Project Description: "Engaged Learning in Online Communities"

Vision

The world is increasingly mediated by advanced communication technologies and all social spaces are becoming hybrid spaces combining traditional physical space with social cyberspace. This is evident in the ways that cell phones, handheld computers, and the Internet are used. It also is clear in the ways that work-places and businesses are being reorganized around the flow of information. The most economically developed societies have made such significant social investments in communication and information technology that the sociologist Manual Castells (1996,1999) has argued for what he calls "the information society".

Online communities appear to have a tremendous potential to reach a mass audience and to support engaged learning. Lenhart, Rainie, and Lewis (2001) reported that 73% of youth ages 12 through 17 use the Internet (surely even higher in 2005). Almost all online teens (94%) use the Internet to do research for school. The proportion of online girls that has used instant messaging (IM) exceeds that of boys -- 78% for girls and 71% for boys. Also, girls begin IM at an earlier age, with 72% of girls 12 to 14 using the service, compared to 60% of boys the same age who use IM.

New technologies have helped to form fluid linkages (e.g., between work and school) where there used to be abrupt divides. These technologies form rich socio-technical networks that have come to constitute life in this digital age, and participation in these networks is becoming commonplace. They exist in various stages, forms and venues, in non-profit Internet forums, newsgroups, and successful online professional learning communities such as the Math Forum (mathforum.org), Digital Library for Earth System Education (DLESE; dlese.org), and Hawai´i Networked Learning Communities (HNLC; hnlc.org). They also are evident in diverse and highly profitable enterprises such as multi-player video games, online courses, and consumer services (Match.com, Amazon.com, eBay). In fact, the socio-technical world cuts across socioeconomic and international lines and public access is increasing.

Although the Internet is widely used for socializing, conducting business and information retrieval, it is rarely used for the kind of knowledge-building and deep learning that is needed in a knowledge society. In fact, the online mode tends to pressure people into quickly locating facts or registering opinions without becoming engaged enough to foster more complex understanding of a topic, such as a scientific or mathematical theme. There are aspects of the online experience, such as persistence of text and computational support that suggest an untapped potential for individual, group and organizational cognition that is rare to find in the Internet today (Stahl, in press). **How can the technical potential of online engaged learning be realized in concrete social settings?**

Online learning is clearly a new context for learning that needs to be understood, because it is increasingly being used as a context for education. Online learning spaces can be highly reflexive. There are spaces in which the learner, as well as the mentor or teacher and the researcher can look at and reflect on the process of learning. These interactions and reflections can be used as tools to support other people's learning. Further, the creation of online spaces

through cell phones, handheld computers, and the Internet can mean that learning interactions are occurring in cyberspace. This context raises questions about the nature of the relation between computer-supported collaborative learning environments, human learning and human development: **When deep and engaged learning occurs in online communities, what is taking place and how can it be supported and sustained?**

Online learning contexts have characteristics that allow for studies of processes in archived data such as reflection, revision, and questioning that cannot be undertaken as easily in the physical world. They also afford multiple options for engagement—including synchronous and asynchronous communication, writing, browsing, images, video, etc.—each of which has the potential to change the way in which a person represents and understands information they work with. This context also raises questions about the relation between a person's sense of him or herself as a learner online and the activities he or she takes on: **What new forms of joint activity online are responsible for different aspects of human development, and what are the psychological and social consequences of these forms of activity?**

Online learning communities and other informational technologies also allow networks to be formed quickly and easily. Often these networks can involve experts as well as novices. The communities that get formed allow for an easy kind of apprenticeship, and so readily become communities of practice (Lave & Wenger; 1991, Wenger, 1999). They have the potential to be very democratic, allowing many voices to speak, in addition to making visible the development and construction of learning to all who join the community. Understanding how collectivities get formed and under what conditions they best operate are critical issues (Klamma, Rohde & Stahl, 2004). Thus, this context also raises questions about leadership in online communities, contributors to the community, and sustainability of the community: **What are the necessary conditions for the development and sustainability of online learning communities?**

Understanding the interaction between the individual and contents of interest is critical. This interaction gates attention, goal-setting, and learning strategies (Hidi & Renninger, 2005). This interaction also enables learning interventions (Renninger, Sansone, & Smith, 2004). What is motivating to individuals and to the group? How are individual interests influenced by and also influencing the development of the group? In the learning sciences there has been a tendency to create a binary relation between individual and what might be termed situated cognition or group cognition. In online learning interactions, there is often a dialectical interplay between the individual and the community (Stahl, 2004). There appears to be valuable interaction going on in some moments online where the formal and informal meet and individual interest can be reshaped as individual-group-community interaction develops (Renninger & Shumar, 2004). This context raises questions about the learning opportunities in working with online communities, specifically the relation between the cognitive, affective, and social moments in learning and the flexibility inherent in the construction of online learning contexts: **What is the relation between learner development and the online collectivities in which learners participate?**

The online environment is new and it needs to be fully understood. It is being used widely and its potential for supporting individual learners to learn through collaboration in small groups and/or in the larger context of community that is associated with sites needs to be examined carefully. Because of its flexibility and the archiving that is possible, this environment affords study of

issues central to the learning sciences that have not previously been able to be studied, as well as new dimensions of these issues that the online context introduces.

