

# **“ITR/EFW: Collaborative Research on Knowledge-Building Environments: Growing a National and International Research Community for Distance Learning Information Technology”**

## ***Project Summary***

Knowledge-Building Environments (KBEs) are software systems to support collaborative distributed learning. This is a complex research area that has made significant progress in the past decade but that will require substantial work by an international research community to achieve its potential in the next decade. Active research networks have been established in many countries, but there is no organized network of KBE researchers in the US to work collaboratively within this international community.

Coordinated multi-disciplinary work is needed at the levels of theory refinement, software design, and curriculum development. Many of the necessary enabling elements are becoming available now for progress in developing this new KBE information technology that will meet rapidly growing societal requirements: theories of learning that recognize the role of social context; technologies for building and combining software components; experiments in structuring effective distance collaborative learning; and networks of researchers in other countries. This project will build on these elements in the following areas:

- ◆ *Learning Theory*: synthesizing theoretical approaches into an analysis of social knowledge-building, oriented toward the design of software to support collaborative distance learning;
- ◆ *Information Technology*: defining technical standards for the interoperability of KBE data, knowledge-base servers, Web interface components, and agent widgets from different research prototypes;
- ◆ *IT Education*: developing curriculum, course methods, and assessment measures for educating multi-disciplinary students in the theory, design, and educational use of KBEs;
- ◆ *IT Workforce and International Collaboration*: involving students and researchers in hands-on software design and the sharing of design ideas in face-to-face workshops and in Web-based discussion, and growing a network of researchers and students in the US to work with researchers abroad.

The project will expand over five years from one grantee (Colorado) and three subawards (Berkeley, Cornell, Southern Illinois) to five collaborative grantees and five subawards, directly supporting from 9 to 21 students each year and involving many more in courses and conference workshops. The project will create an active research community, involving educators and technologists together, enhancing the utility, scope, and depth of IT support for knowledge-building activities. This will create a workforce capable of turning the potential of distance learning into a classroom and workplace reality, using the theories, technologies, and methodologies developed in this project through international collaboration.

## *Project Description*

### **Problem Statement**

“Long-distance learning is skyrocketing” according to an Associated Press article (December 19, 1999). Already in 1997/98, 60% of colleges offered Internet classes, with 54,000 different courses enrolling 1,600,000 students. Yet, the technology and methodology for designing Internet courses is still very poorly understood. Most teachers simply put traditional course materials on the Web, ignoring the potential of computational support. At best, they use generic communication technologies (like First Class, NetMeeting, Lotus Notes/Domino) that were not designed to support learning, or they use systems that administer and deliver traditional materials (like WebCT or LearningSpace) but do not go beyond this (Cameron et al., 1999).

The educational research community of the past decade has established a consensus that traditional lecture-based and teacher-centered approaches do not by themselves produce the most effective learning. Students should be actively involved in constructing their own understanding within collaborative social contexts. Students in a course should function as a community of learners, community of practice, or knowledge-building community (Brown & Campione, 1994; Brown & Duguid, 1991; Lave, 1991; Scardamalia & Bereiter, 1996). Active student projects that provide authentic motivation can form the core of a problem-based learning (PBL) approach (Barrows, 1994). Computer-based tools should be designed to support the collaborative knowledge-building process. Although there is broad agreement that methodologies and tools are needed for computer support of collaborative learning (CSCL), these have yet to be developed.

Important initial steps have been taken to formulate theories, try out prototype systems, develop pedagogical methodologies, and experiment with innovative courses (Hoadley & Roschelle, 1999). These steps have provided enough experience to demonstrate how much is left to do and to indicate a path for further research. There is an assortment of theoretical approaches that seem vaguely complementary, but no synthesis that provides a coherent framework for designing courses and knowledge-building environments (KBEs). One software system – CSILE (Scardamalia & Bereiter, 1996), now Knowledge Forum – has been under development for over a decade and has been widely fielded and assessed. A number of other prototypes are being designed and investigated to explore alternative functionalities: CoWeb (Guzdial et al., 1999), WEBGUIDE (Stahl, 1999b), WISE (Cuthbert, 1999), CoVis (Pea, 1993), FLE (Muukkonen et al., 1999). These attempts to support collaboration repeatedly run into the same technical and social problems: low participation levels, shallow discussions, divergence of ideas, little building of deep knowledge structures (dePaula, 1998; Guzdial et al., 1999; Guzdial & Turns, forthcoming; Hewitt et al., 1998; Hewitt & Teplovs, 1999; Stahl, 1999a, 1999b, 1999c). The overcoming of these barriers to collaborative learning remains an open research issue.

