented with from *WoW* consists entirely of the grunt: “eh”. The difference is that discussions of argumentation referred in the classical discussions (e.g., Toulmin, 1958) to the imagined ideal mental chain of propositions of an individual philosopher or scientist. In the data from *WoW*, the arguments extend over the brief chat postings of multiple players, reacting to each other. It is here a transactive, collaborative, or group argument, presented not by an individual thinker but by a sequence of interacting members of a team (guild) planning an action (quest). The quality of the argumentation is an attribute of the group interaction, although the data analysis separates it into categories of isolated utterances and then rates 81% of them as falling into the quality category. This paper raises some important issues for the flash themes of argumentation and gaming: To what extent is the undeniable motivation of games like *WoW* for teenage boys (perhaps especially for disengaged students) a manufactured and manipulated need? Does it reflect a rejection of their conventional life, rather than a potential training ground for it? Or should we adopt a Vygotskian perspective on learning-to-argue by proposing that one can argue first as part of a virtual group and later internalize the skills for individual scholarly cognition in school?

Scripting has, of course, been a flash theme in CSCL since *ijCSCL* began publishing, and has remained active in recent years (e.g., Onrubia & Engel, 2012; Perez-Sanagustin et al., 2012; Pozzi, 2011; Rummel, Mullins & Spada, 2012). The study reported here by *Hannie Gijers, Armin Weinberger, Alieke Mattia van Dijk, Lars Bollen and Wouter Reinder van Joolingen* combines scripting with awareness prompts, another researched CSCL intervention. In particular, it applies these measures in an elementary school setting involving drawing scientific diagrams representing photosynthesis processes. The authors argue that such drawings can be educationally productive but that scripting of collaborative drawing has not been explored extensively in the past. Dyads of students—in a scripted, awareness, or control condition—are asked to construct individual diagrams and then combine them in a shared diagram. Although the drawings are intended to aid student comprehension of photosynthesis by providing an additional medium to reading and discussing for the students to individually and collaboratively construct meaning, the quality of the drawings is operationalized as the quantity of concepts from the science lesson that appear in the drawing. Even using this reified measure, the awareness prompts did not have the expected positive effect on the drawing quality. Interestingly, it did stimulate discourse about more of the concepts, but this did not translate into the anticipated effect on the shared drawings. A qualitative look at the dyadic discourse reveals that “when students combine their individual drawings they often feel the need to provide additional explanations considering the meaning of the represented objects.” Methodologically, the conditions of scripting and awareness prompts were kept separate in order to demonstrate that they could each have a positive effect on collaborative discourse and drawing. However, at this point in the research it is important to go beyond the affirmation of the possible positive effect of such mechanisms in order to guide educational designers and teachers in how and when to invoke particular instances of them in concrete situations. It is clear that multiple interventions can interfere with each other or result in over-scripting (Dillenbourg, 2002). Students at specific ages, knowledge, aptitudes, and social relations may not be responsive to selected prompts. Experienced teachers know how subtle it is to judge a teachable moment and to respond appropriately to guide individual students or small groups effectively. Perhaps if one now combined the two experimental conditions and tailored the script to the dyad based on the awareness measures of the collaboration process, one could discover an effective synthesis.

A recent flash theme in *ijCSCL* is the use of tabletop interfaces for collaborative learning (Dillenbourg & Evans, 2011; Falcao & Price, 2011; Higgins et al., 2011). In their contribution to this issue, *Roberto Martinez-Maldonado, Yannis Dimitriadis, Alejandra Martinez-Mones, Judy Kay and Kalina Yacef* exploit data from tabletop interactions among triads of students to provide “learning analytics” indicators to guide “classroom orchestration” by teachers. Envisioning future classrooms in which student groups are active at multiple tables, they argue that teachers need real-time feedback about how the different groups are doing. Using the dimensions of measuring collaboration from Meier, Spada and Rummel (2007) to classify the student triads as more collaborative or less collaborative, they compare the use by these triads of verbal and/or physical participation in the assigned concept-mapping task. An important contribution of the paper is how the authors supplement the tabletop equipment with special devices designed to identify the speakers and actors. This is needed in order to determine the social network of interaction. The analysis of captured voice and object-manipulation actions on the tabletop involved detailed classifications, conducted automatically by the assembled technology. Although the correlations are not statistically significant, they suggest that refined versions of this approach could be useful in identifying, at least post hoc, teams that are behaving less collaboratively than desired. Thus, the authors have succeeded in capturing and automatically analyzing dimensions of interaction around the tabletop, which could in theory prove useful to teachers and even to the students in guiding improved collaboration. While several graphical representations are presented in the paper, the vision of learning analytics providing real-time visualizations of collaborative processes to the participants to guide their interaction remains a distant goal, without having addressed major issues, such as intrusive intervention in the interaction, interpretation of the information by the participants, or strategies for them to repair problems. How are teachers and especially students to make sense of such abstract representations of interaction characteristics in a way that is likely to improve their situated collaborative learning?

Flash themes may flare up or die down over time, but it seems—based on a critical reading of these articles—that the task of CSCL remains unwavering. It must be "centrally concerned with meaning and the practices of meaning making in the context of joint activity, and the ways in which these practices are mediated through designed artifacts" (Koschmann, 2002, p. 18). No matter how technological the theme and no matter how objective the methodology, issues of human group meaning making must still be centrally addressed.

Reviewers

The quality and relevance of papers published in *ijCSCL* is primarily due to the peer-review process that filters out inappropriate or premature submissions and guides the authors of promising submissions to make the revisions necessary for publication. During the eight years of *ijCSCL* publication, the following CSCL researchers conducted 1,537 reviews:

Shaaron Ainsworth, Rick Alterman, Lisbeth Amhag, Jerry Andriessen, Nancy Ares, Baharuddin Aris, Hans Christian Arnseth, Maarit Arvaja, Christa Asterhan, Maria Avgerinou, Gerardo Ayala, Michael Baker, Maria Bannert, Liam Bannon, Ulrika Bennerstedt, Marina Bers, Johanna Bluemink, Daniel Bodemer, Jacqueline Bourdeau, Paul Brna, Bertram Bruce, Amy Bruckman, Juergen Buder, Murat Cakir, Angela Carell, John Carroll, Carol Chan, Rosanna Chan, Tak-Wai Chan, Elizabeth Charles, Clement Chau, Fei-Ching Chen, Gaowei Chen, Britte Cheng, Ming Ming Chiu, Samuel K.W. Chu, Cesar Collazos, Ulrike Cress, Charles Crook, Lucilla Crosta, Ton de Jong, Bram De Wever, Anne Deiglmayr, Muhammet Demirbilek, Sharon Derry, Pierre Dillenbourg, Angelique Dimitrakopoulou, Lone Dirckinck-Holmfeld, Nina Dohn, Gilles Doiron, Paul Dourish, Nathan Dwyer, Anna Engel, Tanja Engelmann, Noel Enyedy, Gijsbert Erkens, Michael A Evans, Deller Ferreira, Frank Fischer, Brian Foley, Andrea Forte, Norm Friesen, Hugo Fuks, Andreas Gegenfurtner, Anne Gerdes, Sean Goggins, Ricki Goldman, Luisa Aleyda Gonzalez, Christian Greiffenhagen, Begona Gros, Jonathan Grudin, Frode Guribye, Joerg Haake, Kai Hakkarainen, Paivi Hakkinen, Raija Hamalainen, Andreas Harrer, Wu He, Libby Hemphill, Thomas Herrmann, Friedrich Hesse, Steven Higgins, Cindy Hmelo-Silver, Christopher Hoadley, Ulrich Hoppe, Christine Howe, Tien-Chu Huang, James Hudson, Diane Hui, Chris Hundhausen, Liisa Ilomaki, Shahrinaz Ismail, Seiji Isotani, Michael Jacobson, Isa Jahnke, Manoj Jain, Sanna Jarvela, Anne Jelfs, Patrick Jermann, Richard Joiner, Christopher Jones, Robert Jorczak, Regina Jucks, Yael Kali, Victor Kaptelinin, Manu Kapur, Anastasios Karakostas, Fengfeng Ke, Liesbeth Kester, Diane Jass Ketelhut, Andrea Kienle, Joachim Kimmerle, Paul Kirschner, Lars Kobbe, Matthew Koehler, Bas Kolloffel, Timothy Koschmann, Ingeborg Krange, Eleni Kyza, Therese Laferriere, Minna Lakkala, Victor Lally, Niki Lambropoulos, Mary Lamon, Yu-Ju Lan, Annika Lantz-Andersson, Johann Larusson, Nancy Law, Mark Lee, Erno Lehtinen, Maria Ligorio, Kenneth Lim, Robb Lindgren, Oskar Lindwall, Lasse Lipponen, Eva Lira, Geoffrey Liu, Han-Chin Liu, Jia-Jiunn Lo, Jacques Lonchamp, Chee-Kit Looi, Jingyan Lu, Rose Luckin, Sten R. Ludvigsen, Andreas Lund, Kristine Lund, Johan Lundin, Kim MacKinnon, Alejandra Martinez, Camillia Matuk, Richard Medina, Monika Mital, Naomi Miyake, Anders Morch, Johannes Moskaliuk, Daisy Mwanza-Simwami, Bonnie Nardi, Brian Nelson, Bernhard Nett, Matthias Nackles, E. Michael Nussbaum, Miguel Nussbaum, Angela O'Donnell, Hiroaki Ogata, Claire O'Malley, Javier Onrubia, Jun Oshima, Khaziyati Osman, Roy Pea, Eduardo Penalosa, Mar Parez-Sanagustan, Ruediger Pfister, Manoli Pifarre, Wojciech Podraza, Sara Price, Mingzhu Qiu, Subba Rao, Ingvill Rasmussen, Janet Read, Peter Reimann, Ann Renninger, Jochen Rick, Alan Roberts, Tim Roberts, Jennifer Rode, Markus Rohde, Jeremy Roschelle, Carolyn Rose, Liam Rourke, Nikol Rummel, Nadira Saab, Roger Saljo, Johann Sarmiento-Klapper, Claudia Sassenrath, Marlene Scardamalia, Tammy Schellens, Oliver Scheuer, Bertrand Schneider, Gregg Schraw, Baruch Schwarz, Beat Schwendimann, Anna Sfard, David Shaffer, Wesley Shumar, Amy Soller, Nancy Songer, Hans Spada, Marc Stadtler, Gerry Stahl, Karsten Stegmann, Constance Steinkuehler, Alan Stevenson, Jan-Willem Strijbos, Masanori Sugimoto, Daniel Suthers, Berthel Sutter, Seng-Chee Tan, Steven Tanimoto, Gustav Taxan, Pierre Tchounikine, Meng Yew Tee, Chris Teplovs, Sacip Toker, Ramon Prudencio Toledo, Stefan Trausan-Matu, Michael Tscholl, Nan Uhlik, Jan van Aalst, Marije van Amelsvoort, Ravi Vatrapu, Marjaana Veermans, Patricia Verdines, Chieu Vu Minh, Erin Walker, Sarah Walter, Feihong Wang, Barbara Wasson, Jim Waters, Christof Wecker, Rupert Wegerif, Armin Weinberger, Gordon Wells, Patrick Wessa, Martin Wessner, Tobin White, Alyssa Wise, Donghee Wohn, Volker Wulf, Fatos Xhafa, Kui Xie, Ling Ling Yen, Jennifer Yeo, Fu-Yun Yu, Nicola Yuill, Joyce Yukawa, Jianwei Zhang, Coco Zhao, Joerg Zumbach,

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9(1): Analyzing the multidimensional construction of knowledge in diverse contexts

Gerry Stahl * Ulrike Cress * Nancy Law * Sten Ludvigsen

This year's International Conference of the Learning Sciences (www.isls.org/icls2014) will feature the theme of "practices encompassing the range of contexts and processes in which people learn." In this first issue of 2014 of *ijCSCL*, we present four explorations of that theme. We begin with a consideration of Activity Theory as a framework for analyzing the systemic contexts of CSCL practices. This is followed by detailed qualitative and quantitative analyses of knowledge building across the age spectrum of schooling: from primary school (4th and 5th grade) to tertiary school (first year college). Finally, the collaborative construction of knowledge is studied at the global level of adults posting to Wikipedia.

In preparation for last year's CSCL conference, a series of editorial introductions to *ijCSCL* raised the issue of the interrelationships among individual, small-group, and community learning (Stahl, 2012; 2013a; 2013b). It is interesting to read the articles in this new issue as in part investigations of such interrelationships. The notion that "interactional resources" such as geometric objects in mathematical problem solving can be seen to be bridging levels of analysis was recently elaborated in (Oner, 2013; Stahl, 2013c, esp. Ch. 6; Zemel & Koschmann, 2013). This notion of resources plays a theoretical role similar to that of artifacts in Activity Theory and appears, for instance, in the scaffolds of epistemic games, the notes of knowledge-building forums and the pivotal-knowledge postings of Wikipedia in the papers of the current issue.

Activity Theory

In her presentation of Activity Theory, *Susan Timmis* proposes a framework for "understanding the complex interrelations between discourse, actions, and community, and as a result how new technological innovations and knowledge-creation practices can be appropriated and sustained." She thereby references the micro, meso, and macro units of analysis in terms of individuals' actions, small-group discourse, and community practices. Going beyond the usual superficial application of the Activity Theory template to describing CSCL settings, she seeks a path to sustaining CSCL interventions beyond short-term research projects by understanding the dialectical tensions involved in institutionalizing practices through multi-level analysis. This requires studying how micro-level processes can be transformed into persistent macro-level knowledge-construction practices.

Expanding on Vygotsky's understanding of the role of artifacts, Timmis refers to material "meditational means," which are resources for human activity. She then expands Activity Theory itself to focus more explicitly on dialogicality and communicative action, e.g., small-group interaction, as the intermediate level at which micro and macro are typically bridged: "Agents [individuals] negotiate a shared understanding [group] of the new activities and artifacts, and in this process, new knowledge and practices [community] are created." However, an illustrative multi-level analysis of college students in the UK reveals contradictions—e.g., course assessments opposed individual grades to collaborative work—which militate against sustainability of the educational innovation. Moreover, knowledge-construction practices, relationships, and technologies have important influences on these cross-level systemic tensions.

Knowledge-building games

Perhaps the most influential approach to CSCL to date has been the theory of knowledge-building communities developed by Scardamalia and Bereiter (1996) and their associated Knowledge Forum collaboration environment. Their idea is to introduce students to the knowledge-building practices of academic research communities through collaborative experiences of refining theories of scientific phenomena using an online forum—bridging from the individual learner to the level of science discourse through the intermediate scale of online classroom discussion. Interestingly, the emphasis is not on the students learning facts or playing the roles of scientists as individuals, but on groups of students in a classroom gradually enacting social practices of large communities: "Students learn to use each other's diverse knowledge and skills as resources to collaboratively advance the community's understanding of a problem under investigation."

In their contribution to this issue, *Katerine Bielaczyc and John Ow* explore how to introduce young students (about 10 years old) in a Singapore classroom to collaborative knowledge building. It is well known from decades of experience using Knowledge Forum in classrooms around the world, that it takes years for teachers, students, schools, and school systems to adopt the necessary philosophy of knowledge building (Chan, 2011; Looi et al., 2011). To begin this process with young students, the authors frame the online discussion as a multi-user knowledge-building ("epistemic") game. The game involves progressively improving tentative ideas that the players propose in response to a given topic. In Knowledge Forum, postings are categorized by knowledge-building roles ("my theory," "I need to know," etc.—foreshadowed by Think Cards in the authors' game). Other students can respond to or build on these notes. They can also synthesize sets of notes and arrange the notes graphically. Progress in building knowledge takes place through interaction among the notes. Existing notes are interactional resources for the group process of building knowledge through new notes. The categories and interactional moves of the game supported by the software are further resources, which the students must learn to enact effectively. The scientific topic (such as: "How do we know if something is a living thing?") is another resource, which guides a particular group inquiry toward approaching the established theories of the scientific community.

Collective and individual knowledge building

Ke "Coco" Zhao and Carol K. K. Chan apply a battery of mixed methods to analyzing the knowledge-building achievements of university students in Shanghai, China, using Knowledge Forum (compared to students undertaking similar classroom projects without the CSCL medium). While extending Knowledge Forum research into Chinese tertiary students' understanding of business concepts and academic literacy, the authors support the contention that individual learning and literacy development can be by-products of collective knowledge building. Without fully capturing the mechanisms and resources through which community knowledge diffuses to the participants, they do address whether the CSCL knowledge-building model can affect both collective and individual learning by measuring learning gains at both levels.