Background

This section presents an overview of research at the main centers involved in this Catalyst project: The Math Forum (e.g. Catalyzing & Nurturing Online Workgroups to Power Virtual Learning Communities –VMT, NSF REC 0325447), The Digital Library for Earth System Education (DLESE) Program (e.g., REC 0215640), The Wisconsin Center for Education Research, and The Hawaii Networked Learning Communities (e.g., NSF Rural Systemic Initiative REC 0100393). Themes from prior research at the four main centers involved in this catalyst are brought into dialogue with other related research in the Learning Sciences to frame some of the issues for the development of the proposed center.

Online Contexts Redefine and Increase Learning Opportunities

As part of the NSF-supported *Virtual Math Teams* (VMT) project at the Math Forum, PI Stahl and collaborating researchers Weimar and Shumar currently investigate online collaborative problem solving in mathematics while addressing issues of software support for collaborative learning services within a digital library. Research to date has focused on the study of student collaboration via synchronous online collaboration in the context of university courses and Math Forum's Problem of the Week learning service. In addition research activities have identified key features for software support such as enhanced mathematical communication, support for organizing the results of conversations as they emerge, and mechanisms for facilitating contributions, in terms of both group attention to all contributions made and creating a participatory space for all students. Further research questions include: (a) How is mathematics done by online small groups of students such that we can say, for instance, that the group is displaying deep mathematical understanding versus simply manipulating things algorithmically without such understanding? (b) What methods are used systematically by small groups in online, text-based environments for taking turns, keeping interaction flowing, repairing mistakes or misunderstandings, opening and closing sessions, constituting the group as a collectivity, etc.? (c) Can online events, activities and environments be designed to stimulate group cognition and to lower the barriers to participation and group success? (d) How can math discourse communities be catalyzed, grown and sustained by networks of small groups interacting with each other?

Research at The Math Forum has also contributed to the potential of online contexts to increase access to fields such as mathematics and science that have not previously been accessible to all learners. Although preliminary, studies of online learning have begun to suggest that these contexts can lead to new senses of possibility (Markus & Nurius, 1986; Shumar & Renninger, 2002), because they enable learners to explore and to shift their identities as learners (Linehan & McCarthy, 2000). Learners through online scaffolded support are better able to see themselves as competent in a particular area of study and relinquish their incompetent identity (Renninger & Shumar, 2002. It appears that the Web and online learning could be a context for supporting the development of and/or deepening of interest, and consequently the attention, goal-setting, and learning strategies that learners bring to engagement (Hidi & Renninger, 2005). Such findings further suggest that the context of learning in online communities may make a difference for

learners for whom access to subjects such as mathematics and science has been challenged previously.

Online Contexts and Theoretical Approaches to the Study of Complex Learning

Theory and research on online learning need to focus analyses, not simply on specific components such as the web environment itself, the student behaviors and interactions, or the designs of learning activities, but rather on the complex interactions among many factors that cannot sensibly be broken apart and studied individually. This will involve developing theoretical and methodological approaches that view learning environments as complex systems, a likely goal of our center. A complex systems approach has been foreshadowed throughout the years by Bransford et al.'s (Bransford, Brown, & Cocking, 2000) developing analyses of learning environments as learner-centered, assessment-centered, and knowledge-centered within larger social contexts. Activity theory (Engeström, 1999, 2001), in which the smallest unit of analysis is an entire complex activity system, has become an increasingly important theoretical lens for studies of learning with new media. Arrow, McGrath and Berdahl (2000) have also proposed a research agenda for the study of small groups as complex systems, with wide implications for the field of experimental social psychology

