10th International Conference of the Learning Sciences
The Future of Learning

Program

July 2-6, 2012
Sydney, Australia

www.isls.org/icls2012

WELCOME

On behalf of the Organizing Committee, we are delighted to welcome you to Sydney for the *International Conference of the Learning Sciences* – ICLS 2012. Since the first ICLS in 1991, the conference has developed a reputation as one of the leading scientific meetings for reporting the most current and rigorous research into how people learn and how to design environments for learning in formal and informal settings.

On this, its tenth anniversary and the first time it has been hosted in the Asia-Pacific region, ICLS looks forward with its theme: "*The Future of Learning.*" ICLS 2012 will bring together researchers, academics, professionals, and educators from all over the world to share their experiences, discuss trends, and examine how the learning sciences can and should impact the future of learning.

Conference highlights include keynote presentations by distinguished researchers in the field: Janet Kolodner, Pierre Dillenbourg, Judy Kay, and Manu Kapur. In addition, there is a Presidential Session on the future of learning and an overall ICLS schedule that includes 18 symposia, 126 papers, and 63 posters over 8 parallel sessions. There are also 11 pre-conference workshops, including the Doctoral Consortium and Early Career Workshop. The conference provides ample opportunity to socialize with a Gala Opening Night and an optional (but highly recommended) dinner cruise on Sydney Harbour on Thursday evening.

The conference venue combines the new with the old; sessions will take place in the state-of-the-art New Law Building and the Eastern Avenue Complex on the grounds of the University of Sydney (Australia's oldest university) close to Sydney's Central Business District. Nearby are some of Sydney's best places to eat whatever your budget: from opulence and history in the Rocks, to excellent everyday fare in nearby Glebe and Newtown. We hope that you enjoy not only the conference but also your visit to our city and our university.

ICLS could not proceed without the hard work of many individuals. We are deeply appreciative of the countless hours and expertise put in by our Conference Advisory Board and the various conference sub-committees. We would like to thank all those who assisted with the review process. The Conference is also fortunate to have a number of financial sponsors whose support contributes to conference events: *NSW Trade & Investment, Smart Services Collaborative Research Centre, United States National Science Foundation,* the *International Society of the Learning Sciences, Asia-Pacific Society of Computers in Education,* and the *Centre for Research on Computer Supported Learning and Cognition (CoCo)* at the Faculty of Education and Social Work.

In addition, we would like to thank our volunteer staff who will be working hard over the course of the conference to insure everyone has the best possible experience, our session chairs, and all those who volunteered their assistance with the event. And, of course, we would like to thank you, our attendees. We look forward to rigorous research findings and spirited discussions as together we engage issues and opportunities for enhancing learning that will help people meet the dynamic challenges of the 21st century.

Welcome to Sydney and to ICLS 2012.

Professor Michael Jacobson

Professor Peter Reimann

ICLS 2012 Conference Chairs

KEYNOTE SPEAKERS

JANET KOLODNER

Professor Janet Kolodner is a Regents' Professor in the School of Interactive Computing at the Georgia Institute of Technology. She was founding Editor-in-Chief of The Journal of the Learning Sciences and a founder of the International Society for the Learning Sciences, and she served as the society's first Executive Officer. Her research has addressed issues in learning, memory, and problem solving in computers and in people. She pioneered case-based reasoning (CBR), and her lab originated the notion of a case-based design aid (CBDA). She has been a leader in articulating the cognitive model that case-based reasoning implies and the applications and implications of case-based reasoning for education and creative problem solving.

Since 1994, Kolodner has focused on using this model to design science curriculum for middle school. Her approach, called Learning by Design™ (LBD), is a key foundational component of the comprehensive 3-year middle-school science curriculum called Project-Based Inquiry Science (PBIS). With her students, she has also applied the approach to informal education, most notably to design of Kitchen Science Investigators, an after-school program focused on learning science from cooking experiences. At present, she is on loan to the U.S. National Science Foundation, where she is lead Program Officer for a new funding program called Cyberlearning: Transforming Education.

Janet will deliver the opening keynote, "Envisioning the Next Generation Classroom and the Next Generation of Learning Technologies" on Tuesday afternoon. For more information see the full program listing for Tuesday.

MANU KAPUR

Manu Kapur is an Associate Professor of Curriculum, Teaching and Learning (CTL) and a researcher in the Learning Sciences Lab (LSL) at the National Institute of Education (NIE) of Singapore. An engineer by bachelors training, Manu taught mathematics to 12th graders in Singapore before getting his doctorate in instructional technology and media from Teachers College Columbia University, where he also completed a Master of Science in Applied Statistics. Manu conceptualized the notion of productive failure to explore the hidden efficacies in the seemingly failed effort of small groups solving complex problems collaboratively in an online environment. Over the past six years, Manu has done extensive work on productive failure in mathematics classrooms in Singapore, during which time, his research has also attracted interest and funding both locally and internationally.