The quantitative analysis establishes a relationship between online collective-processing discourse and individual-learning performance. While many coding schemes used in other CSCL studies also include conceptual, collaborative, metacognitive, and social dimensions, this study identifies discourse moves oriented to collective dimensions and meta-discourse in the group. Then it links these processes to individual learning and aligns this with the goal of collective advances in the knowledge-building designs. Members of groups that engaged in meta-discourse scored higher in their individual learning. Analyses of knowledge-building discourse suggest that students' work together can contribute to each other's understanding. As students take up each other's ideas, they weave between individual and group understanding. Student teams often explain, compare, synthesize, and connect different ideas together. Again, the notes posted in Knowledge Forum mediate between individual and collective (team or classroom) knowledge building by means of the practices supported by the software and the pedagogical philosophy underlying it.

Pivotal knowledge in Wikipedia

We have seen a shift of focus from individual student minds, personalities, and biographies to the artifacts of Activity Theory, the resources of epistemic games, and the notes of Knowledge Forum. While such notes are similar to the utterances that construct knowledge within small groups, articles that are created collectively, like those in Wikipedia, are the product of extended histories of contributions, references, edits, and refinements at the macro level, and cannot be construed as expressions of momentary individual consciousnesses. What are the methodological implications of this for CSCL analysis? *Iassen Halatchliyski, Johannes Moskaliuk, Joachim Kimmerle, and Ulrike Cress* propose that "in contrast to the analysis of interaction sequences—artifacts and their meaningful interconnected structure offer a unique way of operationalizing knowledge-related processes in collectives. Maintaining the research focus at the intersubjective level, we extend the concept of collective knowledge to long-term processes and large-scale network structures." To exemplify this, they investigate the German version of Wikipedia articles categorized as educational and/or psychological.

In Wikipedia, there is very little direct interaction between people or within well-defined groups. Knowledge is constructed through the evolution of interconnected articles. In addition to a proliferation of links relating articles to each other, there is a hierarchical category system in the German Wikipedia (but not in the English one), which structures the evolving mass of articles. Although Wikipedia is not intended to construct new knowledge, but just to introduce and reference existing knowledge, it creates immense amounts of what we might call meta-knowledge through its interconnected overall structure. The analysis by Halatchliyski and associates proposes techniques for analyzing the structure of that meta-knowledge at the community level. Using social-network analysis on the links between articles, it defines disciplinary and inter-disciplinary clusters of articles. These clusters, in turn, define different categories of articles, such as pivotal and boundary-spanning articles. The authors then use the results of their analysis at the community level to analyze participation at the individual level of contributors, confirming their hypotheses about different kinds of contributors posting to different categories of articles. One could imagine also analyzing the participation of people in the small-group discussions and differences of opinion that often take place within the evolution of specific articles.

Given the choice of articles (categorized as educational, psychological, and their overlap) in the corpus analyzed, one might guess that the authors had in mind CSCL researchers like themselves. Then the hypothesis would be that contributors to CSCL articles are boundary spanners, who contribute to both educational and psychological articles. However, if one looks at the German Wikipedia, one finds that there is only a brief, largely outdated article on CSCL, with a limited number of links to educational or psychological Wikipedia articles, few researchers contributing, and only a brief, inconclusive discussion (about what to call CSCL in German). Moreover, the German Wikipedia category system itself has no overlap between education and psychology. One wonders what the nature of the articles is that are statistically determined to be boundary spanning in this analysis. Perhaps in addition to the quantitative methods at the different levels one might want to do some qualitative checking on the meaning of findings; otherwise, it is risky to read unwarranted significance into operationalized categories. This is a nice example of how the exploration of an interesting hypothesis about educational research practices requires a carefully designed "multivocality" (Suthers et al., 2013) of methods at different units of analysis.

Epistemic practices

We started this editorial by relating the papers in this issue to the ICLS 2014 theme, "practices encompassing the range of contexts and processes in which people learn." As we looked at the approaches of the papers to this theme, we began to see that knowledge-building practices have more to do with artifacts, resources, notes, or inscriptions than with the phenomena traditionally associated with people learning, such as thinking, acquiring facts, and mental models. In particular, practices are typically defined at the community unit of analysis and are generally enacted at the small-group, discursive unit. Of course, we are still concerned with learning by individuals and the contributions of individual cognition, so we must investigate the working of these various epistemic or cognitive levels of analysis as they interpenetrate each other. As the articles in this issue illustrate, such an undertaking requires innovative analytic approaches. We have only begun to tease apart and grasp the practices and processes of collaborative learning in an effective multidimensional manner. Perhaps these articles will stimulate ideas about how to do so in preparation for ICLS 2014 and CSCL 2015.

Resources for CSCL researchers

ISLS has recently begun the taping of about 50 webinars on topics central to the learning sciences and CSCL, coordinated by Frank Fischer. These 90-minute videos are intended primarily for use in college courses within programs on the learning sciences, but are freely available to the public at: http://isls-naples.psy.lmu.de/intro/all-webinars. They feature many prominent researchers in the field discussing with groups of students: how people learn, supporting learning, methodologies for the learning sciences, and computer-supported collaborative learning.

The Springer CSCL book series (http://www.springer.com/series/5814?detailsPage=titles) now offers 15 books, mainly edited volumes on themes of interest to CSCL researchers. The latest release, *Productive Multivocality* (Suthers et al., 2013), was edited by five members of the *ijCSCL* Board based on a series of workshops at CSCL and ICLS conferences. The book-series editors are currently accepting proposals for new monographs or compilations reporting on major CSCL research efforts.

Changes in the *ijCSCL* Board of Editors

The *ijCSCL* Board is continuing to evolve as we begin the 2014 volume. The major change is that Friedrich Hesse has decided to step down from his position as an Executive Editor of *ijCSCL*. He will remain active on the Board. As you know, Friedrich co-founded the journal in 2005. He collaborated on publishing the eight volumes of the journal to date. Friedrich was a close policy advisor, reviewing every editorial introduction and discussing journal business at the annual CSCL/ICLS conferences. Friedrich provided an essential balance to the journal leadership, which we will maintain in the future with the new changes. Furthermore, KMRC—the research center that Friedrich directs—has contributed many valuable Board members, reviewers, and paper submissions, as well as maintaining the *ijCSCL.org* website with all our articles freely available to the world in their pre-publication full-text versions.

An additional motivation for Board changes is that as the CSCL field spreads around the world—along with the journal's reputation—the number of submissions is increasing, requiring more reviewers and meta-reviewers.

Ulrike Cress and Sten Ludvigsen have now joined Nancy Law as Executive Editors. In addition to continuing their previous duties as Associate Editors, they will participate in journal leadership tasks. Ulrike leads the Knowledge Construction Lab at KMRC; she authored the popular article on multilevel quantitative analysis (Cress, 2008) and the co-evolution model of individual and collaborative knowledge construction (Cress & Kimmerle, 2008). Sten has long been a leader in the European CSCL community and a representative of the sociocultural tradition in Scandinavia (Furberg, Kluge & Ludvigsen, 2013). Nancy continues to focus on international educational policy matters and to promote CSCL in Asia.

Expanding the number of Associate Editors, Sanna Järvelä, Peter Reimann, and Baruch Schwarz have agreed to take on this role, joining Carol Chan, Manu Kapur, Carolyn Rosé, and Dan Suthers. That will increase the number of people writing meta-reviews and recommending acceptance of articles from 9 to 11.

In addition, eight reviewers have agreed to join the Board. They are all CSCL researchers who have completed at least six reviews in the past. We welcome Fengfeng Ke, Oskar Lindwall, Kris Lund, Mingzhu Qiu, Chris Teplovs, Marjaana Veermans, Alyssa Wise, and Coco Zhao to the Board of Editors. They further extend the expertise, diversity, and balance of the Board.

Collectively, we look forward in 2014 to a stimulating ninth volume of *ijCSCL* in the service of the CSCL research community.

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9(2): Dialogic foundations of CSCL

Gerry Stahl * Ulrike Cress * Sten Ludvigsen * Nancy Law

The dialogical perspective provides an important theoretical framework for CSCL. The strain of this approach most influential in CSCL arose in the throes of the Russian revolution. In the social and intellectual ferment of revolutionary Russia—during the decades preceding and following 1917—groups turned to the theories of Marx (1867/1976) not only to leave behind feudal relationships, but also to leap over the capitalist stage of economic development. While the official soviet philosophy developed a dogmatic version of Marxism-Leninism and even Stalinism, theoreticians like Vygotsky (1930/1978) and Bakhtin (1986) remained true to the social impetus of Marx' thought. They provided social, developmental, dialectical approaches to psychology (Vygotsky, 1934/1986) and linguistics (Voloshinov, 1973) that complemented Marx' revolutionary philosophy, history, economics and politics. In particular, these two authors—and the circles of researchers around them—pioneered dialogical outlooks that overcame the ideology of individualism, which is associated with capitalist culture.

Philosophies propounded in the early days of the bourgeois era, like reflections by Descartes (1633/1999) of an isolated mind or the social contract among individual citizens postulated by Rousseau (1762) led to views in which (i) minds are possessions of individuals and (ii) communications are exchanges between individuals. Vygotsky countered the first of these views (i) by demonstrating how the higher psychological faculties of human cognition develop historically and evolve culturally through discourse and labor by groups of people; the mind is not innate to isolated individuals, but is an evolving composite of skills and practices developed through social interaction. Bakhtin opposed the second view (ii) by analyzing the dialogical character of communication; ideas are not first produced in self-contained individual minds, but emerge from multi-vocal discourse, whether in conversation, in self-talk or in novels. This is a developmental outlook, which views the nature of things as the result of their history—propounded by philosophers like Hegel, Nietzsche, Wittgenstein and Heidegger as well as scientists like Darwin, Marx and Freud.

For both of the Russian researchers, language—a thoroughly social product and essential mediator of cognition—is the focal phenomenon. According to

Vygotsky, thinking is a mediated and internalized form of self-talk, a dialog with oneself. In Bakhtin's writings, the cultural and historical forms of language speak through us: The voices of countless social groups are sedimented in the words, phrases and genres of our speech. For an individual to “have an idea” is for meanings which have previously been incorporated in a community's language to be brought together in a multi-vocal and dialogical interaction. Although an adult can formulate new meaning, develop an idea or elaborate an argument as an individual achievement, such abilities are originally learned in small groups or dyads. Even as an individual act, the use of language in thought, speech or writing retains the dialogical character of all language as a historically evolved and culturally established medium of communication among people.

Dialogical philosophy has strongly influenced CSCL theory. Not only the Russian theorists Vygotsky and Bakhtin, but also the American pragmatists Dewey (1920) and Mead (1934/1962) provided seminal analyses of dialogical interaction and of the intersubjective grounds of meaning making. CSCL researchers like Sfard (2008) and Wegerif (2006; 2007; 2013) have taken up these theoretical directions. The perspective of dialogicality provides visions of collaboration and conceptualizations for the analysis of collaborative learning. Conversely, contexts of CSCL, with their technologically mediated forms of discourse and interaction, provide new forms of discussion and offer innovative access for exploring dialog. The first two of the following studies investigate the nature of dialog in specific CSCL settings, building on other recent dialogical studies in *ijCSCL* (e.g., Ligorio, Loperfido & Sansone, 2013; Lim, 2012; Silseth, 2012). They focus on the group as the unit of analysis, studying group processes and looking at the interaction more than the characteristics of the participants as individuals.

The other two studies in this issue also investigate discussion in CSCL settings, but taking a different methodological approach, drawing from the cognitive tradition with its neo-Cartesian conception of mind, empiricist and rationalist epistemology derived from Locke and Hume, and neo-Kantian positivism. Applying multilevel analysis, the third paper considers the group level as well as that of individuals. However, it examines how the opinions and actions of individuals may or may not be influenced by other people in group settings, treating the interaction as an external condition impacting the individuals, in contrast to a dialogical focus on the group-level interaction itself as constitutive of the participants. The final paper explains group outcomes through group awareness and trust, but measures awareness, trust and other variables through individual psychological questionnaires administered outside the groups. Group outcomes are, here too, treated as caused by individual behaviors rather than by group processes and effecting individual mental states rather than emerging out of group interaction or materializing in group products.

The empiricist approach of cognitive research implicitly postulates that if dialogical situations influence knowledge creation and stimulate ideas, then it should be possible to find these effects in standardized situations that allow for experimental testing of the relevant conditions. The positive potential of collaboration emphasized by the dialogical tradition has not always proven measureable under the highly controlled conditions of the empiricist approach (Cress, 2008; Jeong & Chi, 2007). With regard to the task of brainstorming, for instance, group discussion in laboratory studies has even been shown to lower efficiency (see Mullen, Johnson & Eduardo, 1991). The same holds true for certain processes of knowledge exchange, where studies repeatedly show that people in experimental situations often do not take into account arguments provided by others (e.g., Winquist & Larson Jr., 1998).

The contrasting approaches illustrated in this issue of *ijCSCL* document that there is no single theory or methodology defining CSCL. Rather, the field thrives on the "dialog" among different approaches (Arnseth & Ludvigsen, 2006). Seemingly incompatible conceptualizations may work complementarily (Sfard, 1998) and multi-vocal methods may supplement each other's limitations (Suthers et al., 2013). In other cases, opposing assumptions and contradictory results can lead to irreconcilable differences. The issues addressed by CSCL are subtle and complex; it takes a village of scholars—around the world, over stretches of time and using different approaches—to discuss and understand them, as exemplified in this issue. The dialogical view is an important voice in that conversation, but there are a number of contending theoretical and methodological voices as well.

Dialogical Polyphony in CSCL

The field of Computer-Supported Collaborative Learning began with a vision that collaborative learning could be transformed from an occasional additive for individual instruction into a primary force for group learning. In addition, inspired by the promises of artificial intelligence and of computational models of cognition, pioneers of CSCL envisioned software tools that could significantly aid research in collaborative learning, for instance by automating the analysis of student discourse and even by the assessment of individual-student learning within groups. While we have subsequently discovered much about the complexity of human language, the social character of cognition, and the situated nature of discourse—which tend to pose serious limitations to automated analysis—CSCL researchers are still exploring how software algorithms can be applied to the examination of collaborative interaction. PolyCAFe—presented in our opening article—

represents a current artifact within this agenda, along with the reflections of its developers about the structure of CSCL chats.

The developers of PolyCAFe and article authors, *Stefan Trausan-Matu, Mihai Dascalu,* and *Traian Rebedea*, have adopted the metaphor of polyphony from the field of music to conceptualize the ephemeral interpenetration of individual and group contributions to discourse. As previously stressed in these editorial pages (Stahl, 2013a; 2013b), the relationship among the different units of analysis remains one of the great, unresolved questions in CSCL. We have increasingly recognized that supposedly individual cognition is thoroughly social, while we still have a lingering tendency to hear group discourse as consisting of individual contributions. However, this is similar to sitting in a concert of a Bach fugue and alternatively focusing on the voice of one instrument or the synthetic flow of the ensemble. The genius of Bach's works was to orchestrate single notes of individual instruments to create a meaningful integrated sound within the throbbing temporality of a performance. The technical term for this accomplishment is polyphony: the coordination of multiple synchronous voices as a coherent unity. Perhaps inter-animation of productive collaborative discourse in text chat can be analyzed in analogy to the counterpoint of polyphonic compositions. Just as Bach's music resolved tensions in its harmonics and rhythms through techniques of polyphonic control, groups can negotiate conflicting views and converge discordant perspectives through specific discourse practices.

The PolyCAFe analysis software operationalizes several factors that contribute to collaboration according to the authors' theory of polyphonic discourse. Instances of the factors are identified using current techniques of automated quantitative analysis of text. Visual representations of these factors (learning analytics) are then displayed in screens for researchers, teachers or potentially even participating students. These views highlight utterances and discourse passages that are key to the unfolding collaboration. Founded on an interactional and developmental view of discourse, this system pictures the relationships among the interacting voices in historical, temporal visualizations.

The research on PolyCAFe is also noteworthy as a CSCL design-based research project that has been largely driven by theory and that has further developed that theory through empirical findings of an iterative sequence of classroom trials. The cycles of theory, software prototyping, classroom intervention, analysis of interaction and re-design—in which all components co-evolve through their mutual coupling within the extended research-and-design trajectory—are emblematic of much CSCL investigation. Another common characteristic of such research is its international background: the PolyCAFe line of inquiry began a decade ago when the Romanian first author was a visiting scientist at the VMT

Project in the US, where he studied Bakhtin avidly and began to discuss polyphonic dialog (Trausan-Matu & Rebedea, 2009).

Dialogical Engagement in CSCL

The next exploration of dialog in CSCL is a case study that shows how mediation by collaboration software can transform the nature of dialog and, in turn, the dialogical pedagogical approach can alter the nature of the interpersonal interaction. In their reported research, *Benzi Slakmon* and *Baruch B. Schwarz* investigate how a group of initially disengaged students begin to engage in a school-course discourse, thanks to scaffolded dialogical group processes.