Online learning as a complex system is explicitly addressed in the work of Derry and colleagues (Derry, in press; Derry & Hmelo-Silver, in press) who have used the activity field construct to analyze complex interactions among student, task, facilitator and tools within online learning environments they created for teacher professional development. Their work is conducted in STELLAR (Socio-Technical Environment for Learning and Learning Activity Research), a general theory-based system they have created for designing and supporting online courses. They used STELLAR to create web-based courses in cognitive science for pre-service teachers, which were offered and studied in two university settings over several years. Online activities in these courses were explicitly designed to foster transfer of course ideas to professional practice through activities that systematically integrated text and video case study with problem-based learning. This work produced: 1. A theoretical model for online instruction on a large scale that addresses a continuing major problem: the failure of most college classrooms to teach conceptual content in ways that insure transfer to professional practice; 2. Extensive online video, text materials, instructional activities, and online tools for supporting this instructional model to teach cognitive science to future teachers; and 3. Empirical support from controlled and quasi-experimental studies for the STELLAR approach and theory, as well as hypotheses for future research on online learning.

Since 2002, students' evaluative ratings of STELLAR activities and tools have been stable and positive, and suggest students' preferences to work collaboratively rather than individually on activities (Derry, in press; Derry, Seymour, Lee, & Siegel, 2004). Derry and Hmelo-Silver (in press) developed psychometrically validated concepts-in-use rubrics to score the quality of pre-service teachers' discourse and products created in this environment. These data are important for understanding the level of specific acquisitions that are possible in the kinds of online environments that can be created with STELLAR. Stepwise regression analyses with these data suggested relations between preservice teachers' experiences on line and their actual learning outcomes, as well as their perceptions about how much they learned and their beliefs about the needs of the pupils with whom they work. These multiple layers of information are important for instruction, understanding student motivation and needed support, and conceptualizing the multi-

dimensional character of learning. These types of archived data are simply unavailable except from the online environment.

In their study of online learning, STELLAR researchers integrate findings from Cognitive Flexibility Theory (CFT) (Spiro, Collins, Thota, & Feltovich, 2003; Spiro, Feltovich, & Coulson, 1992), online professional development approaches through video case studies (e.g., Segoe, 2002), and from related cognitive theories of case-based reasoning (Kolodner & Guzdial, 2000), embodied perceptual learning (Glenberg, 1997), Schwartz and Brandsford's work on reflection as a scaffold for transfer, and self-regulated learning (Azevedo, Guthrie, & Seibert, 2004; Pintrich, 2000; Winne, 2001). Like the STELLAR project, our center will approach online learning from multiple theoretical perspectives.

Engaging learners through participation

STELLAR, Math Forum and DLESE illustrate online learning environments that are committed to engaging learners through participation in authentic and personally relevant problem solving. Relevance and authenticity are strong motivators and have been found to help learners make connections between content knowledge and real world applications (Zech, Vye et al., 1998). This is a cyclic process as Verschaffel and De Corte (1997a) point out. However, learning in authentic contexts is not easy and goes against the grain of traditional instruction. Instruction organized around authentic problems may not honor the structure of the discipline being taught; problems bring concepts together in varied combinations. Thus, online environments that engage students in authentic problem solving must provide well-designed facilitation and scaffolding to help students make sense of problems in terms of their previous, current, and future experiences (Salomon & Perkins, 1989). As a recent special issue of the *Journal of the Learning Sciences* on scaffolding shows, there are many theoretically important research issues associated with online scaffolding of authentic problem solving (Pea, 2004). These issues will be addressed in the work of our center.

Researchers and educators concerned with transfer have long used problem solving to help connect classrooms to problem contexts that are far removed from the instructional setting. However, an alternative that is often preferable to simulated problem solving is learning through engagement with the actual context of practice. Although many design issues remain to be resolved, online collaborative communities are well suited to support this kind of learning.

As an educational digital library, The Digital Library for Earth System Education (DLESE), like STELLAR and The Math Forum, places particular emphasis on supporting interactions between educators, students, and resource creators and developers, in both face-to-face and online communities (Marlino, Sumner, et al., 2001). The heterogeneous nature of the DLESE communities prompts an expansion and reconsideration of what learning may involve, moving beyond the context of the classroom, and towards a consideration of practitioners, content generators, and students considered as technologically supported communities. In particular, the expansion of technologically-supported learning contexts implies an equivalent expansion in the social and technical complexity of such contexts. In such an approach, learning and knowledge can be seen not just as something passed between educators and students, but as general properties of wider social-technological networks; for instance, in a network educators may learn new practices from other educators, which they can then apply in their own teaching contexts. Learning is relatively easy to track in a classroom, but how is it to be conceptualized in networks of teachers, students, and resource creators – in what ways for instance does each group learn

from the other groups in the network? DLESE researchers have begun an effort to answer questions such as these (Khoo 2001b, Khoo 2004, Sumner, Khoo et al., 2003).