Experience indicates that the design of the KBE “killer app” is too complex for any one research group. The theoretical, technical, and pedagogical issues are deeply intertwined and each still requires basic research. A high-functionality system is needed, unlike the self-contained functions of email, the Web, or e-commerce. An international research community is emerging to address this challenge, with energetic research networks and international virtual universities in a number of countries. Unfortunately, there is no coordinated effort within the United States which can relate to these networks abroad. We need to develop a multi-disciplinary community which can understand and advance the theory, technology, and pedagogy; can disseminate that understanding in carefully conceived courses; and can interact in the international community.

## **Project Goals**

*Learning Theory:* To synthesize and adapt current theories of computer supported collaborative learning to define a conceptual framework for the design of knowledge-building environments.

*Information Technology:* To propose, negotiate, and promote interoperability standards for data and components of knowledge-building environments.

*IT Education:* To develop and test content and methodology for multi-disciplinary, problem-based courses on information technology for distance learning.

*IT Workforce and International Collaboration:* To build a US network of established researchers and new students in the field of computer supported collaborative learning that can collaborate with networks in other countries on information technology for distance learning.

## **Research Issues**

*Learning Theory:* How can current theories be synthesized into a coherent view of knowledge-building processes and how can this guide the design of software?

*Information Technology:* How can standards be defined for interoperability of KBE data, knowledge-base servers, Web interface components, and agent widgets to promote exploration without restricting software design options?

*IT Education:* How can problem-based learning be adapted to distance learning? What software can support this? What constitutes an effective curriculum (problem case-base) for coverage and depth concerning information technology for distance learning?

*IT Workforce and International Collaboration:* How can a productive network of US researchers be established, grown, and sustained so they can collaborate with distance learning research networks in other countries?

## **Project Objectives**

*Learning Theory:* To produce a series of white papers that are discussed by the project community and then published.

*Information Technology:* To establish a set of interoperability standards, examples, and tools.

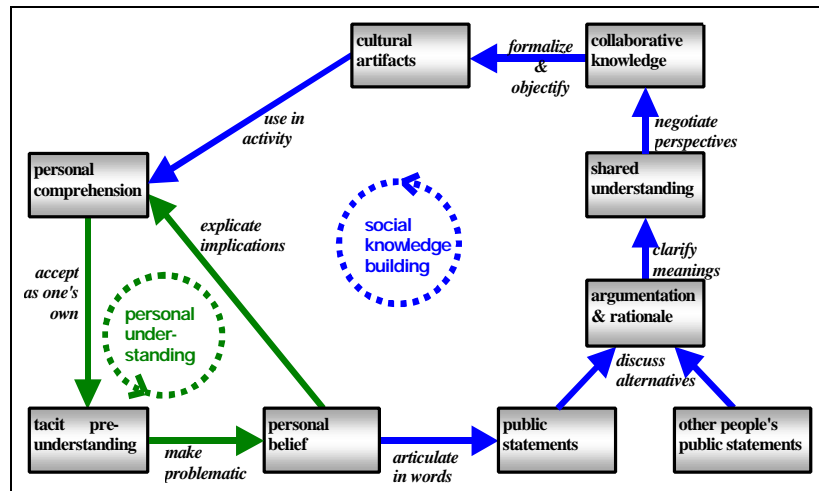
*IT Education:* To develop and test a sequence of courses on the technology and pedagogy of distance learning.

*IT Workforce and International Collaboration:* To organize periodic workshops for project members, students, and international collaborators and to provide Web-based media for project reports and discussions between workshops.

## **Theoretical Framework**

This project focuses on a particular approach to CSCL – namely the Web-based support of collaborative knowledge-building (KBE) – and a particular approach to instructional design – namely problem-based learning (PBL). While face-to-face PBL is an established method, the design of distributed PBL using KBEs is very much a current research topic (Cameron et al., 1999). To provide a framework for the design of KBEs to support distributed PBL, the project will synthesize and refine a set of currently accepted theoretical approaches from the perspective of guiding software design.

The diagram below (from Stahl, 2000) provides a starting point for this, combining aspects of activity theory, situated learning, hermeneutic philosophy, and distributed cognition theory.



The idea of this diagram is that the knowledge-building process can proceed through many different phases. A KBE can be designed to support a number of these phases with different functionality. A similar approach is being developed in Finland (Muukkonen et al., 1999).

### Technology Approach

Many ideas of KBE functionality have been tried out and a number of promising new features and approaches have been proposed. The problem is how to combine various sets of features into a technically and pedagogically coherent system. In order to allow functions from different prototypes to be recombined to explore new system configurations, we need to achieve interoperability of data, servers, components, and widgets.

