SIG GROUP Bulletin

Special Issue on

Community-Based Learning: Explorations into Theoretical Groundings, Empirical Findings and Computer Support

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Introduction to the Special Issue

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COMMUNITY-BASED LEARNING

This very special (and final) issue of the *ACM SIGGROUP Bulletin* presents products of a workshop on *Community-Based Learning: Explorations into Theoretical Groundings, Empirical Findings and Computer Support* that was held at the International Conference of the Learning Sciences (ICLS 2004).

The workshop generated considerable enthusiasm and a palpable sense that the participants were heading in a strikingly (and surprisingly) similar direction that was important to the future of the larger research community. Individuals came to the workshop with brief position papers that had been shared on a pre-workshop website. In the day-long discourse, themes surfaced, became explicit and developed; they created a sense of shared knowledge building that was directly relevant to the individual contributions that people had brought with them. Perhaps the most productive time of the workshop was a period when smaller workgroups were formed to brainstorm specific aspects of the day's theme. During subsequent days of the conference, as part of the preparation of this publication and through circumstances of life in the research community, workshop participants interacted further with each other in many combinations. The papers being published now are knowledge artifacts that reflect and encapsulate what the workshop community learned, as re-formulated from within the scientific perspectives of individual authors.

Contributions to the workshop aimed to better understand learning within diverse educational communities and to explore their potential support by means of community-based technologies. Workshop discussions focused on intersections and relationships between educational research and computer science as applied within the learning sciences. Although the papers below are grouped into sections on theoretical groundings, empirical findings and computer supports, almost all of the contributions actually span the three focal areas. The theory reflects practical experiences, at various levels of abstraction. The empirical inquiries involve computer-supported learning and explore related theoretical issues. The computer support investigates technologies that are motivated by theoretical stances or questions, and they try these technologies out in practical settings.

The premise of the workshop was that the learning sciences need to better understand theoretical, empirical and technical aspects of community-based learning, in their interactions in concrete settings. New computer systems need to take into account the complex needs of educational communities, which typically change dynamically, are emergent, evolve over long periods of time, and allow multiple interacting memberships. While socio-cultural and related theories recognize these features on a theoretical level [1; 2; 9; 16; 17], empirical research results focus on diverse learning communities and aim to draw design implications for technological support [3; 4; 11; 13].

The design of tools for supporting learning in schools and universities has too often neglected the notion of community. Most educational technology still focuses on supporting the individual learner or the traditional role of the classroom teacher [10; 12; 14; 15]. Individual classes are seen as the focus of activity, where the class is seen as a set of individuals rather than as a community structure having relations with other classes and situated within the cultural communities where the students are rooted. Some recent computer systems have shifted their focus from supporting individual learners or teachers to supporting group work [5-8]. This does not solve all the problems when it comes to supporting the creation of a learning community, where learners contribute and build on other people's experience, combining different perspectives across classes, direction of study and diverse cultures. Most existing systems fail to acknowledge that knowledge is not just an asset of the individual, but rather of the group and the community as a whole.

The notion of community-based learning is particularly indebted to the concept of "community-of-practice" (CoP). Popularized in Lave and Wenger's *Situated Learning* [9] and their other publications, this concept was forged in small workgroups within a vibrant research community in the late 1980's that included the Institute of Research in Learning in Palo Alto as well as participants from Xerox PARC, Berkeley and UCSD. Fifteen years later, it is high time that this influential concept be reflected on critically, not in order to dismiss its importance but to extend its applicability while recognizing its limitations and variations. This special issue reflects the view that innovative insights like the CoP concept emerge from small group discourses and are subsequently adopted by larger communities. The small groups and the larger communities can take on many forms, resulting in a variety of ways in which knowledge building and learning take place within them.

It is perhaps fitting that these workshop papers—which respectfully critique the concept of CoP and point to the role of groups within the CoP—be published as a final act of ACM's special interest group for software support for groups. Taken together, the contributions to this issue suggest the importance of a theoretical, empirical and design focus on the group—on small groups within communities. They thus propose a renewed concern with the group within the research communities of CSCW and CSCL, which will carry forward the SIGGROUP mission.