Like Fischer (January, 2003), we argue that more online programs could encourage students at all levels to be life-long, reflective learners who employ new media to conduct research and collaborate with others to solve important problems. Emerging technologies and the new social discourses they afford enable and push us to conceptualize new systems for learning in which there are stronger linkages between learning environments and peoples' everyday lives. Increasingly, "students" of the future will learn in the process of living, working and playing in a world where people of all ages and backgrounds participate in local and global learning communities made possible by new media. How to design and scaffold online communities that support learning in real-world contexts will likely be a major part of the research agenda for our center.

Fostering Development of Collaborative Online Communities

Almost all authentic problems transcend the individual human mind and require collaboration, since knowledge is distributed across domains and individuals (Arias, Eden, Fischer, Gorman, & Scharff, 2000; Bennis & Biederman, 1997; John-Steiner, 2000). Collaboration online takes on many forms. It can be individual work within an interactive context such as the Math Forum's Problems of the Week, in which an online mentor works with a student around his or her solution. Or, an individual can work with interactive site services, including the community of participants who populate the site, as in the case of the teacher working with the Math Forum. It can also be large or small group interactions that are formally structured and facilitated, as in the case of preservice teachers working within a STELLAR course.

The Hawaii Networked Learning Communities, in turn, prioritizes deep engagement with a statewide school system to effect systemic improvement of science and mathematics education, using online collaboration technology to support the statewide community of educators engaged in this initiative. The emphasis to date has been on the pragmatics of this challenging application: gaining trust of the organizations and individuals within the over 30 schools statewide in the network, and developing the professional and leadership development model in conjunction with the software that supports it. Recently the network has reached the point where realistic evaluation can begin. Research foci for this project, including study of the expectations of new community members and what motivates their use or disuse of the online environment; the development of mentoring and collaborative relationships online and how these relationships effect change in practices within the organization; the use of an "artifact centered discussion" tool derived from previously funded NSF research, and use of a shared community database of educational resources.

Similarly, design support for collaboration takes many forms. It can be supported or hindered by a facilitator's guidance, and by design of online tasks, tools and representational support systems (Suthers et al, 2004). For example, the Virtual Math Teams project in which teams of students are organized online to work on sets of problems (e.g., problems that prepare them to take SATs, or rich non-routine projects), required thoughtful design of site services to promote productive interactions with others. A major design consideration in this instance was what feedback was required to support learners to continue working in the face of frustrating situations.

Whether or not participants are reflectively aware of the community-based aspects of their work online, the emergence of overlapping knowledge-building communities is a critical development

in the Web-based universe. Helping this universe develop through scientifically-grounded design is an important part of our research agenda. If we assume that the world of working and living relies on interdisciplinary and cross-cultural collaboration, creativity, definition and framing of problems, dealing with uncertainty and change, and distributing cognition across people and tools, then the online learning environments we create need to prepare and support learners to be productive in such a world (Fischer & Derry, 2005).

Cognitive, Affective and Social Components of Engagement

Central to reform efforts in both mathematics and science are the goals of enabling learners (students, teachers, etc.) to make connections to and generate strategies for working with the tasks that they are presented (Ginsberg, 1998; Kuhn, 1989; Schauble & Glaser, 1990; Schoenfeld, 1992; Strauss, 1998; Tweney, 2001) and concern for the context, or conditions, that are needed to provide such support (Crowley & Schunn, 2001; RAND Mathematics Study Panel, 2003). Dewey (1914) in his now classic work, *Interest and Effort*, points to the power of interest to support students to engage, or make connections, to materials to be learned. He says that a person can not be made to have interest, but can be supported to develop interest. He also observes that where there is interest, effort follows.

In a forthcoming review of the literature, Hidi and Renninger (2005) note that interest—the predisposition to reengage particular content over time— differs from other motivational variables in at least four ways. First, interest has both affective and cognitive components, a position supported by neuroscientific research (LeDoux, 2000a, 2000b; Panksepp, 1998, 2003). Second, both the cognitive and affective components of interest have biological roots (Hidi, 2003; Davidson, 2000; Panksepp, 1998). Third, interest is an outcome of interactions between a learner and particular content. Finally, interest is always content specific rather than applying across all activity.