The PI has already begun to define an XML standard for interchange of threaded discussion data, which forms the core of many KBEs. Data from four different prototype systems used at Colorado have been exported to the XML standard, where they can be displayed in XSL and analyzed by simple text manipulation tools. Work has already begun on separating a perspectives server out from the PI's WEBGUIDE KBE (Stahl & Thomas, 1999), so that Web client interfaces developed using HTML, Perl, or Java can easily access a shared knowledge-base without worrying about the database or perspectives computation internals. Java beans technology provides a technical foundation for programming components and widgets that can be mixed and matched in alternative systems. So the technology for interoperability seems within reach.

The problem is to agree on standards within the KBE community. The goal is for someone to be able to combine, for instance, a knowledge-base server from Colorado's WEBGUIDE, a discussion interface from Toronto's CSILE, domain scaffolding from Berkeley's WISE, and a design module from Helsinki's FLE with some innovative notification agent widget. Then they can assemble a system to test the effectiveness of their new agent widget (McLean, 1999) without having to build a whole system from scratch. The data from their experiment can then be exported to XML and analyzed with existing tools to compare the results with those of other systems.

The definition of interoperability standards requires international collaboration. Although many researchers are informally converging toward a common set of technologies (SQL backends,

Java servers, Web-based clients, threaded discussion), the KBE software field is still very immature. It will be important to devise standards that foster experimentation rather than restrictions that limit design options. That is a tricky research issue.

### **Curriculum Development**

The starting point for curriculum development in this project is provided by the work of the Problem Based Learning Institute (Cameron et al., 1999) and the Canadian CollabU (Breuleux et al., 1999). The PBLI has tried to support distributed PBL with commercial communication tools, and has identified specific needs for customized KBE software. CollabU has begun to experiment with a course on learning technology taught at five different universities, with students divided into cross-campus projects. The PI has also conducted two multi-disciplinary seminars using KBE prototypes for class discussion: one on the theory of KBEs and one project-based course of KBE research with students at Colorado and Dortmund.

This project will begin by working with PBLI and CollabU, participating in their experiments and offering our own multi-campus courses. Our courses will focus on the wicked problems of KBE software design and will use various KBE prototypes.

During the grant period, we will develop both a curriculum and an instructional methodology for courses on information technology for learning. The methodology will define an approach to distributed learning design, incorporating and adapting techniques that have proven successful in face-to-face PBL. The use of appropriate technologies will be described. The methodology will emerge from our experimental courses. Course content will cover theory, pedagogy, and technology. It will be aimed at a multi-disciplinary undergraduate and graduate audience, as well as at classroom teachers, distance education instructors, and workplace trainers.

### **Community Building**

The PIs of this proposal will be hosting the next CSCL conference (December 2001) and the next GROUP conference (October 2001) at the University of Colorado. Project participants will also be active in the European CSCL (December 2000) at Maastricht in the Netherlands, as well as meetings of ICLS (International Conference of the Learning Sciences), CILT, AERA, CHI, Cognitive Science, WebNet, CSCW, and other important international meetings of computer science and education researchers.

At CSCL '99, the PI (with Marlene Scardamalia and Timothy Koschmann) planned and conducted a successful workshop with over 60 participants from the US and abroad on "Collaborating on the Design and Assessment of Knowledge-Building Environments in the 2000's". Many of the ideas and prospective participants of this project were involved in that workshop, which itself grew out of an earlier working group at CILT '99 (the NSF-supported Center for Innovative Learning Technologies). This proposal is a product of collaboration funded by a CILT seed grant intended to stimulate collaboration among KBE researchers.

International conferences provide a convenient venue for national and international collaborators to meet face-to-face as a supplement to Internet-mediated communications. This project will organize four meetings per year for project participants and collaborators to get together. Two of these will be day-long organized conference workshops where people will exchange and discuss their project work results. The other two will be informal SIGs where people can socialize and exchange ideas one-on-one. Some of the meetings will be in Europe; some will take place at

research labs. The project will support some costs of student participants to attend these meetings and international conferences.

The building of a national and international collaboratory is an explicit aim of this project. In addition to involving people as project participants (collaborating PIs, subaward recipients, student researchers) and as students in project courses, the on-going work of the project will be publicized widely. Articles in conference proceedings and journals will be important, with shared focus and special tracks or special issues arising naturally from the project identity. In addition, a project newsletter will be circulated by email and Web, and discussion forums on project topics will be supported by the KBEs that emerge from the project.