Like the polyphonic analysis of the previous paper, this presentation emphasizes and analyzes the temporal flow of the interaction within small groups of students. Whereas the polyphonic approach involved factors of the discourse that are susceptible to identification by software algorithms—such as repetition of words—this one takes advantage of ethnomethodologically informed conversation analysis—adapted to CSCL—to trace more subtle linguistic moves. It uses this approach to understand the ways each student group creates social order at different phases of their interaction trajectories: how the students position each other as peers, how discourse norms are established, and how participation in meaning making evolves. In addition, it takes into account the social status of different students, focusing on disengaged students, whose "off-topic" comments are so often excluded from consideration in educational research.

Given the interest in the role of the teacher in CSCL interactions (e.g., Asterhan & Schwarz, 2010; Greiffenhagen, 2012; Onrubia & Engel, 2012; Song & Looi, 2012), it is striking that the authors argue that the trajectory that led from disengagement to engagement was facilitated by student peers—in ways that a teacher could not do precisely because of the teacher role. In addition, a number of characteristics of the CSCL software contributed to the possibility of this transformation, although it was not clear that the argumentation support of the software as such was decisive in overcoming the barriers to discourse.

While this paper presents a small case study, it is taken from the international Argunaut and Digalo projects, involving labs from France, Germany, Greece and the United Kingdom, as well as the Israeli authors and their colleagues throughout the past decade.

Dialogical Attention in CSCL

Even a strong dialogical view recognizes that certain aspects of discourse are best considered in terms of individual behaviors, while others are appropriately analyzed in terms of group dynamics, depending largely on the aim of the analysis. For instance, the polyphony model includes individual voices and the argumentation model allows for more or less engaged participation of individuals. Cognitive studies generally focus even more on the individual actor, although they may take into account influences on the individuals from a group level. In the contribution by *Alyssa Friend Wise*, *Simone Nicole Hausknecht*, and *Yuting Zhao*, the knowledge-building quality of the group discourse is analyzed primarily through statistical measures of the online, asynchronous, text-based listening and speaking of the individual students.

Initially, this quantitative study from Canada is skeptical about the occurrence of effective dialog in threaded-discussion settings. The paper starts by referring to findings in the literature that have shown that students often do not attend well to others' posts. The authors propose a "theory of online listening," arguing that accessing others' contribution is an active and constructive selection process by an individual, similar to "listening" in a face-to-face setting. They analyze data from an online discussion lasting six weeks. Using multi-level mixed-model linear regression, the study takes into account variables on both the group and student level.

The authors found little evidence for an influence of the group on students' listening behavior, but high inter-individual differences. A cognitive interpretation could be that students' differences in listening behavior are less a matter of the dialogical situation than of their individual competencies. The study further found that students' listening behavior is correlated with their personal speaking behavior.

A central recommendation of the study is to emphasize the importance of deep, repeated attention (listening) to postings of others in order for a student to make valuable and productive contributions of her own (speaking). This makes sense in that effective collaborative knowledge building requires co-attention to a shared topic (Stahl, 2013c, Sec.8.2). To attend to a topic the same way as a particular prior posting, one must read that posting carefully; only then can one respond appropriately to it (discursively, content-fully and reflectively), whether in a critical or supportive way. Attention at the individual level is a precondition of joint co-attention at the group unit of analysis.

While a small research group conducted this study, it is firmly situated within a research agenda that extends even beyond CSCL to investigate knowledge building in asynchronous threaded discussions. Using coding schemes developed within the broader research community and hypothesizing popular expectations about the influence of careful listening on productive speaking in discussion forums, the authors provide quantitative evidence to support and refine previous assumptions. The literature on knowledge building in threaded discussions has often been discouraging, which is concerning given the widespread use of such systems for e-learning, for instance in Blackboard and MOOCs. It is, therefore, significant that the authors reflect on suggestions of their findings for the design of software features and collaboration guidelines to help students increase their collaborative knowledge building. The authors believe that software features that support good listening combined with guidance in good listening practices can lead to effective online dialog. This paper is part of a research agenda aimed at designing supports to improve the effectiveness of knowledge-building discourse in Web-based forums.

Dialogical Trust in CSCL

The final paper, written by *Tanja Engelmann*, *Richard Kolodziej* and *Friedrich W. Hesse*, presents a laboratory experiment that was conducted under highly controlled conditions. These conditions are designed to eliminate or randomize other possible factors, so that hypothesized variables can be measured and correspondences among statistically aggregated values can be calculated with generalizable results. The clearly defined task and the laboratory setting make it possible to measure and compare group efficacy and group effectiveness between experimental conditions.

This study involves a well-defined, artificial problem to be solved by triads of students. The participants have little or no social relations with each other. They are asked to solve the problem rationally by putting together a puzzle of propositional facts—which have been distributed among the triad members—and come to conclusions, which are either right or wrong. An awareness tool named KIA is used by the triads, in which subjects display concept maps of their own share of the distributed knowledge to each other (experimental condition) or just to themselves (control condition).

The study considers the group level and analyzes how group effectiveness and group efficiency in this problem-solving task are affected by the mutual trust of the group members and their awareness about the knowledge distribution within the group (as represented in KIA). The study considers trust as a personal trait, self-reported through items of standardized questionnaires, whereas individual awareness is manipulated through the software tool KIA. Group efficacy and effectiveness are measured by the solutions the groups produced. The results show that high trust may have a negative effect on the group result, if group members are not aware of the knowledge of their group partners. Without this awareness, high trust leads to less cautious behavior, involving less critical regulation, which in turn results in more mistakes done by the group members. Thus, effective collaboration requires shared awareness. This conclusion confirms that productive collaboration requires that the social setting provide certain group pre-conditions—including shared awareness of the distribution of group knowledge among individuals.

Dialog in the CSCL community

The differences of perspective and approach within CSCL research are well illustrated in this issue. The laboratory experiment from Germany, for instance, provides several contrasts to the dialogical approach of the second article. By comparison to the decontextualized laboratory subjects, the disengaged Israeli students are in situations dominated by social relationships, and level of trust as observed in the group dynamics determines whether the students engage in bullying insults or respectful discourse about the course curriculum's posed moral questions, which have no correct or erroneous answers. Disengagement is overcome here through the establishment of trust using discourse norms: "Yoel and Dor's peers did not show any discomfort with the change they introduced, nor did they demonstrate suspicion or alienation towards them.... As an in-group trustworthy member [Yoel] mediated the gap between the 'external' teacher's voice … and his peers' genre." The breakthrough for the previously disengaged students was a clear result of the culture of trust that spread from the teacher to some groups of students, from them to specific individuals who joined those groups, and ultimately to the groups of the disengaged. In this way, trust is viewed as a group phenomenon, whose trajectory is analyzed as the interaction style of one group is passed to another group, through the mediation of group practices internalized by individual group members. Trust in the dialogical approach is observed in group interaction, rather than being measured by psychological tests administered to isolated individuals.

Recognition of the difficulties of collaboration is not new to CSCL. Probably the oldest and most robust finding in the history of CSCL—and that of collaborative-learning research or even educational innovation more broadly—is its problematic character. No experienced educator assumes that just putting students into groups to talk with each other will result in rich dialog, effective knowledge building or substantial learning. On the contrary, studies using diverse methods show that subtle guidance and the development of a classroom culture of certain social practices is necessary (Hakkarainen, 2009; Law, Yuen & Tse, 2012). One of the oldest theories of cooperative learning was that a group has to go through a painful process of "forming, storming, norming and performing" in order to interact productively (Tuckman, 1965). It typically takes a good teacher at least three years to master the facilitation of collaborative learning (or most other transformational pedagogical innovations). Each of the four articles in this issue recognizes that group interaction requires fine-tuned supports and practices in order to avoid the many possible negative results (dissonance, disengagement, superficiality, mistrust). They each propose a technological and/or procedural support (PolyCAFe, Argunaut, listening supports, KIA) to help overcome these problems.

Measuring the effectiveness of dialog or collaboration is not a straightforward affair. It highly depends upon the details of the setting and the group practices. Methodological concerns related to this were expressed early in the history of CSCL, for instance by Dillenbourg, Baker, Blaye and O'Malley (1996, p. 189):

> For many years, theories of collaborative learning tended to focus on how individuals function in a group. More recently, the focus has shifted so that the group itself has become the unit of analysis. In terms of empirical research, the initial goal was to establish whether and under what circumstances collaborative learning was more effective than learning alone. Researchers controlled several independent variables (size of the group, composition of the group, nature of the task, communication media, and so on). However, these variables interacted with one another in a way that made it almost impossible to establish causal links between the conditions and the effects of collaboration. Hence, empirical studies have more recently started to focus less on establishing parameters for effective collaboration and more on trying to understand the role that such variables play in mediating interaction. In this chapter, we argue that this shift to a more process-oriented account requires new tools for analyzing and modeling interactions.

These considerations raise thorny issues for CSCL research of any flavor: How can a study that has been organized as part of a short-term research project duplicate the conditions of a classroom with a culture that takes years to establish? Can experimental situations or technological interventions induce dialogical situations with the same kinds of interaction, group processes and individual effects as authentic classroom discourse? Do statistical computations sometimes aggregate across significant temporal variations between pretest and posttest, thereby obscuring potentially interesting transformations or group processes taking place in between? To what extent does the highly situated character of discourse and its dependence upon its unique conditions limit the possibility of algorithmic analysis? Are disappointing results of studies of knowledge building often the consequence of the choice of particular elements being studied, perhaps using a software prototype that is suboptimal or subjects who are not adequately acculturated or guided?

A design-based research approach may begin to address some of these issues because it does not assume a fixed set of conditions, but aims to co-evolve better theory, pedagogy, software and analysis procedures through iterative cycles of re-design. Concern for orchestration of the affective, motivational and pedagogical context may also be needed (Dillenbourg, Järvelä & Fischer, 2009). Despite any differences among them, the four articles herein all represent interim reports from on-going efforts to support the still elusive vision of CSCL. It would, no doubt, be a mistake to interpret studies like these as summative assessments of the potential of computer-supported collaborative learning, as though the journey of CSCL had already attained its end.

It is often said that case studies and controlled experiments can provide complementary perspectives, suggesting the use of mixed methods or even multi-vocal research. Of course, to produce synthetic results, the approaches must share some common ground as well, so that they can effectively talk to each other (Suthers et al., 2013). The assumption of archival journals of a field, like *ijCSCL*, is that the published literature builds an ever-growing body of knowledge, which results in deeper understanding of a topic like collaborative learning. As you read the following contributions, you may want to consider the extent to which they complement each other. You may also think about the ways in which they diverge in their conception of collaboration and of collaborative learning by the ways they set up their interventions or experiments for research and by how they analyze the resultant data. Does the dialog of CSCL sound to you like a composite of classical harmony or postmodern dissonance?

This editorial introduction led to a lively discussion among the four of us. We hope it will stimulate dialog within the CSCL community. The September issue of *ijCSCL* will continue these reflections by looking in more detail at the range of methodological approaches in the CSCL literature.

Meanwhile, we look forward to seeing you in Boulder at the Learning Sciences conference, ICLS 2014, and to engaging together in the many forms of interaction that will take place there.

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9(3): CSCL artifacts

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Artifacts are central to CSCL. In a typical CSCL setting, artifacts can play multiple pivotal roles:

- Technological artifacts like web apps can provide communication media that support collaboration.
- Further, they may structure the representations that groups of students use in building their intersubjective knowledge, making it visible, shared and persistent.
- Instructional artifacts presenting domain topics, lessons, guidance, scaffolding or scripting may supply motivation and direction to the collaborative efforts.
- In addition, the group efforts may be oriented toward co-construction of an artifact: a work of art, a design, a plan, a report or a summary text.
- Finally, the CSCL process may result in such a knowledge artifact, as the group product.

CSCL researchers can study the use of artifacts by student groups to see how collaborative learning takes place and to judge its success. They can observe how artifacts mediate the communication—whether synchronous, asynchronous, face-to-face, textual and so on. They can see how the groups enact the representational guidance and use it to structure their shared understanding of their goals and the co-construction of their knowledge. They can observe the evolution of collaboratively generated artifacts to track processes of productive group interaction.

Moreover, CSCL researchers themselves make use of artifacts and produce their own knowledge artifacts. Like most scientific fields (Latour & Woolgar, 1979), CSCL research can be conceived as an international effort to generate a growing corpus of academic textual inscriptions, specifically discussing the use of CSCL artifacts. While CSCL research involves many activities (designing innovative technologies, intervening in classrooms, analyzing data, teaching theories, etc.), the lasting product of this work is primarily publications in conference proceedings, specialized journals and edited-book chapters.

In this issue of *ijCSCL*, we present two papers that look in detail at some of the roles of artifacts in CSCL settings. We also present two papers that mine the corpus of CSCL publication artifacts for indications of the nature of our research field.

Artifacts in the CSCL paradigm

In the introduction to his classic volume of CSCL studies, Koschmann (1996) proclaimed that CSCL provided a new paradigm of research on instructional technology. A few years later, he clarified what he thought distinguished CSCL from earlier approaches:

> Traditional theories of learning treat learning as a concealed and inferred process, something that "takes place inside the learner and only inside the learner" (Simon, 2001, p. 210). CSCL research has the advantage of studying learning in settings in which learning is observably and accountably embedded in collaborative activity. Our concern, therefore, is with the unfolding process of meaning making within these settings, not so-called "learning outcomes." It is in this way that CSCL research represents a distinctive paradigm within IT. By this standard, a study that attempted to explicate how learners jointly accomplished some form of new learning would be a case of CSCL research, even if they were working in a setting that did not involve technological augmentation. On the other hand, a study that measured the effects of introducing some sort of CSCL application on learning (defined in traditional ways) would not. (Koschmann, 2001, p. 19)

Then, in his keynote talk at CSCL 2002, Koschmann proposed a definition of a paradigm of CSCL. He said, "CSCL is a field of study centrally concerned with meaning and the practices of meaning making in the context of joint activity, and the ways in which these practices are mediated through designed artifacts" (Koschmann, 2002, p.17).

Anticipating the findings of the papers in this issue, we might modify Koschmann's definition of CSCL as follows:

> CSCL is a research community that produces papers centrally concerned with intersubjective meaning and the practices of meaning making as joint activity, and how best to design CSCL artifacts to mediate these practices.

This definition incorporates a number of points:

- CSCL research is not defined by a set of fixed attributes, but by the work of an international community, whose focus shifts over time as its established understanding evolves.
- The nature of the community is externalized in the corpus of its publications.

- An "artifact" is defined as a physical object created by people and embodying human meaning—thereby overcoming the old distinction between what is in the mind vs. in the world.
- The meaning may be projected by the original designers of the artifact into the form of the artifact, but it must also be enacted by the users of the artifact.
- Creation of meaning is a social process, in which the meaning is necessarily intersubjectively defined.
- Meaning is not created in the mental processes of an individual, but in joint activity, typically in accordance with established social practices. (This is why learning in CSCL settings can be observable and understandable to researchers—without looking inside the learners.)
- CSCL research is both a theoretical enterprise, concerned with how groups make meaning, and a design endeavor, concerned with how to design artifacts of collaboration media, representational guidance, group interaction and pedagogical approaches to promote collaborative learning.

In an excerpt quoted in last issue's editorial, Dillenbourg, Baker, Blaye and O'Malley (1996) concluded "that the group itself has become the unit of analysis" and that CSCL requires a "more process-oriented account" of how interaction is mediated—in contrast to the traditional orientation to learning outcomes of individual students. In Koschmann's example of a seminal analysis in this paradigm, Teasley and Roschelle (1993), pursued a specific version of this question by asking how dyads of students created a joint problem space around a computer representation of physics concepts. In their often cited introduction to CSCL, Stahl, Koschmann and Suthers (2006) characterize CSCL as involving: (i) meaning making (social constructivism as opposed to positivist realism), (ii) examination at the group unit of analysis (rather than exclusive focus on or reduction to the individual mind) and (iii) investigation of group processes (instead of just measuring pre/post learning outcomes). In other words, a paradigm-shaping research question for CSCL would *treat learning as essentially an intersubjective, interactional process*, and would *study it by investigating the dynamic developmental processes through which individual, small-group and community cognitive practices emerge*. We can summarize this by saying that a post-cognitive approach to CSCL should be: *dialectical* (the problem and technological artifacts that mediate the group interaction must be seen to be enacted by that interaction), *interactional* (group-cognitive phenomena should not be reduced to individual mental structures) and *dynamic* (there should be a concern with developmental processes at multiple levels).

Recent editorial introductions to *ijCSCL* (Stahl, 2012; 2013a; 2013b; Stahl, Cress, Law & Ludvigsen, 2014), have suggested that artifacts can serve to connect different levels of analysis in CSCL settings, providing a synthesizing role within

CSCL theory. Interactional artifacts—like the representation of acceleration in the Envisioning Machine (Teasley & Roschelle, 1993) or a scientific question in Knowledge Forum (Scardamalia & Bereiter, 1996)—can mediate between the perceptions of an individual student, the work of a small group and the accepted discourse of a scientific community.

Having noted some ways in which artifacts are central to CSCL, let us now see how the papers in this issue advance our understanding of CSCL artifacts.