Interest has been found to have a significant impact on learners' *attention* (Hidi, 1990, 1995; Hidi, Renninger, & Krapp, 2004; McDaniel, Waddill, Finstad, & Bourg, 2000; Renninger & Wozniak, 1985; Schiefele, 1998), *goal setting* (Harackiewicz & Durik, 2003; Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000; Pintrich & Zusho, 2002; Sansone & Smith, 2000); and *levels of learning* (Alexander, 1997; Alexander & Murphy, 1998; Hoffmann, 2002; Koeller, Baumert, & Schnable, 2001; Krapp & Fink, 1992; Renninger, 1989, 1990; Renninger, Ewen, & Lasher, 2002; Renninger & Hidi, 2002; Sadoski, 2001; Schiefele, 1999; Schiefele & Krapp, 1996; Schraw & Dennison, 1994; Wade, Buxton, & Kelly, 1999).

Because interest exists in the interaction between learners, particular content, and the social context in which the learning occurs, interest is a variable that can be impacted by changes in support or feedback and features of learning contexts including opportunities to work with others (Renninger, Sansone, & Smith, 2004). Interest appears to develop through phases that begin with the triggering of interest and can lead to well-developed individual interest over time (Hidi & Renninger, 2005). Although not well understood, shifts in interest over time appear to be characterized by the changing relation between positive affect and opportunities to develop and/or deepen knowledge.

While students need to have positive feelings about an activity if they are to think that it is "cool" and worth trying (Resnick, Rusk, & Cooke, 1998); activities need to be both appealing and substantial if learners are to continue to work with and learn from them over time. Importantly, interest can be supported to develop and with support, it can deepen over time (Renninger,

2000). Given that the online environment is new and affords numerous and evolving opportunities for learning, it has attracted the attention and use of a wide-range of learners. The goal for these learners is that they will continue to engage over time, exerting effort to make connections to and generate strategies for working with content that may be more difficult to learn, or less accessible, in other contexts. Not only does their learning need to be promoted and sustained, but the staff members of communities of which they are a part need information about the ways in which they and their design can help. Because it gates attention, and with support can develop and/or deepen over time, the variable of interest appears particularly promising for exploring the affective, cognitive, and social components of engaged learning in online communities

Research Agenda

The online environment is new and it needs to be fully understood. It is being used widely and its potential for supporting individual learners to learn through collaboration in small groups and/or in the larger context of community that is associated with sites needs to be examined carefully. The context of the Web affords possibilities for archiving and studying aspects of learning that have not before been available and subject content (e.g., new forms of mathematics) that has not been known to exist.

The complexity of interacting factors and the differences among the individual, small group, and community dimensions of online learning have not been systematically studied in terms of participants' learning and how learning can be supported. Experiments to date have primarily been descriptive formative evaluation studies focused on particular contexts that are not generalizable. In Catalyst discussions and the proposed studies of a SLC, commonalities of findings across online contexts need to be identified, methods should draw on multiple disciplines, and systematic studies that allow comparison across forms of online learning, and include control groups need to be designed and conducted.

Thus, key considerations for the proposed Catalyst year include characterization of what presently is understood about the unique aspects of learning dynamics in online communities, including (a) hypotheses about the way in which learning interacts and evolves for individuals and for groups in the development of online communities and (b) information about what practitioners and developers need and want to understand. What is presently understood as well as the hypotheses to be developed about learning online will be framed around the center's key research questions from the vision:

- When deep and engaged learning occurs in online communities, what is taking place and how can it be supported and sustained?
- What new forms of joint activity online are responsible for different aspects of human development, and what are the psychological and social consequences of these forms of activity?
- What are the necessary conditions for the development and sustainability of online learning communities?
- What is the relation between learner development and the online collectivities in which learners participate?

It is expected that research slated for study by a SLC will target (a) the cognitive, affective and social relations between learners and the contexts in which they participate (individual, small group, and/or community) and (b) the forms of joint-activity that learners engage in online, including the psychological and social consequences of these forms of activity. Sampling needs to be purposeful and independent variables need to include, at minimum, gender, minority status, and age of participant.

Specific research goals to be developed during the catalyst year that will inform the center are listed below:

- Develop a framework for engaged online learning based on insights from the learning sciences and innovative uses of new media.
- Identify success models for engaged online learning in various STEM fields.
- Develop and study prototype online learning environments that:
    - Engage students in educational experiences that will help qualify them for and support them in successful STEM careers.
    - Scaffold students to learn through participation in technically, scientifically, socially, and artistically important inquiry and design.
    - Improve teaching and learning-environment design at all levels by fostering engaged individual and collaborative learning.
    - Provide models for broadening the sectors of the nation's population that aspire to and participate in STEM education.
- Understand what it means to be connected and what it means to collaborate for students in school, where they will be using powerful mobile devices for learning, entertainment, socializing, etc.
- Create a center where the scientific principles underlying this new form for interaction is studied in all its forms.