**National Collaboration**

In years 2 through 5, from 2 to 4 other universities will be added to this project as collaborative institutions. Each will submit a collaborative research proposal with biographical information about their PI and a budget to support a graduate student and an undergraduate student to work on this project. Each collaborative budget will run about \$120,000 per year. Collaborating institutions will be selected as part of the work of the project, with the following institutions tentatively interested at this time (more details in full proposal):

<i>Institution</i>	<i>PI</i>
Stanford	Christopher Hoadley
Berkeley	Jim Slotta
Georgia Tech	Mark Guzdial
Hawaii	Daniel Suthers

<i>Project Year</i>	<i>Number of Institutions</i>	<i>Total Project Budget</i>
1	1 (Colorado)	\$510,000
2	3	\$740,000
3	4	\$869,000
4	5	\$990,000
5	5	\$990,000

**International Collaboration**

There are now active KBE research networks in the following countries who have expressed strong interest in collaborating with this project (more details in full proposal):

<i>Canada</i>	OISE Toronto	Marlene Scardamalia and Robert McLean
<i>Finland</i>	Helsinki & Turku	Kai Hakkarainen and Erno Lehtinen
<i>Norway</i>	Oslo & Bergen	Anders Morch
<i>Germany</i>	GMD & Dortmund	Wolfgang Prinz and Thomas Herrmann
<i>Canada</i>	TeleLearning NCE	Alain Breuleux and Tom Calvert
<i>Mexico</i>	Monterrey Virtual U	Jose Rafael Lopez Islas
<i>United Kingdom</i>	Open University	Simon Buckingham Shum

**Anticipated Impact**

This project will establish a new research focus on KBE design and a national network of established researchers and new students that will significantly contribute to an existing international collaboration exploring this field of information technology. It will produce enabling theories, technologies, and pedagogies to support the efforts of this new workforce to move KBEs from research prototypes to robust IT systems that can fulfill growing societal requirements. Effective KBEs will provide a new paradigm of collaborative knowledge management, exploiting the online availability of information with more powerful means than are currently available.

## *References Cited*

Papers from CSCL '99 are available at the conference website. Papers by the PI are available at: [www.cs.colorado.edu/~gerry/publications/](http://www.cs.colorado.edu/~gerry/publications/)

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## ***Biographical Sketch of Gerry Stahl, PI***

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### **Education**

#### **University of Colorado**

1993 Ph.D. in Computer Science  
1990 M.S. in Computer Science

#### **Northwestern University**

1975 Ph.D. in Philosophy  
1971 M.A. in Philosophy

#### **University of Frankfurt**

1973 Graduate study in critical social theory

#### **University of Heidelberg**

1968 Graduate study in continental philosophy

#### **Massachusetts Institute of Technology (MIT)**

1967 B.S. in Humanities & Science (Math & Philosophy)

### **Professional Experience**

#### **Research Professor**

1999-present Department of Computer Science and  
Institute of Cognitive Science, Boulder, CO

#### **Post Doctoral Research Fellow**

1996-1999 Center for LifeLong Learning and Design, Boulder, CO

#### **President**

1995-1996 Personalizable Software, Niwot, CO

#### **Director of Software R&D**

1993-1996 Owen Research Inc., Boulder, CO

#### **Graduate Research Assistant**

1990-1993 College of Environmental Design, Boulder, CO

#### **Intern Interface Developer**

1990-1991 US West Advanced Technology, Denver & Boulder, CO

#### **Computer Science Instructor & Teaching Assistant**

1989-1990 University of Colorado, Boulder, CO

#### **Executive Director**

1984-1989 Community Computerization Project, Philadelphia, PA

#### **Planning and Evaluation Specialist**

1979-1984 Southwest Germantown Community Devel. Corp., Philadelphia, PA

#### **Community Organizer & VISTA Supervisor**

1978-1979 Philadelphia Council of Neighborhood Organizations, Philadelphia, PA

#### **Systems Programmer**

1974-1977 Temple University, Philadelphia, PA

1970-1971 Northwestern University, Evanston, IL

1969-1970 Temple University, Philadelphia, PA  
**Applications Programmer**  
Summer 1966 Brown Bovari Cie, Baden, Switzerland  
Summer 1965 University of Pennsylvania, Philadelphia, PA

### **Related Publications:**

- Stahl, G. (1996) Armchair missions to Mars: Using case-based reasoning and fuzzy logic to simulate a time series model of astronaut crews, *Knowledge-Based Systems*, 9, pp. 409-415. Available at:  
<http://www.cs.colorado.edu/~gerry/publications/journals/crew/index.html>.
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<http://www.cs.colorado.edu/~gerry/publications/journals/c&e/>.