Manu will deliver his keynote on Productive Failure on Wednesday morning. For more information see the full program listing.

JUDY KAY

Judy Kay is Professor of Computer Science at the University of Sydney and a principal in CHAI (Computer Human Adapted Interaction), leading research into advanced technologies for human computer interaction, personalization, pervasive and mobile interaction. She is Immediate Past President of the International Artificial Intelligence in Education Society (IAIED).

Her personalization research aims to empower people to harness and control the large amounts of data from their digital footprints, to support life-long and life-wide learning. The research ranges from direct mirrors with useful forms of that data in Open Learner Models, data mining to extract meaningful additional insights and personalized interfaces. Critical to this vision is that the user should always have a sense of control over the personalization. She works on innovative user interfaces, with software for surface computing such as interactive tabletop and wall displays. This explores the new ways that this emerging technology can help small groups to learn collaboratively and to learn how to collaborate more effectively.

Judy Kay's keynote, presenting a vision for lifelong learning as a driver for designing pervasive technologies, will take place on Thursday morning and is sponsored by NSW Trade & Investment. For more information see the full program listing.

ID	PARALLEL SESSION 1	Location
Sym1.2	**Symposium 1.2** Engaging Middle School-Aged Students in Classroom Science and Mathematics: Implications for Design and Research Kimberley Pressick-Kilborn, Melissa Gresalfi, K. Ann Renninger, Jessica Bachrach, Nicole Shechtman, Britte Cheng, Patrik Lundh, Gucci Trinidad, Richard Walker	**NL102**
FP1.1	**Full Paper Session 1.1** Learning how to create: Toward a learning sciences of art and design Sawyer, Keith Is Computer Support More Significant than Collaboration in Promoting Self-Efficacy and Transfer? Andreas Gegenfurtner, Marja Vauras, Koen Veermans Situating epistemological development Sandoval, William	**NL105**
FP1.2	**Full Paper Session 1.2** Investigating the Relative Difficulty of Various Complex Systems Ideas in Biology Sao-Ee Goh, Susan Yoon, Joyce Wang, Zhitong Yang, Eric Klopfer Multiple Trajectories for Understanding Ecosystems Catherine Eberbach, Cindy Hmelo-Silver, Rebecca Jordan, Suparna Sinha, Ashok Goel Understanding How Learners Grapple with Wicked Problems in Environmental Science Brian Slattery, Chandan Dasgupta, Tia Shelley, Leilah Lyons, Emily Minor, Moira Zellner	**NL107**
FP1.3	**Full Paper Session 1.3** Challenging Assumptions: using sliding window visualizations to reveal time-based irregularities in CSCL processes Gregory Dyke, Rohit Kumar, Hua Ai, Carolyn Rose The Impacts of Flexible Grouping in a Mobile-Assisted Game-based Chinese Character Learning Approach Lung-Hsiang Wong, Ching-Kun Hsu, Jizhen Sun, Ivica Boticki Processes of decision-making with adaptive combinations of wiki and chat tools Kate Thompson, Nick Kelly	**NL115**
SP1.1	**Short Paper Session 1.1** Collaborative Reading Comprehension with Communication Robots as Learning Partner Jun Oshima, Ritsuko Oshima, Naomi Miyake Inevitable breakdowns in putting argumentation into practice Baruch B. Schwarz, Nitza Shahar Memetic Processes as Conceptual Framework for Idea Improvement in Knowledge Building Karsten Krauskopf, Johanna Bertram, Ya Ping (Amy) Hsiao, Stefan Huber, Katherine Panciera, Nicole Strafling, Astrid Wichmann, Jan van Aalst Legitimate Peripheral Participation in Academic Communities of Practice - How Newcomers' Learning is Supported in Student Councils Julia Eberle, Karsten Stegmann, Frank Fischer Using Critical Reading Tools to Facilitate the Learning of Argumentation Skills Jingyan Lu, Nancy Law Developing Primary Students' Argumentation Skills in Inquiry-Based Mathematics Classrooms Jill Fielding-Wells, Katie Makar	**NL 117**

LUNCH BREAK :: 11.45 - 12.45 (NOT CATERED)

Lunches are not catered but there are plenty of options nearby. (See the CoCo's Rough Guide to Sydney for suggestions.)