The Catalyst year will involve the bringing together of the existing data and studies on online learning communities in order to consolidate the descriptive phase of research in this area. The research teams will frame the different learning theory perspectives and appropriate methodologies for those perspective in order to define the work in this field and create an organizational structure around the further development of that work. Finally these intellectual activities will be brought into dialogue with the discussion about the organization of the Center for Engaged Learning in Online Communities in order to frame the structure of the center and make sure it maps onto the intellectual imperatives in this field. This work will ultimately contribute to the development of the center proposal.

Project Plan & Timeline

The Catalyst Project has the central goal of collaboratively developing a research agenda for extending the frontiers of knowledge on engaged learning in online communities. There are three primary deliverables:

- The creation of an American network of researchers committed to defining and carrying out this research agenda. This network will coalesce into an online learning community. It will be effectively connected to research centers and networks in other parts of the world. It will have its own identity and infrastructure.

- A proposal for a Science of Learning Center for the study of engaged learning in online communities. This proposal will describe an appropriate intellectual, organizational, technical and physical infrastructure to support rigorous, scientific study of this topic. The Center will bring together researchers with diverse, multidisciplinary approaches, in partnership with active online communities and schools across the country and around the world.
- A special issue of the *International Journal of Computer-Supported Collaborative Learning* (*ijCSCL*) on the topic of engaged learning in online communities. This will be an important public presentation of the research agenda, reviewing the state of the art and motivating the agenda. The articles in this issue will be scholarly and peer-reviewed. Drafts of the articles will be presented at relevant international conferences: CSCL, CSCW, CRIWG, AERA, EARLI.

These deliverables will be developed through an iterative process of meetings and online collaborations involving the PIs, lead researchers, collaborating researchers and international collaborators. The process will be designed to foster partnership-building and interdisciplinary investigation of central research issues.

Following is a chart summarizing this process during the 18 month project period:

#	month	activity
0	June 2005	Preliminary informal meetings with IKIT and others at CSCL 05 in Taiwan. PI visit to NIE in Singapore.
1	July	Meeting of Catalyst PIs: define 5 workgroup focal areas.
2	August	Invite lead researchers to join workgroups, approx. 5 people in each of 5 online groups. PI meets with Kaleidoscope, KMRC, and other international network contacts at European Association of Research in Instruction and Learning (EARLI 05) conference in Cyprus
3	September	Workgroups hold meetings to outline whitepapers. Website is established. PI keynote presentation at CRIWG conference in Brazil.
4	October	Each workgroup drafts a whitepaper on its focal area.
5	November	Major meeting held to outline Center research agenda based on whitepapers.
6	December	Draft Center research agenda. Select additional lead researchers for Center to complete disciplinary coverage.
7	Jan. 2006	Draft preliminary Center proposal. Select PIs for Center.
8	February	Submit preliminary Center proposal.
9	March	Hold workgroup meetings to revise Center proposal.
10	April	PIs of Center meet to critique and strategize proposal. Present research agenda at AERA 06 conference.
11	May	Draft final Center proposal.

12	June	Submit final Center proposal; present research agenda at International Conference of the Learning Sciences (ICLS 06) at Indiana.
13	July	Outline journal special issue papers.
14	August	Draft journal special issue papers.
15	September	Circulate, review and critique journal special issue papers.
16	October	Present research agenda at CSCW 06 conference.
17	November	Final drafts of journal special issue papers.
18	December	Prepare Center start-up. Submit journal special issue papers to ijCSCL.

The planning process will take place at the individual, small group and community levels simultaneously. Although ideas and documents will be circulated widely though a broader research community, five small groups will take the lead in focusing the work and developing core working documents. The five Catalyst PIs will be individually responsible for organizing and facilitating these groups. Each workgroup will concentrate on a broad area, such as the effect of individual cognition and affect on participation, the knowledge-building function in small groups or the impact of diversity on learning in online communities.

Initially the PIs will continue the process of collecting key research questions from both participating researchers and from leading practitioners in the online communities of the partners. The first set of working groups will pull together critical findings, important unanswered questions, and perceived needs or opportunities for collaboration from other fields. These will form the basis of whitepaper drafts articulating the research agenda from each focus. The larger conference will bring together representatives from the working groups and other leaders in the field to react to the whitepapers, along with sample data to stimulate ideas for shared infrastructure for data collection and analysis. The conference will identify gaps in the research considered so far, critique priorities, and build connections across the working groups and to other relevant research, including the generation of proposals for possible studies to address the emerging issues. The PIs will draft a Center research agenda based on the conference and working group results to date. The next set of smaller working groups will be reconfigured to focus each on a core research program and the related coordinating functions of the proposed Center. The evolving PI team for the Center integrates working group output and takes a draft Center proposal back out to the field looking for theoretical and empirical studies that tie together Center foci. Strong paper concepts that emerge from the whitepaper and proposal process will be cultivated for development and submission to the journal after the proposal submission.