### **Major Recent Grants (last 3 Years)**

- *Education & IT*: 1997-2000: "Allowing Learners to be Articulate: Incorporating Automated Text Evaluation into Collaborative Software Environments" (primary author and primary software developer; PIs: Gerhard Fischer, Walter Kintsch and Thomas Landauer) \$678,239; Sponsor: James S. McDonnell Foundation
- *Learning Theory & IT*: 1997-2000: "Conceptual Frameworks and Computational Support for Organizational Memories and Organizational Learning" (co-PI with Gerhard Fischer and Jonathan Ostwald), \$725,000; Sponsor: NSF
- *International Collaboration & IT*: 1999-2000: "Interoperability among Knowledge Building Environments" (PI) \$9,124; Sponsor: Center for Innovative Learning Technology / SRI
- *Education & IT*: 1998- 1999: "Collaborative Web-Based Tools for Learning to Integrate Scientific Results into Social Policy" (co-PI with Ray Habermann) \$89,338; Sponsor: NSF

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### **PROFESSIONAL EXPERIENCE AND EDUCATION**

- 1994-present Director, Center for LifeLong Learning and Design, University of Colorado, Boulder
- 1988-present Full Professor, Computer Science Department, Member of the Institute of Cognitive Science, University of Colorado, Boulder
- 1984-1988 Associate Professor (with tenure), Computer Science Department, Member of the Institute of Cognitive Science, University of Colorado, Boulder
- 1978-1984 Assistant Professor, Computer Science Department, University of Stuttgart
- 1977 PhD in Computer Science, University of Hamburg, Germany

### **MEMBER OF EDITORIAL BOARDS (BOOK SERIES, INTERNATIONAL JOURNALS):**

- Book Series “Computer-Supported Collaborative Learning”, Kluwer Academic Publishers
- International Journal “Knowledge-Based Systems”, Butterworth-Heinemann, Oxford, UK
- International Journal “Interacting with Computers”, British Computer Society & Butterworths Publishing
- International Journal “User Modeling and User-Adapted Interaction”, Kluwer Academic Publishers
- International Journal “Automated Software Engineering”, Kluwer Academic Publishers

### **KEYNOTE SPEECHES (LAST 2 YEARS)**

- **1999** — UM99 (User Modeling) Conference (Editor: Judy Kay), "User Modeling: The Long and Winding Road", Banff, Canada, June
- **1999** — ICCE 99, 7th International Conference on Computers in Education on "New Human Abilities for the Networked Society", Lifelong Learning: Changing Mindsets", Chiba, Japan, November
- **1998** — International 'bauhaus der kommunikation' Symposium 1998, Paderborn, Germany, June
- **1998** — 3rd Asia Pacific Computer Human Interaction Conference, IEEE Computer Society, Japan, July
- **1998** — ACM Japan Annual Meeting, “Lifelong Learning—New Challenges and Opportunities for Computer Science”, Japan, July
- **1998** — International Symposium “Artificial Intelligence in Structural Engineering”, Ascona, Switzerland, July

## RESEARCH INTERESTS

- **Human-Computer Interaction:** human problem-domain communication, useful and usable systems, dynamic media, convivial systems
- **Artificial Intelligence:** knowledge-based systems, intelligent support systems (e.g. critics, advisors, coaches), user modeling, collaborative problem-solving systems
- **Education and Computers:** learning on demand, learning-on-the-job, just-in-time learning, lifelong learning, motivation, multimedia, AI and education
- **Design:** integration of problem framing and problem solving, reflection-in-action, breakdowns, design memories
- **Cognitive Science:** learning environments, mental models, design principles for comprehensible systems
- **Software Engineering:** object-oriented architecture, programming environment, design, reuse, redesign, domain-oriented, design environments

## MAJOR GRANTS AND FINANCIAL SUPPORT (LAST 3 YEARS)

- 1997-2000: "Allowing Learners to be Articulate: Incorporating Automated Text Evaluation into Collaborative Software Environments" (with W. Kintsch and T.K. Landauer), \$678,239; Sponsor: James S. McDonnell Foundation
- 1997-2000: "Explorations in the Design of Future Computational Systems for Every-Day Life", \$450,00, Sponsor: PFU, Ltd., Tokyo, Japan
- 1997-2000: "Conceptual Frameworks and Computational Support for Organizational Memories and Organizational Learning" (with J. Ostwald and G. Stahl), \$725,000; Sponsor: NSF
- 1996-1999: "Lifelong Learning - Bringing Learning Activities to Life" (with M. Eisenberg, H. Eden, and A. Repenning), \$1,935,996; Sponsor: NSF

## SELECTED PUBLICATIONS:

- "Lifelong Learning: Changing Mindsets", Proceedings of ICCE 99, 7th International Conference on Computers in Education on "New Human Abilities for the Networked Society", November 4-7, 1999, Chiba, Japan (in press)
- "Social Creativity, Symmetry of Ignorance and Meta-Design", Proceedings of Creativity & Cognition 1999, L. Candy and E. Edmonds, eds., ACM Press, pp 116-123.
- "Seeding, Evolutionary Growth and Reseeding: Constructing, Capturing and Evolving Knowledge in Domain-Oriented Design Environments", International Journal "Automated Software Engineering," Kluwer Academic Publishers, Dordrecht, Netherlands, Vol. 5, No.4, October 1998, pp. 447-464.
- "Embedding Critics in Design Environments" (with K. Nakakoji, J. Ostwald, G. Stahl, T. Sumner). In M. Maybury, W. Wahlster, eds., Readings in Intelligent User Interfaces, Morgan Kaufman Publishers, San Francisco, 1998, pp. 537-561.
- "Computational Environments Supporting Creativity in the Context of Lifelong Learning and Design", (with K. Nakakoji), Special Issue of the International Journal "Knowledge-Based Systems," Elsevier Science B.V., Oxford, UK, 10, pp. 21-28.