Artifacts and Other Layers in CSCL

In her analysis of effective collaboration, *Crina I. Damşa* distinguishes three interconnected layers of small-group learning: productive interaction, knowledge-object development and shared epistemic agency. Through her focus on how a group is oriented to co-constructing its final artifact, she sheds new light on these three distinct phenomena as components of computer-supported collaborative learning.

The group interaction is analyzed in terms of its potential productivity. This provides a framework for analyzing and even judging the interaction: to what extent is it aimed at effectively producing the group's knowledge object? One can then analyze how the interaction works to contribute to evolving the discussion and the successive drafts of the report that the team must present. In the past, analysis of interaction tried to discover generic discourse forms or to code the discourse for various categories of utterances. Here, the objective of producing a report provides a specific, grounded basis for the analytic approach. Accordingly, productive interaction is interaction that (potentially at least) contributes to the group production of its target object.

The objective of the interaction thereby also defines the second level, the knowledge object that provides the group's goal. This objective is largely proposed from outside the group interaction. In the particular case analyzed, it is provided by a university course and the companies associated with the course. However, it is up to the student groups to interpret, refine or enact precisely what their problem or goal is. As they work on their knowledge object, they learn more about it and clarify just what problem they are pursuing. Thereby, the knowledge artifact mediates the interaction even as it emerges as a product of that interaction. Notably, the knowledge is not a mental phenomenon, but a material artifact, physically and jointly observable as persistent text, which, however, evolves over time through drafts.

Setting a goal, deciding how to pursue it, keeping on track and concluding when the goal has been accomplished is part of what is known as agency. The notion of shared epistemic agency is perhaps the most interesting of the layers discussed here. As reviewed by Emirbayer and Mische (1998), agency has historically been associated with individuals. However, the definition they develop could apply equally to group agency or even community agency. Given a dynamic notion of group agency, one can analyze in excerpts of productive interaction exactly how a group negotiates, reflects upon and carries out its action objectives. This does not necessarily involve a rationalist sub-goal hierarchy, but can include group members orienting the group in various subtle ways toward projected joint goals and reminding the group of objectives articulated in the past. Like knowledge, agency is here conceived as observable in the interaction, rather than as a hypothetical psychological state. Furthermore, the concept of agency can be applied to artifacts as well. Designed artifacts exercise a referred agency, designed into the form of the artifact by the intentions of the designer—and visible in that form. A software developer embeds certain goals in the software, which determine to some extent how it can and cannot be used. Thereby, the interaction that takes place can be viewed as an inter-action among many sources of agency, coming together in a concrete and unique situation formed by that agentic confluence.

The document drafts produced by the groups are conceptualized here as knowledge objects. The study concludes that increases in the discourse about these textual objects lead to improvements in learning or better knowledge building. However, the study does not reflect upon the advantages of the affordances of literary text over verbal discourse for the development of complex ideas. The students' texts are not simply "objects," but are shared inscriptions. Written language has powerful knowledge-building affordances, as seen in the difference between oral and literate cultures (Ong, 1998). Issues of idea organization (outline), structure (sentence and paragraph) and conceptualization (choice of words) become explicit in the translation from verbal discourse to report construction. Persistence, shared attention, longer sequences and other affordances of literary texts make huge differences as vague objectives become refined artifacts. Materialization and objectification facilitate co-authors building on each other through multiple drafts and edits. The history of CSCL began with attempts to support group literacy (Stahl et al., 2006), yet current CSCL research often ignores the design of technological media for supporting joint writing.

Bringing Artifacts into Use

Technological artifacts are not simply present to users with fixed attributes; they must be enacted by the users through specific ways that the users discover for making use of them. This notion is forcefully put forward by *Maarten Overdijk, Wouter van Diggelen, Jerry Andriessen and Paul A. Kirschner* in their analysis of a dyad of students using a form of planning software.

There are many similarities between the first two studies in this issue. They both adopt and advance the dialectical, interactional and dynamic paradigm of CSCL research. They explore the processes of enacting by observing the details of interaction and tracking processes of group practices. The second study builds on Rabardel's notion of instrumental genesis (Lonchamp, 2012b; Rabardel & Beguin, 2005; Ritella & Hakkarainen, 2012) by developing an analysis of the dialectic of *resistance* and *accommodation* driving the enactment of designed artifacts by users. There are also striking contrasts between the two studies, notably in the very different level of maturity of the students and the span of time given for their interactions.

Of particular methodological interest is the way the second paper analyzes enactment. It compares the *practices* of the group before and after the artifact is introduced. It adopts a design-based research perspective by looking at successive iterations of an instructional intervention: before a technological artifact is introduced and afterwards. In this case, the artifact is a software medium for inscribing steps in a planning process. Initially, the student dyads simply transferred steps from their instructions into a generic spreadsheet. Given the introduced software support, they then figured out a way to arrange the given steps within the new format.

One can well ask the same question here as with the first study: How is the medium for co-constructing knowledge objects designed to support the collaborative knowledge-building goals? Here, a sophisticated application is suddenly inserted into the instructional setting. We are not told where this medium came from or what its design objectives were. What were the referred intentions contributing to the resistance of its material agency? It is not presented as part of a design-based research integration of iterations of software development with classroom trials, data analysis and theory refinement. We are told that the student pair "does not engage in a real problem representation. Instead of simulating, evaluating and revising planning decisions, they stick with the specification and following the order of the assignments as they are presented in the syllabus. To them, this is an acceptable solution to the planning problem." Presumably, the software artifact was intended to guide the student groups to learn new planning practices. The student practices changed, but not necessarily in the ways intended by the intervention facilitators or the artifact designers. What are the implications of the analysis of how the students enacted the software for redesigning that medium of inscription?

Coding CSCL Journal Artifacts

Given the two papers on the theory of artifacts in CSCL, we might wonder if they represent a latest stage in a trend within the CSCL corpus of publications. Are they part of a paradigm shift within the learning sciences that was anticipated in the mid-1990s, but has been slow to materialize, or are they simply examples of one approach among many unrelated methodological fashions? The very first article published in *ijCSCL,* (Kienle & Wessner, 2006), aimed to display major trends in the field through analysis of CSCL publications. More recently, Lonchamp (2012a) tried to map changes in the field through computational analysis of *ijCSCL* content. Now, we have two new energetic examinations of the CSCL literature.

The first of these is a report from an on-going effort by *Heisawn Jeong, Cindy E. Hmelo-Silver and Yawen Yu*. It investigates CSCL empirical articles from 2005 to 2009 in seven journals that publish CSCL studies. The report clearly represents significant work gathering, filtering and analyzing publications. It applies a large number of interesting analyses, combining automated and manual examination in order to explore various relevant issues. It dissects and categorizes hundreds of empirical CSCL papers along multiple dimensions: (1) research design, (2) setting, (3) data and (4) analysis.

The discussion in the report reflects a deep understanding of relevant issues for analyzing the CSCL corpus and attempts to avoid potential biases. Yet, when one views the specific findings of the analysis or even scans the list of papers selected as representative of CSCL journal articles during the time period, one is struck by the low number of publications by well known CSCL researchers and of papers that show up in lists of most often cited or most frequently downloaded articles. Are the items that made it through the selection and filtering process the most influential CSCL publications of the period, or are they, rather, primarily archival reports of uncontroversial experimental confirmations of generally accepted findings?

For instance, given the papers in the present issue of *ijCSCL*, which of these papers would be included in the final list if the study were extended to 2014? Would it be clear within the selection method that the first two papers report stages of larger design-based research efforts and that they systematically focus on practices and group processes rather than on individual learning outcomes? More abstractly, they can be considered to be exemplars of research approaches in a distinctively CSCL paradigm that is post-cognitive. One would like to know if there has been a general paradigm shift in this direction from 2005 to the present. What kind of analysis of the literature would be necessary to determine this?

The findings of the reported analysis suggest that post-cognitive approaches were not prominent in the selected sample. First, the majority of data sources for the selected articles were questionnaires—sources of self-reports rather than knowledge objects or discourse interactions. (In recent years, both *ijCSCL* and *JLS* automatically reject submissions that rely solely on questionnaire data.) Second, the dominant analysis method other than statistical is code-and-count, an approach that usually systematically eliminates the sequentiality of interaction, which is necessary for analyzing group-level interaction and practices. Third, many of the remaining qualitative or mixed-method studies rely on "loosely defined" narrative, suggesting that their authors do not adopt a rigorous method for analyzing group practices or processes. Fourth, the technologies used in the CSCL settings were not analyzed, so there is no way to know if conventional commercial technologies like Blackboard or Facebook were used or if innovative technologies were being explored. Fifth, the role of theory is not well defined: are the theories just given an obligatory mention in a paper or does the study contribute to expanding the theory, for instance by fleshing out new concepts—like group agency or artifact resistance?

Of course, this examination of methodology and theoretical frameworks during 2005-2009 does not claim to answer all the possible and interesting questions. It defines its goals and reflects carefully on its limitations. However, the larger questions arise insistently for our community. Studies of the CSCL corpus like these attempt to implement an objective approach to selection and analysis. The question is then whether the self-imposed limitations of the objective approach themselves impose bias. Should one restrict oneself to journal articles as the most highly ranked formats for research? Is it possible that the more innovative and influential inscriptions are presented at conferences and workshops? Or might books—both edited volumes and monographs—still provide a medium for more significant statements than a journal article, limited to a single intervention and one focal finding? In particular, does the selection from seven highly ranked journals unavoidably entail biases based on the commitments of those particular journals within current academic practices and institutional pressures?

Co-citing CSCL Journal Artifacts

The final contribution in this issue takes up some of the challenges just mentioned. The presentation by *Kai-Yu Tang, Chin-Chung Tsai and Tzu-Chiang Lin* expands the collection to conference papers and book chapters as well as journal articles. It also brings the coverage up to the present. Furthermore, it provides a useful triangulation by approaching the analysis of CSCL literature with a quite different, but still objective, method. It applies the well-established bibliometric technique of co-citation analysis, and then clusters the results using social network analysis (SNA).

Academic papers always reference previous publications, which they build upon. Thus, it is natural to categorize articles together that reference or are referenced by each other. A more sophisticated approach is to discover which pairs of papers are cited by the same sources; the members of these co-citation pairs are likely to be especially closely associated within the field.

The co-citation analysis of CSCL literature yields a set of "seminal works" for the field according to the authors of this study. The resultant list is striking in several ways. First, it has little overlap with the results of the previous study. Although all eight of the central works are from journals included by the other study published within its time period, only three of them (37.5%) are even included in the previous study's list of 278 selected papers. Second, with the exception of the paper by Suthers, they are all from a couple of labs in northern Europe, who interacted with each other as part of the European Union's Kaleidoscope network. They knew each other and worked closely together, so it is not surprising that they cited each other and were co-cited in later publications (probably especially by each other and their colleagues). It seems likely that the method over-generalized and focused on a sub-network of the CSCL community.

Some of the papers may have been excluded from the previous study because they were not primarily empirical in their focus, but more theoretical. The Suthers (2006) paper argues for a post-cognitive CSCL paradigm, Cress and Kimmerle (2008) propose a combination of systems theory and cognitive psychology and Kobbe et al. (2007) introduce the theme of scripting in *ijCSCL*. The others report on examples of content analysis, argumentation support or scripting that are more empirically based. These were probably all important publications within the CSCL research community, so they confirm the method to some extent despite the fact that the list itself may also be biased by certain factors such as personal associations, funding sources and timing.

Some of the papers on the list of eight seminal works reappear on other catalogs of popular CSCL publications, such as most frequent downloads of *ijCSCL* papers, top citations in the World of Science (WoS) or Google Scholar. In order to check the clustering based on co-citation and SNA, it would be interesting to analyze which papers cite the same sources (e.g., Piaget vs. Vygotsky, or the foundational works of different theories).

Another approach would be to cluster papers based on their latent semantic similarities, using LSA or LDA. Now that conference proceedings, journals and book chapters are readily available on the Internet, it would be possible to form a large corpus of CSCL publications and mine or cluster it automatically to discover themes, sub-areas and focal topics. Looking at different time slices by publication date could document trends and evolutionary directions for the field.

What are the core questions that we would like answered by analyses of the CSCL corpus? It seems that we want to know about both the bulk of CSCL publications—what are the various approaches taken—and about the leading-edge pioneering articles—which are they and how are they trending. In what ways is CSCL defining a distinctive research paradigm and in what ways does it remain an eclectic mix of incommensurate approaches? The first of the literature analyses here looks at the breadth of empirical work during a formative period in CSCL history and the second one shows how some seminal works stand out in this corpus. How do the findings of these analyses compare with your subjective sense of the field?

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9(4): Analyzing roles of individuals in small-group collaboration processes

Gerry Stahl * Nancy Law * Ulrike Cress * Sten Ludvigsen

The papers in this issue present innovative approaches to analyzing the roles of individuals in small-group collaborations supported by computer technologies. In reading these articles, you may find it interesting to consider the ways in which their methods conceptualize the relationship of collaborative group learning to the roles of its individual participants. Taken together, these studies envision and explore a space of possible strategies for analyzing the multi-level phenomena of collaborative learning, sometimes coding utterances of individuals and at other times characterizing group trajectories. They each push the boundaries of CSCL research in various ways. Although they can be read as primarily proposing analytic procedures, they also contribute to theory and technology. Perhaps highlighting their nuanced stances on the issue of unit-of-analysis in probing learning data can help to reveal their contributions to the advance of CSCL as a vision and as a field.

It is often difficult to determine where overall progress is being made in CSCL research and practice. Statistical indicators in comparative reviews tend to be overwhelmed by the diversity of theories and methodologies applied in research and by the variety of pedagogies adopted in practice. In both researcher and teacher communities, there are new participants entering with training in traditional disciplines as well as long-time participants still working within old paradigms. Folk theories derived from common sense linger on and may obscure the visibility of innovations in scientific theory, methodology or pedagogy.

Folk theories of minds and learning still influence classroom practice. According to Bruner (1996) and Bereiter (2002), teachers' pedagogy is often deeply affected by everyday intuitive conceptions of how student minds work. This "folk" perspective focuses on the characteristics of the individual learner: In effect, it treats some students as inherently "smart," some as just "dumb." It views students as taking in factual knowledge offered by books or teachers, and committing these to memory so they can retrieve them for tests. Early research on "cooperative" learning—which preceded CSCL—recommended that having students interact could often enhance their individual learning. The smart students would convey their knowledge to the others, and would strengthen their own knowledge by teaching it. Learning in groups was still conceived of as a mental process unfolding inside individual heads. Participants in groups were labeled as having personal attributes like leader, follower, lurker or lazy.

CSCL has always taken a different view of learning. Adopting Piaget's (1929/1990) developmental approach, CSCL views the individual learner as an evolving actor, who changes through interaction with others and with new learning experiences. Following Vygotsky (1930/1978), CSCL explores social, interactional or intersubjective aspects of learning, in which learning takes place initially in the interaction of learners with mentors, teachers or peers, mediated by cultural artifacts. As more recently described by Tomasello (2014), learning by humans (as distinguished, for instance, from apes) is primarily a matter of enculturation, mediated by language and involving distinctively human collective intentionality. Learning takes place in family groupings and cultural institutions, such as schools, museums, libraries, churches and research centers—institutions designed to reproduce and expand our shared cultures.

Even when a learning event takes place in a presumably methodologically isolated mind, that learning—if it is authentic—is motivated by relations with other people, oriented toward future communications with others, dependent on a community's language, founded upon a store of cultural knowledge and probably built upon the words/ideas of others. Thus, an analysis of learning at least has to take into account the influences on the individual of society, communities, culture and other people. CSCL and the learning sciences have recognized this extensively, as they have magnified previous views of cognition through the lenses of socio-cultural and dialogical perspectives (Stahl, Cress, Ludvigsen & Law, 2014).

However, as we have suggested in the past, it is also possible to conclude that the analysis of learning should consider cognitive processes at the small-group and community levels on a par with those at the individual unit—not just as secondary influences on the individual. Such processes—like collective intentionality, transactive discourse or group agency—might even turn out to be integral to all distinctively human learning. Moreover, such processes might be particularly visible and accessible to educational researchers in CSCL settings. This could lead to a post-cognitive theory of learning in which collaborative learning is not just a niche distraction from individual learning, but rather a necessary foundation for it.

We have proposed in recent editorials in *ijCSCL* that a primary focus of CSCL research today should be on the relationship among processes at different units of analysis, such as individual student, small group and classroom or community (Stahl, 2012; 2013a). We have illustrated possible ways of relating multiple levels in our own publications (e.g., Arnseth & Ludvigsen, 2006; Cress, 2008; Cress &

Kimmerle, 2008; Law, Yuen & Tse, 2012; Stahl, 2013b; 2015). The papers in this issue take concrete preliminary steps in such directions.