Web technology will be used for on-going communication within the Catalyst project. A project website will include support for email lists, threaded discussion forums, chat rooms, videoconferencing, wikis, a document repository and web pages. Each month, work on the project will be documented on the website, so that all participants can access and comment upon work product and draft deliverables. Infrastructure support for the Catalyst project will be supplied by the Math Forum and the project will be coordinated by the Math Forum Director and the PI.

The publication of a special issue of *ijCSCL* and presentations at relevant conferences will motivate researchers to think deeply about the research agenda and to review the state of the art in a thorough way. It will ensure that the work of the Catalyst grant has a meaningful outcome and furthers progress on the topic of engaged learning in online communities regardless of eventual Center funding. *ijCSCL* is an appropriate venue for this topic (see http://ijCSCL.org), and a number of Editorial Board members are involved in the Catalyst project, including the PI, who is one of the Executive Editors along with one of the Catalyst international collaborators. *ijCSCL* is an international journal and includes all the contacts for the international networks associated with this project (see below) on its Editorial Board.

The Catalyst project brings together an exciting mix of researchers (see below). The project is designed to mold this collection of people and small research centers into an integrated community — itself an online learning community. The nature of the problem being addressed by this Catalyst project requires a deeply interdisciplinary and tightly collaborative process. The PIs are all experienced in coordinating interdisciplinary efforts. They will use the large and small meetings as well as the online communications to intertwine and merge different perspectives to arrive at cross-perspective issues and views. The emergent research agenda must be more than the sum of participants' individual professional agendas — and the Catalyst project will be structured to achieve this through its community-building emphasis.

Project Personnel

Principal Investigators

The PIs are learning sciences researchers associated with four active online learning communities. They have each been involved with a variety of online learning community projects. Among them, they have studied a diversity of different kinds of efforts (see Background and individual bios).

- Gerry Stahl, Drexel University, Virtual Math Teams Project at the Math Forum @ Drexel
- Sharon J. Derry, University of Wisconsin, Wisconsin Center for Education Research
- Mary Marlino, UCAR, Digital Library for Earth System Education Program Center
- K. Ann Renninger, Swarthmore College, Math Forum @ Drexel
- Daniel D. Suthers, University of Hawaii, Hawaii Networked Learning Communities

The PI team will be supported by Stephen Weimar, Director of the Math Forum @ Drexel, who brings a deep experience with K-12 education and organizational development.

Lead Researchers

These are the researchers who will most likely be involved on the focal workgroups, drafting the whitepapers and journal articles. Most have confirmed their involvement (see letters in Appendix), although the list is still somewhat in formation. Many of these people are the pioneers of the field of online learning. Some continue to be leaders, while others are conducting rigorous research on related topics that are central to issues of engaged online community and its development. They bring diverse methodologies from a spectrum of fields. Although most may consider themselves interdisciplinary, they were trained in education, psychology, computer science, information science, anthropology, philosophy, social sciences, cognitive sciences, learning sciences.

Robert B. Allen, Drexel University
Amy Bruckman, Georgia Tech University
Paul Cobb, Vanderbilt University
Gerhard Fischer, University of Colorado
Mary Gauvain, Univ. California at Riverside
Geri Gay, Cornell University
Ricki Goldman, New Jersey Inst. of Techn.
Rogers Hall, Vanderbilt University
Judy Harackiewicz, Univ. of Wisconsin
Starr Roxanne Hiltz, New Jersey Inst. Of Technology
Cindy Hmelo-Silver, Rutgers University
Jim Kaput, Univ. Massachusetts, Dartmouth
Mick Khoo, University of Colorado
Jay Lemke, University of Michigan
Eric Loken, Penn State University
Fred Mael, American Institutes for Research
Roy Pea, Stanford University
Thomas Reeves, University of Georgia
Carol Sansone, University of Utah
Wesley Shumar, Drexel University
Elliot Soloway, University of Michigan
Rand Spiro, Michigan State University
Tamara Sumner, University of Colorado

Collaborative Researchers, American

A list of about two dozen other researchers will also be involved in this Catalyst project. They may attend the major project meeting, participate in online discussions, contribute to the whitepapers and co-author journal articles. Most of the people listed above work in research centers with associates, students and networks of colleagues. So this Catalyst will engage a critical mass of the relevant research communities.