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### **EDUCATION**

1982	BS in Earth Science	University of California, Santa Cruz
1985	BA in Computer Science	University of California, Santa Cruz
1992	Masters in Computer Science	University of Colorado at Boulder
1995	PhD in Computer Science	University of Colorado at Boulder

### **RECENT PROFESSIONAL EXPERIENCE**

1999-present	Assistant Professor, Center for LifeLong Learning and Design, University of Colorado
1996-1998	Lecturer, Knowledge Media Institute, The Open University, United Kingdom
1990-1995	Research Assistant, Computer Science Department, University of Colorado
1983-1989	Member of Technical Staff, Hewlett-Packard, Santa Clara, California

### **RESEARCH INTERESTS**

**Socio-technical Design:** technology-use mediation, adaptive structuration, participatory design.

**Education and Educational Technology:** open learning course design, evolutionary course design, workplace learning, organizational learning, collaborative learning.

**Interactive Publishing:** learning conversations, community-based publishing, new models of scholarly discourse, knowledge-enriched intranets, digital libraries.

**Human-Computer Interaction:** work practice analyses, media integration, interaction design.

### **SELECTED GRANTS AND FINANCIAL SUPPORT**

**GDL: Collaborative Research for a Geoscience Education Digital Library**, 1999-2001, \$1.2 million, Awarded by the NSF, to create a usable version of the library that helps faculty find, evaluate, use, and create resources that support active learning in undergraduate Earth system science, Co-Principal Investigator.

**ENRICH: Enriching Representations of Work to Support Organisational Learning**, Awarded by the ESPRIT Thematic Call "IT for Learning and Training in Industry", EU Fourth Framework Programme – DG XIII, Principal Investigator and Primary Author.

**Towards Designing Scholarly Documents for the World Wide Web**, Awarded by the British Council Alliance Program for Franco-British Joint Research, Evaluated the usefulness and usability of the Digital Document Discourse Environment (D3E) for supporting collaborative learning and interactive publishing by faculty and students. PI with Nathalie Bonnardel of the Universite de Provence, France.

## RECENT DESIGN AWARDS

**1998 – British Computer Society IT Award** for the design of M206 Computing: An Object-oriented Approach. This multiple media, open-learning course is based on an innovative interactive teaching model that encompasses both traditional media (text and television) and digital media (web resources, CD-ROMs, conferencing system). The course serves 5000 students annually at The Open University in the UK.

**1996 – Charlesworth Group Awards for Electronic Journals** for the design of JIME, the Journal of Interactive Media in Education. The panel found this title ‘the most innovative entry with the greatest potential’. This journal is published using D3E, offering open interactive peer review and commentary as well as embedded interactive demonstrations and simulations.

## FIVE MOST RELEVANT PUBLICATIONS

Sumner, T. and S. Buckingham Shum, "From Documents to Discourse: Shifting Conceptions of Scholarly Publishing," *Human Factors in Computing Systems (CHI '98)*, Los Angeles (April 18-23), 1998, pp. 95-102.

Sumner, T. and J. Taylor, "New Media, New Practices: Experiences in Open Learning Course Design," *Human Factors in Computing Systems (CHI '98)*, Los Angeles (April 18-23), 1998, pp. 432-439.

Sumner, T. and J. Taylor, "Media Integration through Meta-learning Environments", in "*The Knowledge Web: Learning and Collaborating on the Net*", M. Eisenstadt and T. Vincent (eds.), Kogan Page, London, 1998, pp. 63-78.

Sumner, T. R., N. Bonnardel and B. Kallak Harstad, "The Cognitive Ergonomics of Knowledge-Based Design Support Systems," *Human Factors in Computing Systems (CHI '97)*, Atlanta, Georgia (March 22-27), 1997, pp. 83-90.

Sumner, T. (1995). The High-Tech Toolbelt: A Study of Designers in the Workplace, *Human Factors in Computing Systems (CHI '95)*, Denver, CO (May 7-11), pp. 178 – 185.

## RECENT PROFESSIONAL SERVICE

Co-editor and co-founder of The Journal of Interactive Media in Education, <http://www-jime.open.ac.uk>, 1996 to present.