Joint attention in a dyad

Joint attention is the *sine qua non* of collaboration. How can people work together if they are not oriented to the same thing? Tomasello's (2014) comparative research with primates shows that joint attention is a peculiarly human skill, nurtured from infancy, as illustrated in Vygotsky's analysis of the emergence of the intersubjective pointing gesture in the mother-baby dyad (1930/1978, p.56). Shared intentionality makes possible intersubjective meaning making in human groups.

In face-to-face interaction, a variety of deictic gestures, gazes and bodily orientations help to direct attention (Evans, Feenstra, Ryon & McNeill, 2011). In online contexts, an array of subtle linguistic indexical referencing practices dominate (Zemel & Koschmann, 2013). In addition, computer environments can provide technical supports for coordinating attention (Mühlpfordt & Wessner, 2009).

In their article below on shared sensing of gaze, *Bertrand Schneider* and *Roy Pea* analyze the impact of an eye-tracking tool to enhance joint attention. In a contribution to *ijCSCL* last year, they had showed how displaying the gaze of a partner helped a dyad to collaborate and learn (Schneider & Pea, 2013). Now, they develop representations of eye-gaze coordination to predict the quality of collaboration.

They devise a task that requires extensive comparison of visual features at multiple locations on the screen, requiring complex patterns of eye movements. To collaborate on the task, it helps subjects if they can follow each other's gaze—as technologically supported in the experimental condition. The authors analyze the pros and cons for researchers of several representations of the dyads' eye movements, tracking both individual movements and coordinated dyad trajectories. Given the nature of the task, it is often possible to surmise when a subject following the gaze of the partner understands the partner's intention, seeing the meaning of shifts in gaze.

While this study is carefully confined to its research questions, it also raises the possibility of using eye-tracking evidence of joint attention to complement the analysis of other dimensions of collaboration, such as discourse. Can awareness of gaze by participants in online collaboration reduce the frequency of misunderstandings and the necessity of repair moves? Can it provide researchers with evidence to resolve interpretive ambiguities in the often-terse format of online discourse? If so, the technology and the analytic representations could help to counter certain problematic circumstances in CSCL practice and research.

In terms of the relationship of the individual and group units of analysis, the approach taken here demonstrates how they are intimately intertwined. Joint attention is a group phenomenon. It involves both members of the dyad not only gazing at the same object, but gazing with the same intent as each other (for instance to compare the focal object in a certain way with a specific other object in the task). Each member believes that the other intends it that way, and knows that they are gazing together, relating to a shared focal object, taken as the same. The mutuality of intersubjective intentionality is not reducible to either individual's mental representations, but consists in a shared meaning making. However, in addition to being often tightly bound within the dyad, the participants also go off individually in many moments. In fact, the study concludes that the quality of the collaboration is related to the ratio of group to individual activity. Like all group processes, there is an ebb and flow of group cohesion. CSCL approaches and environments can foster higher levels of collaboration by understanding how individual and group activities feed into and constitute each other.

Leadership as interactional

Leadership is another aspect of collaborative learning undergoing increasingly nuanced analysis. *Emma M. Mercier*, *Steven E. Higgins* and *Laura da Costa* examine the work of student groups using multi-touch tablets. The authors build on their previous study of pedagogies related to this technology (Higgins, Mercier, Burd & Hatch, 2011). They view the group as the cognitive unit and see leadership as a form of interaction within the group. For instance, if an individual makes a proposal that is ignored and not taken up by other members of the group, then that action is classified as a "failed bid" at leadership. It does not count as leadership. A leadership move involves a bid being taken up by others (see Stahl, 2006, Ch.21), so it takes place at the interactional group unit of analysis.

The research reported here analyzes leadership moves as attempts to push the group forward by addressing either relational or content matters. Relational issues of group organization include concerns such as turn control, while content issues address intellectual aspects of the task activity, such as idea management and development. Collaborative learning has long been seen within CSCL to include both a content realm or "joint problem space" (Teasley & Roschelle, 1993) and a group relational dimension (Barron, 2003). In this paper, the authors present an analytic approach for studying leadership as a group effort encompassing both these dimensions.

This analysis moves us far from the idea that leaders are just born that way. It sees leadership as emergent from group interaction and distributed among group members. However, beyond that, it examines the way that leadership moves drive the group process and the collaborative knowledge building forward, and how those moves may be made by different individuals as a result of the sequential group dynamic.

Roles as group process

Leadership has frequently been conceptualized in CSCL practice as a role for a particular individual within a group. Often, it is suggested that a teacher assign one student in each small group to take on some kind of leadership role, while another student might be assigned a different role, such as timekeeper (Pozzi, 2011; Schellens, Van Keer, De Wever & Valcke, 2007). In current research, we now see roles being conceptualized as group processes, addressing multiple distinct facets of collaboration and being naturally distributed across the group, i.e., consisting of interactions between group members.

The next article, by *H. Smith Risser* and *SueAnn Bottoms*, looks at the variety of social roles associated with blogging, including forms of leadership. It uses a cluster-analysis method based on social-network analysis, rather than coding, to determine categories of roles, to detect what roles individuals have in blogging communities and to track how those roles shift. The set of these roles is quite dependent upon the specific blog technology. Blogs may, for instance, involve different types of hyperlinks: e.g., blog-rolls, citation links and comment links. Individuals' prominence in the community depends upon their participation in these different kinds of links.

The cluster analysis results in five distinct categories of social roles in the blog community. Although the authors name the five clusters with terms derived from the theory of Lave and Wenger (1991), the categories are actually computed from network analysis of blogging communities. The clusters are called: relative newcomers, inbound participants, peripheral members, full participants and celebrities. The names indicate differing levels of recognition and participation typical in each cluster. In folk theories, celebrity status was assumed to be an attribute of an individual. Here it is derived from the complex network structure of interaction across an active blog community. Roles are group-level characteristics of social structures.

Uncertainty in collaborative learning

Leadership in collaborative learning is—perhaps counter-intuitively—often expressed in a mode of uncertainty. In the final article of this year's volume, *Michelle E. Jordan, An-Chih Janne Cheng, Diane Schallert, Kwangok Song, SoonAh Lee* and *Yangjoo Park* explore the frequent co-occurrence of expressions of uncertainty with effective learning interactions. They document that learning is often expressed with terms of uncertainty and they explore some reasons for this. The tasks undertaken by their subjects involved building knowledge of sophisticated and nuanced ideas, making certainty elusive. However, even more generally, learning by definition involves something new, about which one is not already knowledgeable, and thus often feels tentative. By using hedges, hypotheticals and questions, people can open up a space for safe exploration and provisional statements. Furthermore, by writing ideas online for others, expressions of learning can be treated as dialogical acts, conducive to learning through negotiation over time with others, rather than requiring absolute certitude from the start by an individual.

The notion of using questioning modes of expression rather than propositional pronouncements led the authors to propose an alternative approach to their focus on individual learning and individual certainty. They suggest exploring the possibility that "uncertainty co-occurs with learning, but may not coincide with learning in the same message or by the person expressing the uncertainty. Such an analysis … would require a more dynamic sequential analysis." This would shift the data for examination from the individual to the interactional group unit of analysis. It would view the questioning or uncertain phrasing as an elicitation by the writer for a reader to affirm or modify the proposed expression of learning. The learning would then be a fully dialogical or group act, facilitated by uncertainty expressions that call for confirmatory responses or discussion.

As in the other papers, we see here how a collaborative small group takes action: one member proposes something and the others adopt it (or not). The actions—paying attention, adopting a social role, providing leadership, expressing learning—consist of inter-actions among individual members, resulting in something that cannot be attributed to any one of the individuals or analyzed at the individual unit of analysis because it is an interaction within the group. It might be useful to view such actions as components of group agency (Damsa, 2014). Agency is a temporal undertaking (Emirbayer & Mische, 1998), including deciding what to do in the future, managing the effort now and evaluating the result of past action. Group agency requires joint attention, coordinated action and intersubjective intentionality (shared meaning making). It can involve leadership, social roles and uncertainty. It can be analyzed in the behavior of individuals and of collaborative groups. It can be supported in CSCL environments. The four studies in this issue suggest a methodological orientation toward group agency, which could lead CSCL beyond traditional theories of individual rational decision making and mental representation to the foundations of collaborative learning in the group interaction.

CSCL 2015

We look forward to seeing you in June at CSCL 2015 (isls.org/cscl2015) in Gothenburg, Sweden. Opportunities and challenges of CSCL today will be displayed and discussed there.

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10(1): From the editors: Collaboration and the formation of new knowledge artifacts

Sten Ludvigsen * Gerry Stahl * Nancy Law * Ulrike Cress

To learn in our knowledge-oriented society often involves a deep engagement with knowledge artifacts—objects that combine material and semiotic aspects. This is particularly true in CSCL contexts. Knowledge can be formed and shared in different ways and within different formats.

Through advances in computer-supported collaborative learning technologies and pedagogies, we can create, shape and present knowledge in new ways. Intersubjective meanings can be developed and shared as virtual and/or physical artifacts. The nature of the collaboratively formed knowledge artifacts create specific opportunities for students or community participants to engage in certain types of interaction, both with the artifacts themselves and through them in collaborative efforts with peers, teachers and other actors. One way to express how knowing can be materially mediated is to state how the relationship between a conceptual structure and its material anchors creates special conditions for participant interaction and learning (Hutchins, 2005).

Focus on the interpenetration of semantics and materiality is at the heart of the CSCL community's mission. We need to understand and explain how participants can become deeply engaged with mixes of conceptual and physical structures in their activities. In this issue of *ijCSCL*, these matters are addressed from the perspectives of several different theoretical frameworks. We introduce these articles by raising some overall themes about the formation of new knowledge artifacts in collaborative contexts.

Artifacts have been conceptualized within the CSCL community from cognitive, socio-cognitive and socio-cultural stances. The term *artifacts* is often substituted with *tools* or *instruments* (Lonchamp, 2012; Ritella & Hakkarainen, 2012), and many scholars use the term *structuring resources* or just *resources* to get a grasp of how participants perform their tasks (Arvaja, 2012; Stahl, 2012). This constellation of terms points to the fact that collaborative effort is interdependent with the artifacts that we use—in a bidirectional relationship. This does not necessarily mean that there is a causal relationship between collaboration and artifacts, but that we need to understand how the interdependencies can be played out or enacted. If particular artifacts can foster specific effects, we can conceptualize this as steps toward a causal understanding of mechanisms, although not in a mechanical or predictive manner.

Most theories in CSCL are constructivist in that they posit that learners actively construct their knowledge. However, this is often understood psychologically, as a mental process of representing knowledge in thoughts, mental schema, tacit know-how or practices. Scardamalia and Bereiter (2014) coined the term *knowledge building* that "treats ideas as entities in their own right that can have properties, connections and potentialities independent of the mental states of the individuals who hold the ideas" (p. 397). They thereby distinguish between learning as a change in mental state (e.g., from pre- to post-test) from knowledge building as the production of designs, theories, problem solutions, etc. Knowledge building centrally involves the formation and refinement of artifacts, such as texts, diagrams or models, which embody the knowledge as physical or virtual objects in the world.

The distinction between mental representations of knowledge and the building of knowledge through the refinement of artifacts applies at the group unit of analysis as well as for individuals. A group can acquire joint skills and shared understandings, but this can be distinguished from group knowledge artifacts, which have their origin in group processes, such as argumentation, perspective sharing or negotiation (ibid). The artifact nature of knowledge objects allows meanings to be shared—in the intersubjective world. It also allows the building of collaborative knowledge to be studied by CSCL researchers observing the evolving artifacts.

Whereas theories of individual learning often attribute a priority to the mental, as a source of meanings that are re-presented or ex-pressed in the communal world, the analysis of collaborative learning needs to prioritize the intersubjective meaning of shared artifacts. It is, for instance, in the formation of inscriptions in a joint problem space or postings in text chat—which elicit and respond to each other—that meaning is originally formed. Resources constructed at the group unit of analysis are the prime mediators between individual understanding and community institutions in CSCL contexts (Stahl, 2013b).

The term artifact entails that human knowledge is inscribed in a material object and that the object can be used as a meaning potential within a collaborative effort (Linell, 2009). An important question raised in the five articles below is how the artifacts become aligned in the interactional activities. Productive learning events (Damsa, 2014) can be activated in the interactions that align artifacts. Alignment (Goffman, 1974; van de Sande & Greeno, 2012) is an important term in CSCL since it provides analytic attention to how artifacts can support students in understanding conceptual connections within a theoretical system. By this we mean that students can connect several concepts into a partial understanding of a phenomenon (diSessa, 2006). Alignment in qualitative studies means that one analyzes how artifacts become used and how they can scaffold student development. In quantitative studies, one tests hypotheses in order to establish statistically significant results, which indicate that some artifacts are more productive than others in collaborative efforts.

The foundational role of artifacts in CSCL has been extensively discussed recently in *ijCSCL* (Furberg, Kluge & Ludvigsen, 2013; Halatchliyski, Moskaliuk, Kimmerle & Cress, 2014; Öner, 2013; Overdijk, van Diggelen, Andriessen & Kirschner, 2014; Stahl, 2013a; Stahl, Cress, Law & Ludvigsen, 2014; Stahl, Ludvigsen, Law & Cress, 2014; Timmis, 2014; Zemel & Koschmann, 2013). The following articles address these issues in different and suggestive ways.

Alignment of augmented-reality artifacts

In their article proposing a theory of liminal blends, *Noel Enyedy, Joshua A. Danish and David DeLiema* argue for a new theoretical framework that can explain the relationship between conceptual and material resources. The idea of liminal blends comes from conceptual-blend theory, which emphasizes that in order to perform specific actions we need to combine and blend resources from different source domains into an emerging hybrid conceptual space, and that these resources cannot be found in each of the source domains taken by themselves. While conceptual-blend theory was developed to describe how individuals create emerging conceptual blends, the authors of this article extend and reformulate the theory. Through their socio-cultural and distributed view of cognition and learning, they create a new unit of analysis for explaining how conceptual blends can be enacted. In this study, the new artifact formed is an augmented-reality environment, which young students help to define, enact as usable and reflect upon as they interact in their physical classroom. The empirical basis for the article comes from the project Learning Physics through Play. Here, a new design with augmented reality is tested with first and second graders. In a previous study (Enyedy, Danish, Delacruz & Kumar, 2012), the authors showed that students improved their understanding of concepts like force and motion, through a pre-/post-test design.

In the article, a careful interaction analysis is performed to test the liminal-blend framework. It documents how the students concretely form intersubjective meanings associated with the augmented-reality artifacts through their bodily behavior in the augmented physical world. Alignment of resources becomes the most important process. To align resources from augmented reality and the physical interaction over time, the classroom technology evolves emerging properties that have the potential to transform the students' understanding of the concepts they work with. As the students work in their complex social space, they bring together the conceptual resources, their bodily movements and the emerging resources that become mobilized through the social interaction. Shared meaning is constructed through the enactment of the artifacts in the classroom, and is subsequently available for individual and collaborative reflection.

This study has implications for how we reason about human learning, how we study collaborative interaction in an augmented-reality environment and how we design such a CSCL environment. This is a novel contribution to the development of liminal-blend theory, which avoids the split between conceptual and material structures in the world, associated with previous versions of the theory.

Assessment of informational artifacts

The article by *Andrea Forte* introduces a new area to CSCL research, bringing in the analysis of information-seeking behaviors from information science to understand new technologically enabled genres of literacy. She investigates high school students' information assessment practices as part of an activity in which the students took part in building a collaborative online textual artifact. Here, the artifacts formed are texts generated by the students. The study stretches over a two-year period and makes use of multiple methods, including classroom observations, interviews and stimulated recall about how students become involved in the consumption and production of texts relevant to a topic. As technology innovations from CSCL research, evolution of social media and design of collaborative environments make possible new forms of information artifacts, we need to study how people understand these media, contribute to them and engage in intersubjective meaning making mediated by these new kinds of artifacts.

One important finding is that although the design of the activities is aimed at supporting open collaboration, specific established school norms still become activated. Students have a long history of doing schoolwork, which means that they frame tasks in institutionally sanctioned ways. However, students not only perform their action in accordance with historical norms, they also expand their activities and take certain responsibilities for collective knowledge building, because creating conditions for students to engage in collaborative production efforts creates new learning opportunities. Students become exposed to basic questions about what types of information can be trusted, what the limits of that information are, what their responsibility is for the information produced, and what collective responsibility they share.

This study contributes a more nuanced discussion about what we mean by information-literacy skills and practices and more generally how we understand and explain 21st century skills in CSCL settings. It explores how students might interact with, contribute to and make sense of the increasingly complex informational artifacts, which combine traditional heritages and virtual opportunities.