International Collaboration

The Catalyst project on engaged learning in online communities – and its successor SLC Center – will be the US partner in an international collaboration. There are several reasons for such a collaboration:

- Online communities can easily extend across national boundaries
- Collaborative learning is enhanced by the inclusion of international perspectives
- A number of countries are more advanced than the US in the fostering of collaborative learning
- A number of leading learning scientists interested in online communities are located abroad
- The research communities of the learning sciences and computer-supported collaborative learning (CSCL) are international in character
- International collaboration will enhance the dissemination and impact of the Center's findings

The PIs have well-established international ties in the relevant international research community. A research workshop associated with the PI's VMT project at the Math Forum last summer brought together 36 researchers from 10 countries, including members of some of the networks collaborating on this project. The project will formally collaborate with the following research networks:

- The Kaleidoscope Network of Excellence in the European Union, a network of learning researchers in Europe that includes a 300-member CSCL SIG. Contact: Barbara Wasson, University of Bergen, Chair of the CSCL SIG.

- The Knowledge Management Research Center, a major social science research center conducting basic research on learning. Contact: Friedrich Hesse, University of Tübingen, Director of KMRC in Tübingen, Germany.
- CRIWG, a network of Latin American CSCL and CSCW researchers. Contact: Hugo Fuks, Catholic University of Rio de Janeiro, Brazil.
- Learning Sciences and Technologies Group in the National Institute of Education (**NIE**). Contact: Chee-Kit Looi, Nanyang Technological University, Singapore.

Diversity

One of the co-PIs (Suthers) conducts research on online learning in the context of his own teaching at the University of Hawai`i, a minority-serving post-secondary institution located in an EPSCoR state. He is also engaged in studying learning in the context of online communities of K-12 students and teachers within the "Hawai`i Networked Learning Communities" (HNLC) project, a partnership between the Hawai`i Department of Education and the University of Hawai`i at Manoa (NSF Rural Systemic Initiative, Cooperative Agreement #0100393). The overall goal of the HNLC is to improve science, mathematics and technology learning in the K-12 rural schools. The project focuses on professional development and leadership development for teachers and administrators in the state's rural and remote schools, most of which are located on the outer islands of the state. Of the participating schools, 14 schools are located on the island of Hawai`i, with eight schools on Kaua`i, six on Maui, three on O`ahu, three on Moloka`i and one on Lana`i. To reduce the isolation of the teachers and administrators in these remote and rural schools which are even further isolated because of the island configuration of the state, the project utilizes internet technology in the form of a "Virtual Community Center" (hnlc.org) to support collaboration between a distributed statewide community of teachers and students.

The student population is culturally diverse, and there is no single "majority" ethnic group among students. The largest populations are Filipino ranging (across three cohorts) between 27-29% and the Part-Hawaiian student group (23-25%%). These two groups combined with the Native Hawaiian students (4-6%) represent just under two-thirds of the student population and these students are underrepresented in the target courses in math and science. Furthermore, HNLC reaches an under-served population as defined by socioeconomic status. Currently, 6.2% of the students are Limited

English Proficient and 48.1% eligible for free or reduced price lunch. In addition to the issues of size and rural isolation, the September 2003 release of the state data on No Child Left Behind (NCLB) Annual Yearly Progress (AYP) status revealed that 85% of project schools did not meet AYP compared to a state-wide rate of 66%. More significantly, nine of the 20 schools or 45% are in "corrective action" or "planning for restructuring" compared to only 24.5% of state's schools. In combination with low student performance and small size, many HNLC schools are impacted by low teacher certification rates and poor economics. These findings suggest that the project's rural schools are among the most impacted in the state. As a

result, the HNLC project provides a challenging testbed for the role of online communities in helping schools meet performance objectives.

Evaluation and Assessment

In preparing a Center proposal it is essential to assess the effective working relations of the collaborators and the level of productivity and quality in the results. Sara Kiesler's studies of the KDI program confirm the importance of planning and regular onsite meetings for geographically spread collaborations. Derry, Weimar, Marlino and others involved have significant experience studying effective collaborations and in organizational development and strategy. This team will conduct a survey of project participants in December and then again in October of the following year concerning levels of participation, the quality of the meetings, the quality of the work between meetings, the quality of the results and the emerging design and focus of the Center. An internal review will also be conducted to analyze project activities for the level of interaction, follow through and continuity, adherence to the timeline and plan, and the contributions of various means of collaboration to the overall effort. The team will be able to draw on participating ethnographers such as Wes Shumar and Mick Khoo who have experience studying the development of project groups. These results will form the basis for the design of collaboration functions supporting the Center.