ID		Location
M3	**Closed meeting** - ISLS Board Meeting	EA 116

PARALLEL SESSION 2 :: 12.45 – 14.15

ID	PARALLEL SESSION 2	Location
Sym2.3	**Symposium 2.3** **Building Upon What Is Already There: The Role of Prior Knowledge, Background Information, and Scaffolding in Inquiry Learning** Christof Wecker, Ard Lazonder, Jennifer Chiu, Cheryl Madeira, Jim Slotta, Yvonne Mulder, Ton de Jong, Alexander Rachel, Hartmut Wiesner, Peter Reimann	**EA Aud**
Pst2.2	**Poster Session 2.2** **Advancing understanding using Nonaka's model of knowledge creation and problem-based** learning Meng Yew Tee, Shuh Shing Lee **The Idea Manager: A tool to scaffold students in documenting, sorting, and distinguishing ideas during science inquiry** Camillia Matuk, Kevin McElhaney, Jennifer King Chen, David Miller, Jonathan Lim-Breitbart, Marcia Linn **Teacher education students' research training and e-research: current perspectives and potential for development** Carlos Gonzalez **Promoting teacher candidates' awareness for teaching dilemmas: A field experiment** Elisabeth Wegner, Iris Kaufmann, Matthias Nuckles **The Candy Factory Game: An Educational iPad Game for Middle School Algebra-Readiness** Michael Evans, Anderson Norton, Kirby Deater-Deckard, Mido Chang **Evaluating Claims in Popular Science Media: Nature of Science Versus Dynamic Epistemological Knowledge** Pryce Davis, Rosemary S. Russ **Adolescent profiles of knowledge and epistemic beliefs in the context of reading multiple texts** Leila Ferguson, Ivar Braten, Helge I. Strømsø, Øistein Anmarkrud **Enhancing students' understanding of what ideas are for knowledge building** Chieh-Hsin Chiu, Huang-Yao Hong	**NL100**
Sym2.4	**Symposium 2.4** **Learning as Identity Formation: Implications for Design, Research, and Practice** Rick Jochen, Ben DeVane, Tamara Clegg, Vanessa Peters, Nancy Songer, Susan R Goldman, Cindy Hmelo-Silver	**NL102**
FP2.4	**Full Paper Session 2.4** **Agent-based computer models for learning about climate change and process analysis techniques** Nick Kelly, Michael Jacobson, Lina Markauskaite, Vilaythong Southavilay **Using Heuristic Worked Examples and Collaboration Scripts to Help Learners Acquire Mathematical Argumentation Skills** Ingo Kollar, Stefan Ufer, Elisabeth Lorenz, Freydis Vogel, Kristina Reiss, Frank Fischer **Automatically extract interpretable topics from online discussion** Yonghe Zhang, Nancy Law, Yanyan Li, Ronghuai Huang	**NL105**
FP2.5	**Full Paper Session 2.5** **Inter-Identity Technologies for Learning** Robb Lindgren, Roy Pea **Examining the Adequacy of Students' Priors and Teacher's Role in Attention to Critical Features in Designing for Productive Failure** Pee Li Leslie Toh, Manu Kapur **Improving Revision in Wiki-based Writing: Coordination Pays off** Astrid Wichmann, Marina Becker, Nikol Rummel	**NL107**
FP2.6	**Full Paper Session 2.6** **Peer Collaboration and Mediation in Elementary Students' Lamp Designing Process** Kaiju Kangas, Pirita Seitamaa-Hakkarainen **Design Research in Early Literacy within the Zone of Proximal Implementation** Susan McKenney, Paul Kirschner, Joke Voogt **Learning Innovation Diffusion as Complex Adaptive Systems through Model Building, Simulation, Game Play and**	**NL115**

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Proceedings

Volume 1 - Full papers

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THE FUTURE OF LEARNING

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The University of Sydney, Sydney, NSW, AUSTRALIA

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Jan van Aalst, Kate Thompson, Michael J. Jacobson, and Peter Reimann

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ABOUT ISLS

ISLS is a professional society dedicated to the interdisciplinary empirical investigation of learning as it exists in real-world settings and how learning may be facilitated both with and without technology. ISLS sponsors two professional conferences, held in alternate years. The International Conference of the Learning Sciences (ICLS), first held in 1991 and held bi-annually since 1996, covers the entire field of the learning sciences. http://www.isls.org/