Knowledge representation in exploratory artifacts

In their article on an interactive genetics-visualization exhibit, *Pryce Davis, Michael Horn, Florian Block, Brenda Phillips, E. Margaret Evans, Judy Diamond and Chia Shen* analyze museum visitors' interactions around a multi-touch tabletop exhibit called DeepTree. This article continues the *ijCSCL* theme of tabletop interfaces (Dillenbourg & Evans, 2011; Martinez-Maldonado et al., 2013). The genetics environment was designed with a conceptual focus on evolution and common ancestral descent. Museums as social and historical institutions can create experiences for young people and students that involve access to specific forms of knowledge. In this study, the authors describe how dyads of visitors interact with a multi-touch table in order to coordinate their action and to co-create meaning.

A core feature in the design of the environment is its advanced visualization techniques. The paper's qualitative analysis shows how the dyads work and interact with this technological artifact. The results from the analysis show four patterns of interaction. The article uses the metaphor of paddlers to explain the results. When inexperienced paddlers try to work together, certain coordination problems can be expected. The coordination problem related to the mechanical goal is of a different sort than that of the conceptual goal. The mechanical goal in this environment is related to the direction of exploration activities, while the conceptual goals move the coordination problem to the surrounding scientific terrain. One important finding is that the design itself provides limited support for students to move toward working with the conceptual goals involving understanding evolutionary science. To work with conceptual goals is part of moving beyond sequences of directed tasks.

At the level of experience, the design makes it possible for students to act with representations of knowledge that are unique. This can give them insight about the core concepts of human evolution. For citizens in our society to gain such experience has a value in itself, and they can become motivated to ask questions about different forms of knowledge. Using advanced artifacts—like this sophisticated tabletop exhibit—to interact can make specific aspects of the knowledge involved more transparent for students in their learning processes.

Networked artifacts for second-language learning

Yun Wen, Chee-Kit Looi and Wenli Chen investigate how networked second-language learning can take place across multimedia settings. They focus on the intellectual interaction in groups through what they call diachronic development of understanding across members of a group. A representational tool, Group Scribbles (Song & Looi, 2012), which includes private and public/group spaces, mediates the learning activities across multiple media settings, supporting the building and refinement of knowledge artifacts that both use and reflect on English. The students who form part of this study are eighth graders who speak English as a second language, but come from diverse language backgrounds (Chinese, Malay and Tamil).

The statistics used show variations in group interaction in different media spaces and within the face-to-face setting. The results show that the groups use the tool differently, depending upon their task and their linguistic competence. When the tool serves the function of referencing, the learning activities became less cognitively demanding; however, when the tool serves the function of promoting synergy, realizing parallels, or prompting noticing, the cognitive activities became more productive for language learning. The pedagogical design that stimulates the students to externalize, building upon and pursuing consensus, creates productive interactions between the students.

The study demonstrates again that in order to create productive CSCL environments, we need to take into account the interdependencies between students and artifacts. The analysis draws on recent theoretical insights about the relationship of artifact affordances to their usage and about representational acts to their mediation by specialized technologies (Damsa, 2014; Overdijk et al., 2014; Ritella & Hakkarainen, 2012; Suthers, Dwyer, Medina & Vatrapu, 2010). It applies these perspectives to analyze how the students enact Group Scribbles—both individually and collaboratively—to articulate arguments and to improve their use of English as they refine their inscriptions in the technological medium.

New research artifacts

All the articles in this issue raise important points about how different forms of artifacts, tools and resources with specific features can stimulate productive collaborative learning. The artifacts are new formations of knowledge and formats for collaboration. Artifacts play many roles in CSCL settings: as mediating technologies, as instructional resources, as student work products and as interaction texts. The studies emphasize that, in order to advance the field of CSCL, the detailed analysis of artifacts in interaction is of central concern.

Some of these issues will undoubtedly be discussed at the up-coming CSCL 2015 conference (isls.org/cscl2015). We look forward to seeing you there in Gothenburg.

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10(2): The core features of CSCL: Social situation, collaborative knowledge processes and their design

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The four articles presented in this issue cover a broad spectrum of topics: the hierarchy of learners, different forms of awareness, group composition and classroom orchestration. The learning contexts also differ significantly, considering collaborative learning in university courses, in organizational e-learning and in vocational training. Accordingly, the student actions and interactions that the different settings aim to induce vary strongly (but return to themes in previous articles): sending and answering requests (Wise, Hausknecht & Zhao 2014), building knowledge using Knowledge Forum (Zhao & Chan 2014) or creating tangible artifacts (Damsa 2014).

Even though the surface structures of the four articles are quite different, they all contribute to understanding core underlying topics of CSCL: the influence of social aspects of the collaboration scenario, the type of learning that takes place in collaborative groups and the design of collaborative learning processes.

The influence of the social situation

This issue concerns how the social aspects of the collaborative situation influence collaboration and learning. It considers qualities of the group that the learners are part of, but also characteristics of the group's members. In CSCL, the interaction between group members is generally mediated through a technical tool. This tool communicates cues about the members and the group. The social cues that the CSCL tool delivers can be at least as influential as the objective features of the social situation.

In the 1980s, when computers first became common means of communication, research on "computer-mediated communication" (CMC) mainly regarded its differences from face-to-face communication (e.g., Kiesler, Siegel & McGuire 1984). Early theories assumed that CMC would be deficient, because—compared to direct communication—it would only deliver a limited subset of social cues. For example, if communication partners communicate via text messages, they cannot see each other; this visual anonymity was expected to influence people's interaction negatively.

Later on, research in CMC observed that computer mediation need not necessarily be a hindrance for collaboration. Even the anonymity that may result from remote communication can be seen to be a means to overcoming problems inherent in socially richer face-to face communication situations (Spears & Lea 1994; Walter 1996). For instance, in face-to-face situations people of low status contribute less than those of high status and their contributions do not attract the same amount of attention as those from high-status people. A computer-mediated scenario that hides participants' identity provides low-status participants a higher chance to be equally involved and as influential as high status participants (Sproull & Kielser 1986).

It was also found that in anonymous situations group members can develop an even stronger group identity than in non-anonymous face-to-face situations (Cress 2005; Postmes, Spears, Sakhel & deGroot 2001). This is the case because anonymity can hide the fact that the group members may be quite heterogeneous. If communication takes place in a scenario where others are not visually present in person, an individual may focus more on the group as a whole instead of on its single members. If individuals interact without seeing each other, they may develop a stronger group identity and behave more as group members than as individuals (Reicher 1984).

In contrast to the view that computer mediation provides a socially impoverished environment (where social context cues are filtered out), research in CSCL assumes that mediational tools may also offer social enhancements to the interaction. For example, some technical tools can make cues visible that would not be visible in non-mediated interactions. Many such possibilities are included within the notion of "awareness tools." These tools may present information about the social situation or about the group members, which would not be available in normal, non-mediated communication (Buder 2011). For example, such tools can provide information about characteristics of people, such as their knowledge, activities, expertise, social status or social relations. They can even present this information in an aggregated way that makes particular conclusions salient. An awareness tool can provide information about peers' activity levels or recommend suitable learning partners.

Differentiating the type of learning that takes place in collaborative groups

Probably the most important aspect of CSCL research is the detailed analysis of interaction processes and the learning that takes place during collaborative activities. Collaboration, as it is understood in CSCL (Dillenbourg 1999), is much more than just communication between individuals, contributing information to each other, exchanging ideas, or coordinating activities to reach individual or shared goals. It is more specific than just a general benefit of individuals learning from each other. CSCL is especially interested in situations where people do not just exchange information, but jointly create something new, which could be new knowledge or understanding that none of the participants had before. Joint meaning making and constructing new knowledge can be regarded as a kind of gold standard in CSCL.

Group cognition (Stahl 2006) is achieved when the group not only brings different people together, where the members may or may not benefit from some other members, but when the group as a whole starts to make meaning, develops collective cognitive responsibility (Zhang, Scardamalia, Reeve & Messina 2009) or creates new knowledge (Cress & Kimmerle 2008; van Aalst 2009). CSCL has the vision that being in a group can not only empower individual learning and performance, but can also enable emergent meaning-making processes at the group unit of analysis (Oeberst, Halatchliyski, Kimmerle & Cress 2014; Stahl 2013).

CSCL aims not only to show that learning in a group is efficient—as research in cooperative learning has done for many years (Johnson & Johnson 1999; Slavin 1980). It also aims to demonstrate that the group interaction has a learning or knowledge-constructing effect. This is why CSCL studies go beyond comparing learning in different collaborative situations and try to find out what kind of learning takes place, and how exactly a group benefits from the activities and interactions of its members.

Microanalysis and ethnomethodology can be useful approaches for understanding processes underlying learner outcomes and production of knowledge artifacts. It is not easy to quantify and predict the pivotal moments when collaborative knowledge creation or collaborative meaning making really happen (Law & Wong 2013; Suthers et al. 2013). It still seems to be a "magic" moment (Roschelle & Teasley 1995) when such a pivotal process of shared meaning making takes place. Current research in CSCL shows that we may identify such events in retrospect, but we are far away from understanding how they happen or reliably predicting them. They remain rare, poorly understood and unpredictable.

Designing computer support for collaborative learning

A central aim of CSCL research is to generate situations that make collaborative learning effective and to enhance the probability that emergent processes may take place. Consequently, a core activity of CSCL research is to design adequate CSCL tools and settings. How can activities of deep learning and effective interaction be best induced? Which learning materials can stimulate such processes? What kinds of collaboration scripts are needed (Fischer, Mandl, Haake & Kollar 2006)? How can learning at individual, small-group and classroom levels be orchestrated to support each other fluidly (Dillenbourg 2013)?

Several approaches may be mentioned here: The *knowledge building theory* (Scardamalia & Bereiter 2014) envisions that learners would collectively build knowledge through taking collective responsibility to improve their understanding of authentic problems. The Knowledge Forum software was designed as a discourse tool that scaffolds learners' sharing of ideas, structures the process of critical evaluation, refinement or improvement of ideas, as well as supports the construction of rise-above summaries or the identification of problems of understanding.

Scripting emerged as a necessity in situations where self-regulation of the learning process needs increased external guidance and structure (Fischer et al. 2006; Kobbe et al. 2007). Scripts assign roles and responsibilities to the learners, coordinate their activities and give implicit instructions. Thus, scripts structure the social situation as well as the learning process.

The *construction of artifacts* (Kafai & Resnick 1996; Stahl, Ludvigsen, Law & Cress 2014) was seen as a possibility to ensure that knowledge exchange does not remain abstract, but also comprises practical and tacit knowledge. Collaboratively working on such artifacts enables natural forms of internalization and externalization, which are essential mechanisms of interpersonal learning (Kimmerle, Moskaliuk, Oeberst & Cress 2015; Tee & Lee 2013). However, we have found that the use of well-established CSCL tools and environments alone does not guarantee that collective knowledge construction will take place (Overdijk, van Diggelen, Andriessen & Kirschner 2014).

How the four articles of this issue contribute to these core concerns in CSCL

In the following sections, we do not intend to provide summaries of the studies in exactly the way they were presented by the authors. Instead, we try to relate the four studies to the above mentioned core topics in CSCL and ask what each study can contribute to these aspects.

Hierarchical positions

The article by *Martin Rhem, Wim Gijselaers and Mien Segers* deals with the impact of hierarchical positions on communities of learning. It contributes to our understanding of how the characteristics of group members influences collaborative learning interactions. The authors provide an empirical analysis of a field setting in which an organization's members interact in an organizational-learning setting. The authors find the effects they expected: Participants in the higher hierarchy positions were more active and had better learning performances than those at a lower level.

A surprising result of their study is revealed by a cluster analysis that identifies different clusters of learners: As expected, three groups are determined by the different hierarchy levels (low, medium, high) and their activity pattern is consistent with their hierarchical status. Interestingly the study identifies a fourth group, consisting of the most active participants. These were the drivers of the learning communities, as their agency directed the groups' activities. They authored the most contributions and those with the highest quality. Half of the members in this group were from a high and the other half from a low position in the hierarchy. This second half is the interesting group. They were highly active and valuable leaders in the learning communities—despite their low hierarchical level.

The study reveals a correlation that probably does not result from a causal effect. It might even be expected that people of higher hierarchical positions are more active and more dominant in general. Therefore, it is natural that they also take over the leadership in their learning communities. However, it remains unclear what enables and motivates some low-status members to take over the lead. Are these people who would in principle have leadership qualities, but did not have an adequate career? Does the online setting give them a chance to be more active and to become leaders? What would have been the situation if the collaboration did not take place in a remote e-learning setting, but in a face-to-face scenario? We do not know the answers, but it would be worthwhile to research it. What factors in these learning communities helped at least single learners unfold their leadership potential?

An interesting finding of the study, which is reported more marginally, is the fact that no group effects were found. The non-significant intra-group correlation seems to express that the different groups did not have any specific influence on people's learning and performance. A leader may unfold leadership potential in any group, independent of the group composition. Is this a hint that group composition and the social influence of being in a special group is not as high as we might expect in CSCL? Are such social influences perhaps negligible compared to the characteristics of the single learner? Is this due to the special social setting that was chosen or is this a more general finding? These questions refer to the core of CSCL when it comes to analyzing the influence of the social setting on CSCL.

Social awareness and knowledge awareness

The second article, by *Jian-Wei Lin, Li-Jung Mai and Yuan-Cheng La*, compares the influence of two forms of awareness: social awareness and knowledge awareness. Both were quite commonly researched in earlier CSCL research, but their effect has not been compared directly. The reported study finds that social awareness had much greater effects than knowledge awareness. Especially over time, it unfolded its influence. Social awareness stimulated peer interaction, led to denser networks and resulted in more social connections among group members. It also resulted in better performance of the individual learners. This is interesting because one might have expected that the awareness of others' knowledge can help a learner to find the best partner who can complement the learner's own knowledge optimally. Therefore, it is surprising that the social aspect of others' activities and social relations has a stronger effect (even on performance) than the knowledge about others' expertise. We may ask if this is a result of how the study operationalized both forms of awareness or if it is generalizable to other situations.

This study also leads to interesting questions for future research: What kind of collaboration and learning take place? When learners provided with social awareness perform better in a knowledge test than learners provided with knowledge awareness, does this also mean that learning is more efficient at the level of the group? Did the different types of awareness have an effect on people's interaction, on group cognition and knowledge construction? Was the learning discourse different across the two conditions?

Fixed and opportunistic grouping

The study by *Tuya Siqin, Jan van Aalst and Samuel Kai Wah Chu* about the effect of fixed group vs. opportunistic collaboration tries to answer the kinds of questions raised with regard to the last study. In the fixed-group condition, learners were organized in small groups, where five learners were randomly assigned to a group in order to complete certain tasks. In the opportunistic-collaboration condition, in contrast, learners individually and explicitly decided about the partners they wanted to collaborate with for a particular problem. They disbanded the group when the problem had been solved and flexibly formed new groups to achieve subsequent goals.

In order to compare the two conditions, the authors apply a multi-faceted analysis. They consider quantitative features of participation and interactivity as well as the content of the dialogs and the quality of knowledge construction that took place in the groups. The authors differentiate between knowledge sharing, knowledge construction and knowledge creation (van Aalst 2009). It is interesting that they do not find any knowledge creation at all in any group. The majority of interactions are coded as knowledge sharing (where knowledge was just accumulated), about one third as knowledge construction (where the group got a deeper understanding of a focal problem), but no activity shows knowledge creation (where understanding took place, beyond what was already known in the group). This is the case for both types of groups.

The rarity of knowledge creation is an important result, which has also been found in other CSCL research and that needs to be acknowledged. Even if CSCL environments have the ideal goal of supporting learners to effectively create knowledge, this appears to be a rare occurrence. It remains an ideal that does not take place frequently, and if it takes place, it may not be measured easily. May this be because deep learning in groups needs time to happen? Groups must interact for an extended period to develop effective *group practices* for collaboration and knowledge construction within a classroom climate that values and nurtures knowledge building (Ritella & Hakkarainen 2012; Stahl 2015)? Even then, it may be a serendipitous result, situated in the unique discourse of students working together in a structured educational setting (Hakkarainen 2009; Hakkarainen & Lipponen 2002), which makes it difficult to predict.

Classroom orchestration using tabletops

The article by *Sebastien Cuendet, Jessica Dehler-Zufferey, Giulia Ortoleva and Pierre Dillenbourg* on an integrated way to orchestrate tangible user interfaces in a classroom addresses aspects of designing effective environments and orchestrating classroom activities. The knowledge domain is vocational training for carpenters. The design of the environment is based on detailed studies of how carpenters do their work, in order to minimize the problems of tacit knowledge and of weak knowledge transfer between school and work.

The learning setting involves a tangible user interface called TaraCarp. This top-down camera-projector tabletop system combines real and virtual artifacts. The tabletop is also used as a tool for scripting the collaboration (Dillenbourg & Evans 2011; Dillenbourg & Hong 2008). First, each student has to cut an object virtually on the tabletop and print the developed plan. After having critically reflected and improved on their own individual plans, the apprentices have to pair up and exchange their plans. Each one then marks out a real block and cuts it according to the plan of the other learner. The two apprentices are then brought together to compare the objects. The tabletops are used not only as part of the tangible interfaces, but also as orchestration tools for the teacher.