International Journal of Human-Computer Interaction (IJHCS) - Editorial Board, Special Issue on World Wide Web Usability, Academic Press, 1997.

Program Committee: Asia Pacific Computer Human Interaction Conference (APCHI '98)

Organizer and Program Committee: International Conference on Software Engineering (ICSE 2000), Special 'Software Engineering and Education' Track

Keynote Speaker: Canadian Library Association, June 1999 (CLA '99)

## ***Biographical Sketch of Geri Gay, subawardee***

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607/255-7737 (e-mail: gkg1@cornell.edu); www.hci.cornell.edu

### **Education**

Ph.D., Cornell University, Ithaca, New York, Educational Psychology, Organizational Communication & Evaluation, 1985.

M. P. S., Cornell University, Ithaca, New York, Communication 1980.

B. A., University of Maine, Orono, Maine, English and Biology, 1972.

### **Current**

Geri Gay is Associate Professor of Communication at Cornell University and director of the Human-Computer Interaction Group (HCI Group). The HCI Group is a research and development group whose members design and research the use of computer-mediated learning environments. Professor Gay's research interests focus on cognitive and social issues for the design and use of interactive communication technologies. Past research has explored navigation issues, knowledge management, mental models and metaphors, knowledge representations, collaborative work and learning, and system design.

Professor Gay has received funding for her research and design projects from the National Science Foundation (NSF), the National Endowment for the Humanities (NEH), the Mellon Foundation, Intel, GE Foundation, IBM, Getty, and several private donors. She teaches courses in interactive multimedia design and research, computer-mediated communication, human-computer interaction, and the social design of communication systems.

### **Related Publications**

Gay, G., and Benington, T., eds. (1999). Information technologies in evaluation: Social, moral, epistemological and practical implications. In *New directions for evaluation*, no. 84, San Francisco: Jossey-Bass Inc.

Gay, G., Rieger, R., Martin, W. and Korf, N. (1999). "GDM user interface design." "Global digital museum prototype evaluation." and "Discussion on future directions of global digital museum: Museum and GUI." Chapters in *Senri ethnological report, global digital museum for museum education on the Internet*. Sugita, S., Hong, J-K., Reeve, J. and Gay, G. (eds.). Osaka, Japan: National Museum of Ethnology.

Kilker, J. and Gay G., (1998). The social construction of a digital library: A case study examining implications for evaluation. *Information Technology and Libraries*.

Takahashi, J., Kushida, T., Hong, J. K., Gay, G., & Rieger, R Suguta, S. Kurita, Y., Reeve, J. Lovrance, R.,. (1998). Multimedia information access on the internet: An approach in global digital museum. In Proceedings of the *ACM International Conference on Digital Libraries*, Pittsburgh, PA, USA.

Gay, G., Bohner, K., & Panella, T. (1997). ArtView: Transforming image databases into collaborative learning spaces. *Educational Computing Research*, 15(4), 317-332.



## ***Biographical Sketch of Timothy Koschmann, subawardee***

### **Campus Address:**

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**e-mail:** tkoschmann@acm.org

**home page:** <http://edaff.siumed.edu/tk/>

### **Education**

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University of Missouri-Kansas City (B.A., Philosophy, 1972).  
University of Wisconsin-Madison (equiv. of B.S., Psychology, 1976).  
University of Wisconsin-Milwaukee (M.S., Psychology, 1980).  
Illinois Institute of Technology (Ph.D., Computer Science, 1987).

### **Post-Doctoral Professional Experience**

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Southern Illinois University  
Asst. Professor, Dept. of Medical Education (1988–1994).  
Asst. Professor, Computer Science Dept. (1988-1992).  
Assoc. Professor, Dept. of Medical Education (1994-present).  
Institute of Cognitive Science, U. of Colorado at Boulder  
Visiting Associate Professor (1997–1998).

### **Pre-Doctoral Professional Experience**

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Senior Scientific Analyst, Abbott Laboratories (1978–1983).  
Adj. Assoc. Professor, University of Wisconsin-Parkside (1981–1982).  
Chief Computer Scientist, Chicago Medical School (1983–1985).  
Sr. Member Eng. Staff, Xerox Artificial Intelligence Systems (1985–1988).

## **Biographical Listings**

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Dictionary of International Biography (26th Ed.)  
International Who's Who of Information Technology  
Who's Who in American Education (4th Ed.)  
Who's Who in the Midwest (26th Ed.)  
Who's Who in Science and Engineering (3rd Ed.)

## **Books**

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**Koschmann, T.** (1990). *The Common Lisp companion*. New York: John Wiley & Sons.