ABOUT "COCO" AT THE UNIVERSITY OF SYDNEY

ICLS 2012 is hosted by the Centre for Research on Computer Supported Learning and Cognition (CoCo) at the University of Sydney. CoCo's mission is to contribute to theory and research in the field of the learning sciences in order to discover how innovative learning technologies and pedagogical approaches can enhance formal and informal learning. CoCo is a University of Sydney Research Centre operating within the Faculty of Education and Social Work. http://sydney.edu.au/edsw/coco

PREFACE

Michael J. Jacobson, Peter Reimann, and Jan van Aalst

The international and interdisciplinary field of the learning sciences brings together researchers from the fields of cognitive science, educational research, psychology, computer science, artificial intelligence, anthropology, neuroscience, and other fields to study learning in a wide variety of formal and informal contexts. This field emerged in the late 1980s and early 1990s, with the first *International Conference of the Learning Sciences* (ICLS) being held in 1991 at Northwestern University in Evanston, Illinois, USA. Subsequent meetings of ICLS were held again in Evanston, USA (1996), and then in Atlanta, USA (1998), Ann Arbor, USA (2000), Seattle, USA (2004), Santa Monica, USA (2004), and Bloomington, USA (2006). The first ICLS to be held outside of North America was in Utrecht, the Netherlands (2008), and then back to the USA in Chicago (2010). The ICLS 2012 in Sydney is the first hosting of the conference in the Asia-Pacific region.

Papers for this conference were submitted in November 2011, and then went through a process of peer review. Full papers and symposia submissions received three anonymous reviews with a member of the Program Committee summarizing the reviews and making a recommendation. Short paper poster submissions went through the same process, except with two anonymous reviews. See Table 1 for a summary of the conference paper statistics.

Table 1. Paper submissions, acceptance, and rejection rates.

Full papers	264	
		Accepted as Full Papers: 65 (25%)
		Accepted as Short Paper: 54 (20%)
		Accepted as Poster: 42 (16%)
		Rejected: 103 (39%)
Short Papers	79	
		Accepted: 15 (19%)
		Accepted as poster: 11 (14%)
		Rejected: 53 (67%)
Posters	76	
		Accepted: 37 (49%)
		Rejected: 39 (51%)
Symposia	27	
		Accepted: 18 (67%)
		Rejected: 9 (33%)
Total Submissions:	446	

The final papers included in the *ICLS 2012 Proceedings* are for 18 symposia, 60 full papers, 61 short papers, and 62 poster papers, as well as abstracts for the four keynote talks and three special sessions, including the invited Presidential Session on *The Future of Learning,* and nine workshops.

The themes reflected in the papers and presentations at ICLS 2012 cover a wide range of issues and research areas. Some papers deal with long standing theoretical issues, such as *conceptual change* and *knowledge transfer*, whereas other papers report on new learning research in conventional subject areas such as *science*, *mathematics,* and *literacy*. Research is also reported on newer knowledge areas such as *complex systems*, as well as more recent

perspectives on pedagogy and learning such as *knowledge building*, *inquiry,* and *productive failure*. A number of learning sciences research projects internationally are also exploring ways in which innovative environments for learning may be designed with new technologies such *virtual and game environments, modeling and visualization systems, robotics, collaboration technologies, mobile and hand held devices,* and *educational data mining and learning analytics*. Emerging areas in learning sciences research that perhaps may lead to newer perspectives and directions in our understanding of learning include *creatively*, *identity*, and *embodied cognition*. The field continues to engage the broad issues of contributing to and impacting policy and practice more generally. Overall, the research presented in the proceedings of ICSL 2012 contributes numerous perspectives on the conference theme of *the future of learning*, both as trajectories of research that have been maturing over a number of years and bold new perspectives that promise to shape new trajectories for the future.

Making this conference possible, we thank the hard work and the countless hours put in by our international Conference Advisory Board and the various conference sub-committees. We would like to thank all those who assisted with the review process. The Conference is also fortunate to have a number of financial sponsors whose support contributes to conference events: *NSW Trade & Investment, Smart Services Collaborative Research Centre, United States National Science Foundation, The International Society of the Learning Sciences, Asia-Pacific Society of Computers in Education, Inquirium, LLC, and The Centre for Research on Computer Supported Learning and Cognition*.

Any conference is but a snapshot in the dynamic process of articulating and vetting scientifically principled ideas and approaches. That the *International Conference of the Learning Sciences* has now had its 10th meeting and has entered its third decade are exciting milestones that this proceedings helps to document. We close by reflecting that just as a great movie is about the journey of discovery and development that the characters experience, so might our research field be a journey of discovery and development to more deeply understand how people learn now and as the future unfolds, knowing *learning* itself as a core essence of life and our humanity.

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