The study is a great example of how CSCL can combine work on real and virtual artifacts, how it can structure collaboration and make the complex situation manageable in a classroom. Further studies with this setting could perhaps make clear, how exactly the students benefit from the collaboration. Does the collaboration in dyads have specific effects? Can we trace the interpersonal knowledge transfer of practical knowledge? Does the collaboration just have a motivational effect or can we also identify a more specific effect on the types of learning that take place in such a practical setting? As the article shows, tangible interfaces may provide interesting and innovative means for CSCL that lead to new questions about the nature of what students can learn through collaboration and what kind of knowledge is shared or created.

CSCL 2015

The four articles in this second issue of 2015 contribute to furthering our understanding of CSCL. They raise highly relevant questions about the social nature of collaborative learning, about the kind of knowledge that is collaboratively constructed in a group and about how we can use technical tools to structure or design ongoing social and knowledge-related processes for learning.

They also show that the goal of collaboration to improve understanding and to construct new knowledge is not easy to achieve.

The theme of the upcoming 11th Conference on Computer-Supported Collaborative Learning that will take place in Gothenburg is "Exploring the Material Conditions of Learning: Opportunities and Challenges for CSCL." This may direct our attention to further aspects of collaboration and learning—how social, cognitive and collaborative processes are structured through artifacts, affordances and forces associated with the sociotechnical environment in CSCL.

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10(3): Conceptualizing the intersubjective group

Intersubjectivity may be considered the defining characteristic of CSCL. *Intersubjectivity* is a concept that indicates *shared understanding* among people. This "sharing" is not a matter of individuals having similar understandings, but of them participating productively in a joint meaning-making discourse within a communal world. A group has achieved intersubjectivity if the members of the group interact well enough to pursue the group's aims. Intersubjectivity must be built up gradually through interaction and repaired frequently. CSCL research explores the conditions and processes that are conducive to the establishment and maintenance of intersubjectivity among groups of learners. CSCL pedagogies promote the intersubjectively shared understanding that makes collaborative learning possible. CSCL technologies support intersubjectivity by providing media of communication and scaffolds for meaning making within a specific domain of learning.

When CSCL theories discuss "groups," they are not referring to arbitrary gatherings of multiple learners, but to functional groups that have achieved a degree of intersubjectivity. The concept of collaborative learning in CSCL does not refer to a sum of individual learning that takes place among a group's members, but to the increase in intersubjective understanding or knowledge building within the group that results from joint meaning making in a shared context. It involves the understanding expressed in the group discourse and the knowledge encapsulated in group products, texts or artifacts. The group's understanding may differ from what any individual member might say, write or think when not interacting within the group.

This focus on the intersubjective group differentiates CSCL from other approaches to the study of human learning and educational instruction. It implies a research paradigm that prioritizes the group unit of analysis and studies groups that have achieved intersubjectivity. Analyzing an utterance (or chat posting) as part of a group interaction involves seeing how its meaning is constructed sequentially through its response to previous actions and elicitation of future behavior by other group members. The meaning of the utterance is inherent in the working of that utterance within the shared world of the group, not to be explained in terms of some purported individual mental thoughts accompanying the utterance. As in Ryle's (1968) thick description of a wink, the meaning of a wink (or utterance) is expressed by the wink itself as an interactional action, not by assumed additional intentions of the winker.

Despite the centrality of the notion of intersubjectivity to CSCL, this concept has not often been explicitly discussed in the CSCL literature. Newcomers to CSCL therefore have difficulty determining the boundaries of the field. They may assume that CSCL is the same as traditional educational psychology or instructional design, except that it involves small groups and online technology. However, the importance of analyzing intersubjectivity at the group unit of analysis has become increasingly clear to many established CSCL practitioners. For instance, the *ijCSCL* Mission Statement now specifies that the journal "features empirically grounded studies and descriptive analyses of interaction in groups, which investigate the emergence, development and use of practices, processes and mechanisms of collaborative learning." The central research questions are no longer what experimental conditions produce the most valued learning experiences or outcomes at the individual unit, but how intersubjective meaning making and understanding is established, maintained and increased within the *interaction in groups*, by social practices, small-group processes and interactional mechanisms analyzed at the group unit.

The shift of research from assessing individual student outcomes to analyzing group-level phenomena has been slow coming and is still difficult to implement consistently. In the late 1900s, educational researchers like Johnson and Johnson (1999) or Slavin (1980) explored the effects of group interaction on learning outcomes of individual students; this was called *cooperative* learning. With the advent of CSCL, interest changed to the group processes that could be supported with networked-computer technologies. In their report on the evolution of research on *collaborative* learning, Dillenbourg, Baker, Blaye and O'Malley (1996) noted that new methods were now necessary to study group phenomena. Although Koschmann (1996) proposed that this involved a paradigm shift, it has not been widely recognized what a radical change in perspective and methodology this shift to the group level implied.

Subsequently, Koschmann (2002) defined CSCL in terms of "joint meaning making"—the focus of the opening article in this issue. The centrality of intersubjective meaning making to the concerns of CSCL as a research field have been stressed programmatically in scattered proposals and examples, for instance in (Arnseth & Ludvigsen 2006; Çakir, Zemel & Stahl 2009; Suthers 2006; Suthers, Dwyer, Medina & Vatrapu 2010). Multiple attempts to define new methods corresponding to this agenda of group-level analysis were also proposed, as in several *ijCSCL* articles (Cress 2008; Cress & Kimmerle 2008; Damsa 2014; Furberg, Kluge & Ludvigsen 2013; Noroozi et al. 2013; Öner 2013; Overdijk, van

Diggelen, Andriessen & Kirschner 2014; Zemel & Koschmann 2013; Zhao & Chan 2014).

After 20 years, CSCL researchers are just beginning to work out group-level conceptualizations, such as group cognition, group knowledge construction, group agency, group engagement, group metacognition, group practices and so on. Some researchers now see CSCL as pursuing a post-cognitive paradigm distinguished from the cognitivism of the learning sciences (Stahl 2015). For instance, I have recently been exploring this post-cognitive paradigm through a theory of group cognition (Stahl 2014), a review of philosophical analyses of intersubjectivity (Stahl 2016b), design-based research on software support for multi-user problem solving (Stahl 2013) and a longitudinal study of group-cognitive development (Stahl 2016a). Such a post-cognitive approach may distinguish CSCL most clearly from the methodological individualism of the educational psychology, artificial intelligence and learning sciences from which it emerged.

The current issue of *ijCSCL* provides a set of stimulating papers that illustrate and further develop a group-level focus of CSCL research. First, a discussion of Habermas' philosophy as it relates to CSCL issues introduces to the CSCL audience the work of the contemporary author who has written the most on the concept of *intersubjectivity*. Then, three papers analyze the intersubjectivity of small groups of students in different ways. One looks at how *groups learn how to learn together* with support from specific CSCL tools. A second transforms the concept of engagement to the group unit of analysis as collaborative *group engagement*. The final one makes a parallel move for *formative feedback and metadiscourse*, applying them at the group level. Together, they offer stimulating glimpses of CSCL theory, technology, meta-learning and analysis focused on the group as agent.

Of course, the emphasis on group-level intersubjectivity defines just one of the paradigms active in the CSCL research community. Certainly, not all CSCL researchers identify with a post-cognitive paradigm. Perhaps the much-debated distinction between quantitative and qualitative methods should be replaced with consideration of the unit of analysis as contrasting different CSCL paradigms. CSCL has always incorporated a diversity of methodological perspectives, and *ijCSCL* has always published leading statements from all the different approaches. While this issue emphasizes studies at the group unit of analysis, future issues will continue to highlight studies of individual outcomes or community participation.

The conditions of the possibility of intersubjectivity

In his introduction of Habermas' philosophy of communicative action to the CSCL community, **Michael Hammond** translates from Habermas' application of this theory in the public sphere of traditional media to the online world of CSCL. For him, Habermas is relevant because he brings a fresh, well-considered and critical perspective to the discussion of joint knowledge building. In particular, Habermas' writings provide a framework for judging the evidence we bring to the analysis of collaborative learning as well as for valuing the evidence that our student subjects provide in their argumentation. Habermas defines the conditions necessary for the establishment of intersubjectivity, such as the inherent assumption of an ideal speech situation underlying communicative action. What Kant's (1787/1999) *Critique of Pure Reason* did for the individual mind, articulating the conditions of the possibility of human knowledge, Habermas translated to the group level, explicating fundamental discourse conditions necessary for intersubjective meaning making in social collectivities.

Consider a student chat, a discussion forum or a medium like Wikipedia. How should we judge the quality of the knowledge building that takes place there? Moreover, how should one judge the quality of researchers' analysis of that knowledge building? Habermas provides a standard for judgment that is grounded in the nature of human discourse. He argues that effective communication would be impossible without the underlying postulation of an ideal speech situation—even if this ideal is never in fact achievable (Habermas 1981/1984). The act of communicating with the aim of establishing intersubjectivity, making shared meaning and building knowledge together assumes that there is no other force of persuasion at work than that of the better argument and no other motivation than the cooperative search for truth. Enlightened discourse is only possible under the assumption of this goal. Of course, there always are other forces and motivations present. But the character of the ideal speech situation that underlies collaborative dialog provides a basis for critiquing those systematically distorting forces. For instance, if knowledge building assumes that no one can impose his or her views through force rather than through supported reasoning, then appeals to authority or intimidation can be soundly censured.

Habermas' theory is, additionally, more complex and nuanced. A major contribution of his work was to distinguish realms with different criteria within the public sphere (Habermas 1967/1971). There is, as Hammond puts it, the objective world (of nature and labor), the social world (of institutions and interaction) and the subjective world (of personal experience). Each has very different criteria of validity. The objective world follows the laws of physics and involves human mastery over nature through technical, goal-oriented, instrumental calculation; the social world, in contrast, involves normative rules reached through negotiation; while the subjective world is a matter of one's self-narrative.

Consider the research task of analyzing an online team of students collaborating on a geometry construction. Certainly, this involves comparing the team's work with mathematical knowledge developed in the objective world of mathematical relationships. However, it also involves tracking the development of the team's adoption and mastery of its own group practices of collaborating and of working on geometry in the team's social world. Furthermore, it may be possible to assess individual learning by team members as a personal-world spin-off of their teamwork. Each of these dimensions has quite different methodological criteria. Seeing how each is accomplished with the mediation of specific CSCL pedagogical approaches or CSCL technological tools can feed into design-based research for improving support for collaborative knowledge building.

Habermas' distinction between the objective, social and subjective realms gives him leverage for his critiques of modernism and other popular philosophies, extending the critical social theory of the Frankfurt School. As cited by Hammond, Habermas' concern with mutual recognition led him to criticize classical liberalism for reducing ethical liberty to a "possessive-individualist reading of subjective rights, misunderstood in instrumentalist terms." There are many analogous examples in the CSCL literature, where social phenomena are inappropriately reduced either to individual subjective criteria or to instrumental objective criteria. Hammond suggests that a focus on intersubjectivity could provide a corrective in such cases and open up new perspectives for design and research. It is important to distinguish different levels of analysis carefully and to apply the appropriate evaluative criteria or analytic methods to each.

Intersubjective learning to learn

Teaching students to learn how to learn or to develop thinking skills has long been considered important (e.g., Looi, So, Toh & Chen 2011; Wegerif 2006)—particularly in the information age, where knowledge evolves rapidly. In their research report, **Baruch B. Schwarz, Reuma de Groot, Manolis Mavrikis and Toby Dragon** extend this goal to the group level with their construct of learning-to-learn-together. A core component of this approach is supporting groups of students to engage in argumentation as a form of intersubjective meaning making. Schwarz and colleagues have previously published studies of CSCL support for argumentation in *ijCSCL* (Asterhan & Schwarz 2010; Schwarz & De Groot 2007; Schwarz & Glassner 2007; Schwarz, Schur, Pensso & Tayer 2011; Slakmon &

Schwarz 2014). Now they situate computer support for argumentation in an innovative dual-interaction space.

The authors take a design-based-research approach to developing a software environment, curricular tasks and teacher roles for supporting learning-to-learn-together. They hypothesize that mutual engagement, collective reflection and peer assessment may be three critical group processes to encourage and to investigate. To explore these, they design a prototype with two primary components: a construction space and an argumentation space. The construction space includes a selection of domain-specific modeling applications to support student inquiry in specific topics of mathematics or science. This provides a mutually visible "joint problem space" (Teasley & Roschelle 1993) for collective reflection by the group on the progress of its inquiry. The software creates a shared world for mutual engagement, as opposed to individuals trying to solve a challenging problem on their own. As one group member performs an action in the space, the others assess that action in the argumentation space, either affirming it or questioning it. This prompts the students to build on each other's actions, producing a joint accomplishment.

In some dual-interaction systems, a simple chat feature accompanies an online construction space (Lonchamp 2009; Mühlpfordt & Wessner 2009; Zemel & Koschmann 2013). This provides the possibility of engaged discourse, group reflection and peer assessment when group members are not situated face-to-face. However, the described Metafora system goes beyond this with a sophisticated planning/reflection tool. Even if the students are sitting together around a shared computer, this tool prompts, guides and supports team efforts at planning steps for the group to take (collective agency) and it facilitates team reflection on the current state (collective responsibility) (Scardamalia & Bereiter 2014). While the software mainly displays advice and ideas from the teacher or from individual students, its persistent visibility and its manipulable structure allow it to influence group agency and meta-learning. The potential power of this approach seems to come from the integration of the support for argumentation and reflection by the group with the inquiry activity itself in the shared inquiry environment. As always in CSCL, success also depends on a culture of collaboration: appropriate motivations/rewards, careful training in collaboration and subtle mentoring. The emphasis of the pedagogy and the support throughout is on the group as meta-learner.

Intersubjective engagement

In the next presentation, **Suparna Sinha, Toni Kempler Rogat, Karlyn R. Adams-Wiggins and Cindy E. Hmelo-Silver** provide a multi-faceted conceptualization and operationalization of intersubjectivity based on aspects of what they term "group engagement." Using this approach, they provide a clear illustration of a team of students that does not form an intersubjective group contrasted by one that does. The construct of group engagement developed in this paper allows the authors to identify this contrast and to analyze it using both quantitative and qualitative methods. The quantitative approach includes statistical correlations based on ratings of several aspects of group engagement, measured in five-minute intervals. The qualitative approach involves thick descriptions of illustrative excerpts of group discourse. The descriptions relate the interactions within the groups to their work (or lack thereof) of meaning making in establishing the engagement of the group as a whole in its problem-solving task.

A major achievement of the paper is to shift the analysis of engagement—which is increasingly popular in CSCL—from the psychological individual to the intersubjective group unit of analysis. The authors are explicit about this. Their observational protocol is designed to situate engagement within the collaborative group, its joint problem and its shared situation. For instance, the dimension of social engagement reflects group cohesion, or evidence that the task is conceptualized as a team effort, rather than as an individual activity. The contrast of one group's use of the subject "we" versus the other's use of "I" reflects in the details of the discourse the distinction documented in the ratings—showing that the distinction is actually one made by the group.

The paper is an impressive response to the cited prior research on engagement. According to the literature review, earlier studies generally operationalized engagement as consisting of a single dimension, as a stable state and as a characteristic of the individual learner. In addition, the cited work decontextualized engagement from concomitant conceptual and disciplinary tasks. By contrast, this study proposes a differentiated, evolving, multi-faceted and group-based model of engagement and applies this model to explore an insightful example from actual classroom practice. The paper's mixed-methods analysis reflects a careful attention to the unit of analysis, operationalizing engagement at the group level. Thereby, it adds in a rich way to our conceptualization of intersubjective meaning making.

Intersubjective metadiscourse

Like the preceding paper, the one by **Monica Resendes, Marlene Scardamalia, Carl Bereiter, Bodong Chen and Cindy Halewood** also uses mixed methods, with both quantitative and qualitative analysis. While collecting data at both the individual and group units of analysis, its focus is also at the group unit. In fact, it goes a step further than the previous paper and most other CSCL reports by capturing the outcomes at the group level. Here, because the main data source is a Knowledge Forum database, the group product of shared notes responding to each other within the group is the most important object for examination in response to the primary research question. Thereby, the correlation of the experimental condition with resultant collaborative learning or knowledge building can be conducted at the group level.

The social-network analysis of the Knowledge Forum notes shows the effect of experimental feedback tools on the group process and the degree of intersubjectivity established by each group. The striking visual contrast in the paper's Figure 5 indicates that in the control condition most students are not strongly connected to other students, whereas in the experimental condition everyone is strongly connected to everyone else. Because the connections here represent sharing of vocabulary terms—such as those displayed in the experimental condition's feedback tool—this means that there is a higher degree of intersubjective, shared understanding in the experimental groups. Shared understanding at the group unit of analysis is not dependent upon individuals' cognitive states, internal representations, or personal understandings, but is visibly displayed in the team's unproblematic use of shared language.