**Koschmann, T.** (Ed.)(1996). *CSCL: Theory and practice of an emerging paradigm*. Mahwah, NJ: Lawrence Erlbaum.

Miyake, N., Hall, R., & **Koschmann, T.** (Eds.)(in prep). *CSCL2: Carrying forward the conversation*. Mahwah, NJ: Lawrence Erlbaum.

## **Other Publications**

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**Koschmann, T.**, Feltovich, P.J., Myers, A.C., & Barrows, H.S. (1992). Implications of CSCL for problem-based learning. *ACM SIGCUE Outlook*, 21(3), 32–35.

**Koschmann, T.** (1994). Toward a theory of computer-support for collaborative learning. *Journal of the Learning Sciences*, 3, 218–224.

## ***Biographical Sketch of Christopher Hoadley, subawardee***

### **CHRISTOPHER M. HOADLEY**

Research Scientist  
Center for Technology in Learning  
SRI International  
333 Ravenswood Avenue, Menlo Park, CA 94025-3493

Consulting Assistant Professor of Learning  
Design, and Technology  
Stanford University  
321 Cubberly Hall, Stanford, CA 94305-3096

### **Specialized Professional Competence**

Software design, development, and evaluation: website development, virtual communities, human-computer interaction, groupware for knowledge management and learning  
Psychology and learning: Cognitive science of learning, distributed intelligence, science education, collaborative learning, design cognition, computer programming cognition

### **Representative Assignments**

Co-Principal Investigator, Collaborative Learning in Engineering Using Immersive Multimedia: Co-designer and evaluator for innovative graduate engineering course  
Research Scientist and Technical Lead, CILT Knowledge Network. Design, implementation, and evaluation of software for knowledge management and researcher collaboration  
Research Scientist and Designer, Science Forum. Design and implementation of software for recommending educational web resources to teachers  
Research Associate, *Distant Mentor* project. Design of studies to evaluate joint problem solving in telepresence, intelligent user interface for industrial engineering

### **Other Professional Experience**

Participant, Santa Fe Institute, Summer program in Complex Systems  
Research Assistant, University of California, Berkeley, School of Education  
Project Leader, SYNTHESIS National Engineering Education Coalition  
Teaching Assistant, University of California, Berkeley, Cognitive & Computer Science Depts.  
Instructor, Exploration enrichment program, Wellesley College  
Tutor, Experimental Study Group, Massachusetts Institute of Technology  
Researcher, Media Lab, Massachusetts Institute of Technology

### **Academic Background**

Ph.D.	1999	University of California, Berkeley (Science and Math Education)
M.S.	1998	University of California, Berkeley (Computer Science)
B.S.	1991	Massachusetts Institute of Technology (Brain and Cognitive Sciences)

### **Selected Professional Associations and Honors**

Cognitive Science Society, Association for Computing Machinery, American Educational Research Association (prior Sec'y/Treas: SIG: Advanced Technologies for Learning, and prior Chair, Special Interest Group on Education in Science and Technology)  
Member of Review Board, Journal of the Learning Sciences. Regents Fellowship, UC Berkeley (1991-92,1992-3); Evelyn Lois Corey Fellow (1995); NSF Graduate Traineeship, Science and Design (1997-98)

### **Related Publications**

Hoadley, C. M., & Bell, P. (1996, Sept.). Web for your head: the design of digital resources to enhance lifelong learning. *D-Lib Magazine*.

Hoadley, C. M., Fishman, B., (1997, April). Communication, Collaboration, and Computers: What do we think we know about networks and learning?, *Annual Meeting of the American Educational Research Association* . Chicago, IL.

Hoadley, C. M., & Hsi, S. (1993). *A multimedia interface for knowledge building and collaborative learning*. In Adjunct proceedings of the International Computer Human Interaction Conference (InterCHI) '93, Amsterdam, The Netherlands.

Hsi, S., & Hoadley, C. M. (1997). Productive discussion in science: gender equity through electronic discourse. *Journal of Science Education and Technology*, 10(1).

Hsi, S., & Hoadley, C. M. (1995). Assessing curricular innovation in engineering: using the Multimedia Forum Kiosk, *Annual Meeting of the American Educational Research Association* . San Francisco, CA: American Educational Research Association.

### **Collaborators**

Philip Bell (U-Wash), Benjamin Berman (Berkeley), Marie Bienkowski (SRI), Michael Clancy (Berkeley), Alex Cuthbert (Berkeley), Sherry Hsi (Concord Consortium), Robert Kozma (SRI), Chris Kyriakakis (USC), Marcia Linn (Berkeley), Lydia Mann (College of Holy Names), Roy Pea (SRI), Wee Ling Wong (USC), Gerry Stahl (CU)

### **Graduate Advisors**

Michael Clancy (Berkeley), Marcia Linn (Berkeley)