We are shown further evidence of increased group metadiscourse through the analysis of group discussion in a number of propitious interaction excerpts. While these demonstrate the experimental group's comprehension of the visualizations of their group discourse (displays of its use of domain vocabulary and of Knowledge Forum epistemic markers), the primary metadiscourse moves (prompting the group to plan, question, analyze, explain) were made by the teacher, rather than by the student group. The experimental intervention at the group level led to productive metadiscourse, but this was not at all independent of the teacher. Thus, the study merely indicates a potential for the design of formative assessment visualizations that represent group-level behaviors and that support group metadiscourse. It does not demonstrate that the implemented tools led to student metadiscourse on their own. The students may need more experience with this approach or more maturity to take on this form of agency within the student group. Nevertheless, the paper offers stimulating design suggestions: group-level formative feedback can represent group vocabulary; support the group to evaluate its own progress; give feedback on secondary processes (like vocabulary building, rather than directly on learning or task accomplishment); suggest positive steps (rather than just identify deficiencies); facilitate self-assessment by the group; and guide individual students to become more effective group members.

Together, the papers in this issue of *ijCSCL* suggest the centrality of intersubjectivity to a theory of CSCL and provide inspiring examples of how to explore and articulate aspects of our conceptualization of group intersubjectivity.

Report from CSCL 2015

Just before traveling to Gothenburg, Sweden, for the CSCL conference, we were shocked to hear that Naomi Miyake had succumbed to a long illness. This was the first death of a member of the *ijCSCL* Editorial Board. Naomi was a founding member of the journal and had contributed reviews, advice and encouragement, even during crisis periods in Japan and with her own health. The conference began with a ceremony honoring Naomi. Comments from that event are included in the following memorial statement by **Marcia C. Linn, Hajime Shirouzu and Masaki Miyake**. At the end of the conference, the Naomi Miyake Best Student Paper Award was named in memory of Naomi from now on, in recognition of her commitment to promoting new research talent.

During the conference, *ijCSCL* held its annual Board meeting. We first expressed our deep sorrow that Naomi will no longer be with us except in spirit. Then the Board engaged in a lively discussion of the future of CSCL and how the journal can expand to support the growth of the field—globally, methodologically and in terms of content. It was pointed out that submissions to the journal are coming from more and more parts of the world. For instance, the journal has recently published several articles from Mainland China. Also, downloads of articles from the Springer *ijCSCL* website are evenly divided among Asia, Europe and North America. However, some Board members were concerned that the scope of the journal is perceived as being too narrow to attract submissions from new approaches or from expanding areas of technology and methods. The Board determined to open the journal to new themes that have arisen around the periphery and potential future of the CSCL research field. In particular, the Board agreed to solicit articles in the following areas. Note that *ijCSCL* has already begun to discuss a number of these topics in the current and recent issues.

- Social Software,
- MOOCs,

- Tangibles,
- Mass Communication,
- Learning Analytics,
- Teacher Learning,
- Sensors,
- Vocational Ed & Training,
- Informal/Civic/Lifelong Learning,
- CSCL @ Work.

For such new areas, it might be ideal to start with an overview to introduce the recent literature and state of the art of the area to the *ijCSCL* readership. Then a couple papers could be published illustrating the relevance of the area to CSCL, along with a call for follow-up papers on the theme. This is *ijCSCL*'s alternative to publishing special issues.

The articles presented in the current issue illustrate this approach: the article on Habermas introduces the theme of intersubjectivity and its relevance to CSCL research, while the other papers provide studies of aspects of intersubjectivity in CSCL. If you are interested in submitting a paper or organizing a thread of related papers but are not sure whether it fits the expanded scope of *ijCSCL*, please contact an editor at exec@*ijCSCL*.org. A Board member might be willing to work with you to help frame your initiative.

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10(4): A decade of CSCL

This issue of *ijCSCL* completes a decade of publication of CSCL research.

When the field of Computer-Supported Collaborative Learning emerged about a decade prior to the launching of the journal, there was a pervasive sense of a paradigm revolution in learning research (Koschmann 1996). It was time to transcend cognitive science's critique of behaviorism, extending the unit of cognition beyond the boundaries of the individual mind (Stahl 2015c). For instance, new directions in theory surfaced around the influential Institute for Learning Research (Brown, Collins & Duguid 1989; Lave & Wenger 1991; Orr 1990; Suchman 1987; Teasley & Roschelle 1993; Winograd & Flores 1986), as well as in distributed cognition (Hutchins 1996), activity theory (Engeström 1987) and conversation analysis (Goodwin & Duranti 1992). *IjCSCL* has continued and extended this interest in innovative theory, further exploring the centrality to social cognition of physical artifacts and interactional resources (Arnseth & Ludvigsen 2006; Damsa 2014; Jones, Dirckinck-Holmfeld & Lindstrom 2006; Overdijk, van Diggelen, Andriessen & Kirschner 2014; Stahl 2012; 2013a).

Cognitive science argued that human behavior could not be modeled without hypothesizing cognitive structures like mental representations and computations, which mediated responses to the environment, particularly linguistic responses (Chomsky 1959). However, the cognitive approach did not consider structures of interaction at the dialogical, small-group and community level, where language is primarily learned and practiced. Artificial intelligence—which exerted an important influence on CSCL—had already conceptualized cognition as taking place outside the human mind, in software computations and digital representations. The new post-cognitive theories began to postulate structures and practices at the group level, although they did not always clearly distinguish small groups from larger social institutions. Dialogical, interactional and practice-oriented approaches in CSCL have elaborated these conceptions within the context of collaborative learning (Cress & Kimmerle 2008; Ligorio, Loperfido & Sansone 2013; Öner 2013; Stahl, Cress, Ludvigsen & Law 2014).

While the post-cognitive paradigm dominates CSCL *theory* and seems particularly appropriate to a field focused on group collaboration, it has perhaps been less influential in the areas of technology *design* and analysis *methodology*. CSCL research often relies upon technologies designed on a model of individual learning and knowledge transfer, rather than on an understanding of meaning negotiation, collaborative knowledge building or dialogical interaction. For many researchers, it is easier (or more affordable) to use commercial software to support communication than to develop innovative applications that are devised specifically to foster group cognition. Unfortunately, commercial software is designed to enhance personal productivity and to exchange individual opinions, rather than to support collaborative knowledge building.

Analytic methods applied in CSCL studies also frequently assume a cognitive framework, focused on individual student cognition, even in contexts of small-group collaboration or classroom knowledge building. Researchers are primarily trained in techniques and standards based ultimately on positivistic conceptions of rigor. According to recent analyses of the CSCL literature (Jeong, Hmelo-Silver & Yu 2014; Tee & Lee 2013), statistical measures at the individual unit of analysis dominate the field. Many other educational journals reinforce the associated traditions of experimentation and reporting. Academic institutions and funded labs—in which most CSCL researchers work—reward research that conforms to established practice, militating against development and dissemination of innovative methods. Although there have been calls for analysis at the group unit of analysis (Stahl 2015b; Zemel & Koschmann 2013), most publications still rely upon pre/post tests of individuals or coding of individual utterances/postings. While it is possible to adapt data sessions and interaction analysis from conversation analysis to the online educational context, this requires extensive training and adoption of new practices for research teams. It also results in reports that may be harder for reviewers of some educational journals or conferences to assess.

A clear and positive tendency within CSCL during the past decade has been growth in international efforts, as well as an increase in multi-method and design-based research (DBR) approaches. These two trends are critically important for the future of educational research. They are synergetic, because the sort of DBR needed to influence educational policy and practice requires large multi-disciplinary efforts, which individual researchers and even single labs cannot undertake, manage or fund.

While it is now clear that collaborative learning across networked devices can provide an important component of education for the future, CSCL has yet to make a major impact on schooling around the world. Teachers and policy makers do not generally understand the social basis of learning and how small-group collaboration can be effectively orchestrated with classroom instruction, book learning, Internet browsing and individual reflection to form a mutually supportive and flexible learning environment. Given the institutions of schooling we inherited from the industrial age, there is now a need for teacher professional development in guiding and supporting collaboration as well as the development of curriculum aligned with established standards across grades. The curriculum and pedagogy should incorporate a learning-sciences emphasis on student-centered, collaborative, explorative, immersive, problem-solving, computer-supported approaches.

There is no profit motive to encourage companies to tackle these challenges, so the work is left to non-profit consortia. CSCL research has established that the development of teachers who can create collaborative classrooms takes several years and the development of curriculum that works effectively in small-group interaction requires many iterations of trial and redesign. These costly processes require the commitment of national educational institutions and international funding of educational R&D on levels that we have not yet seen. European Networks of Excellence (e.g., Kaleidoscope), the US Science of Learning Collaborative Networks and initiatives in Singapore and Hong Kong (Chan 2011; Looi, So, Toh & Chen 2011) may be seen as tentative steps in this direction.

We would like to see CSCL technologies, pedagogies and curriculum used by students in multiple subjects and across successive grades. The educational programs should be transferable to or accessible by communities in all countries. The CSCL research community cannot accomplish this on its own, but it can take a leadership role in catalyzing it. John Dewey's insistence that a democratic society requires an educated population that can engage in inquiry on open-ended issues seems more trenchant than ever. A collaborative, informed and reflective attitude among the world's population is needed to solve the pressing issues of global peace, sustainable environment and economic justice.

CSCL research reported in *ijCSCL* on simulations, argumentation support and knowledge building often targets these challenging topics. The Executive Editors of *ijCSCL* are each involved in research labs with national and international collaborations, as are many other members of the *ijCSCL* Board of Editors. They are also engaged in policy discussions with their national and regional educational ministries to implement future-oriented innovations. In collaboration with international colleagues, I have published analyses from the Virtual Math Teams Project, illustrating a concrete model of DBR exploring CSCL technology, pedagogy, curriculum, methodology and theory within an integrated post-cognitive approach (Stahl 2013b; 2015a) as a path for advancing CSCL research systematically.

In the coming decade, *ijCSCL* will continue to feature visionary investigations that suggest broad impacts as well as publishing traditional studies that contribute incrementally to the CSCL scientific literature. In its first decade, the journal helped to establish the potential centrality of CSCL to education for the future; in its next decade, the journal will suggest and support efforts to implement urgently needed educational transformations on a global scale, based on peer-reviewed analysis of international design-based research and other knowledge-building advancements.

Advancing knowledge-building discourse

The most extensive and influential example of an effort to impact schooling with a CSCL approach has been the Knowledge Forum project, directed for many years by Marlene Scardamalia and Carl Bereiter at OISE in Toronto. Based on theories of the role of reading and writing in learning, they proposed that students should have media and practices through which they could communicate and build textual knowledge together on the model of academic communities. Just as journal articles and conference papers allow scholars to articulate their ideas, discuss them and revise them in a community context, so students should be able to propose theories, react to the theories of others, share pro and con evidence and collectively refine the theories. The project developed many iterations of software to support this process, involved researchers from around the world and mentored teachers for years. The project experimented with curricular topics from various academic fields and published analyses of classroom experiences. This continuing project has produced many researchers and teachers oriented to CSCL. It has also developed the central theory of knowledge building, in which ideas are refined through computer-supported classroom discourse.

In this issue, *Bodong Chen, Marlene Scardamalia and Carl Bereiter* propose a new feature for their software, support for promising ideas. The ability to recognize and focus on promising ideas is an important skill for knowledge building. For instance, Ph.D. students must propose a promising idea for their dissertation topic in order to succeed and researchers must argue for a promising idea in order to be awarded a grant. In this article, the authors describe a promising idea for software support of knowledge building: a promising-ideas tool. They show that even young children (about 8 years old) can identify, communicate, respond to and build upon promising ideas in their knowledge-building discussions, mediated by this tool. By making the identification of promising ideas explicit within the classroom discourse practices, the tool instills in the students the important skill of making judgments of what is likely to become an important idea in their community discourse. This tool is just one new refinement to the software and classroom practices of the authors' DBR process of iteratively testing new features, just like last issue's formative-feedback tool (Resendes et al. 2015).

Argumentation style

Another dominant research effort within CSCL has been the exploration of support for argumentation. It seems reasonable that this would be a promising idea in CSCL since argumentation is a way of conceptualizing the negotiation of meaning and the building of knowledge through community discourse. Aristotle began the formalization of rational discourse as logic and Toulmin (1958) proposed a rubric for scientific arguments. Toulmin's logical model has been influential in CSCL research, despite the fact that student discussions of topics generally follow very different patterns. For recent *ijCSCL* articles on argumentation, see (Alagoz 2013; Asterhan & Schwarz 2010; Scheuer, Loll, Pinkwart & McLaren 2010; Schwarz, Schur, Pensso & Tayer 2011).

The Irish authors of our second paper—*Owen M. Harney, Michael J. Hogan, Benjamin Broome, Tony Hall and Cormac Ryan*—explore the effects on argumentation style of various task-level and process-level prompts. These experimentally manipulated features of the support software mediate the student argumentation. This alters the group discourse practice and, potentially, the individual students' style of argument (including their silent mental thinking).

Cohesion and dialogism

The field of CSCL emerged from an interest in taking advantage of artificial intelligence in education and in educational research. One perennial goal has been to automate the analysis of student discourse using AI techniques. Meanwhile—with the use of CSCL technologies like social media, discussion environments and MOOCs—the need for using computer processing of discourse has grown tremendously in order to bring pivotal interchanges to the attention of teachers and others (Law & Laferrière 2013). *IjCSCL* has periodically reported on such efforts (Erkens & Janssen 2008; Gweon et al. 2013; Mu et al. 2012; Rose et al. 2008).

For a number of years, a lab in Romania has been developing procedures to capture the "polyphonic" nature of knowledge-building discourse, in which multiple voices interact in vertical simultaneity and the ideas expressed are repeated and refined in horizontal sequentiality (Trausan-Matu, Dascalu & Rebedea 2014). In an extension to this work, reported by *Mihai Dascalu, Stefan Trausan-Matu, Danielle S. McNamara and Philippe Dessus* in this issue, methods of automatically capturing thematic cohesion are integrated as part of the horizontal progression of ideas. By incorporating McNamara's linguistic theory of topic cohesion, the analysis of knowledge building over time in student discussion is significantly enriched.

Live learning analytics

Live feedback to students about their behavior can be effective in many ways (Enyedy, Danish, Delacruz & Kumar 2012; Schneider & Pea 2013). However, the promise of robust and useful automated discourse analysis—especially in real time—has been largely elusive until now. Statistical AI approaches require large amounts of data, which were hard to collect quickly in the past. With the proliferation of online education—especially using MOOCs—techniques developed for "big data" are now becoming applicable. In the final article of the 2015 volume of *ijCSCL*, *Matthew Berland, Don Davis and Carmen Petrick Smith* provide an example of identifying specific discourse features relevant to collaborative learning and displaying representations of the behavior of these features in the interaction of student groups. These displays are made available to the teacher in real time to inform the process of matching students into collaborating pairs.

While the idea of displaying learning analytics to teachers and students in a live setting has been frequently proposed, the evidence that the analytics proposed by researchers and programmers are understandable and helpful for classroom teachers and their students is far less common. The AMOEBA system reported on here analyzes the software programming work of students and makes recommendations based on its analysis of which students might most effectively collaborate with each other. The study concludes that these automated recommendations did in fact lead to improved learning and more sophisticated programming by the students.

The next decade of CSCL

The four articles collected here are suggestive of future advances in CSCL. Computer science continues to play a central role in implementing new features to support student collaboration, new techniques for aiding analysis of group-level processes, new methods for assessing collaborative learning and new theories, such as promissingness, polyphony or learning analytics. It is important that innovation in our field continue to blossom in a diversity of directions, including both incremental refinements or creative variations and fresh breakthroughs or radical departures. However, it will also be imperative to consolidate the many isolated advances into larger efforts that can effect a fundamental transformation of how the world thinks about education. We need to flesh out models of collaborative learning that are not only demonstrably effective under a range of settings, but are packaged to be used in practice by teachers everywhere. This will necessarily involve new kinds of research networks. Only this way will computer-supported collaborative learning become widely recognized as a fundamental form of learning and be adopted as a prevalent approach.

Ideas want to be free

When *ijCSCL* started, an innovative agreement was negotiated, where the journal could maintain a free and open website with pre-publication versions of all *ijCSCL* published articles (http://*ijCSCL*.org/?go=contents). For the second decade, the agreement has been extended to provide free access for all ISLS members to all the final versions through the members-only page of the ISLS website (https://www.isls.org). By the time you read this, the new benefit should be accessible. So be sure to maintain your ISLS membership and you will have a free online subscription to *ijCSCL* and *JLS*.

Reviewers are the foundation of the journal

We gratefully acknowledge the researchers who have established the high standards of publication in *ijCSCL* by rigorously reviewing submissions and guiding authors to improve their presentations. Most of the *ijCSCL* Board of Editors and reviewers will be continuing in the coming years. The following people submitted reviews during the past decade:

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