THEORETICAL GROUNDING

Although the title of the workshop and of this issue refers to the concept of community-based learning, it may be preferable to use the broader term "computer-supported

collaborative learning" (CSCL) because the presented concepts, approaches and studies reflect learning processes that are characterized by the following three dimensions:

- collective (or collaborative) knowledge building and learning
- technologically supported learning or learning with and about technological media
- learning across geographical distance by means of digital networks

Most of the contributions are founded on socio-cultural and constructivist learning theories and focus on the concept of communities, e.g., as communities of practice, communities of interest, learning communities, knowledge-building communities. However, a terminological concentration on "community-based learning" could neglect the relevance of technological support and spatial distribution. The notion of CSCL offers a broader understanding of technologically mediated collective learning processes that is more appropriate for this collection of research studies, which questions the nature of community. The theoretical contributions actually enhance our understanding of the importance of community to learning by differentiating various structural levels of community and different kinds of learning communities.

The tone of critiquing the notion of community was set by the workshop facilitator, who argued for a methodological focus on small groups within communities. The role of small groups as the locus of group cognition is presented in **Gerry Stahl**'s paper as the site where knowledge building can most likely take place in communities. Looking at the spectrum between individualistic and social concepts of learning in communities, he argues for an analytical perspective focused on the intermediate level of small work groups within larger communities. Stahl reflects on individual and social psychological concepts of individual and group cognition, and the mediation of cognitive processes by the social context in which the individual or the group might be situated. He also examines the mediation of individual and group cognition by technological media. With regard to his own experiences and to others' research on knowledge building in collaborative working and learning settings, Stahl draws the conclusion that "small groups are the engines of knowledge building," creating the basis for both individual internalization and collective externalization of knowledge in cultural artifacts and procedures of social communities. The idea of looking at communities as structured by productive small groups reappears in many of the other contributions.

A small group at the workshop took up the terminological issues raised by talking about small groups within communities. **Markus Rohde and David W. Shaffer** volunteered to write up the brainstorming that took place in this workshop group and to develop the ideas further. In their report, they analyze a variety of terms and concepts to describe collections of people involved in group-learning activities. They discuss meanings and connotations of terms like "group," ("small group," "working group," etc.), "collective," "network" and "community." Furthermore, they reflect on different modes, components and mechanisms of interaction and social perception (e.g., collaboration, culture, identity, history) that are crucial for most studies on community learning. Rohde and Shaffer present a first step to a framework—from group to community—and conclude that there should be different requirements for tools aiming to support collaborative learning and for research methodologies with regard to different kinds of collectives.

Lachlan Forsyth and Lynette Schaverien present a model of collective learning for online learning (and teaching) communities. Based on their findings in educational research, the authors introduce a generative theory of learning and discuss implications of neuroscience and evolutionary psychology for the analysis of collective learning. The generative theory approach understands learning as the cyclic generation and testing of ideas in order to better the chances of survival of an organism, individual or group/culture. The generative model of collective learning analyzes six different acts of learning as collective or emergent phenomena. Forsyth and Schaverien name as topics for future research the adoption of models for the description of processes of enculturation and collective intentionality and the description of appropriate technologically rich environments for support of collective learning.

Liz Charles presents a description of an active classroom enacting a learning-by-design curriculum involving workgroups learning science through design projects. She asks how one can analyze the cognitive and social interactions that take place within or between the levels of individual, small group and larger classroom community. In particular, she explores the applicability of dynamic systems theories that have been so successful in the physical and biological sciences. She proposes combining a particular flavor of complex dynamic systems theory with a focus on timescales and history in order to capture flows of activity. Charles applies this framework to the classroom description that she started with and comes up with two views of the classroom scenario. Not only is she able to capture the relationships of individuals and artifacts to the small group that defines their activity structure, but she also represents change in time.

A contribution from **David W. Shaffer** focuses on the concept of "pedagogical praxis" as a fundamentally different approach to describe and investigate communities of practice in educational settings. Based on the understanding that different professional practices can be characterized by distinct and coherent "epistemic frames," Shaffer posits that for the design of learning environments, a pedagogical praxis of professional trainers that take a learning practices perspective might be of greater importance than the real-world activities of professional experts. Thus, it is not what experts *do* in their everyday practice that should be the basis for practice-oriented teaching, but what *learners do to become experts* that should be the focus. This means that pedagogical praxis as a means to create comprehensive learning environments is not a striving for "real" practice situations, but for "thickly authentic" ones.

EMPIRICAL FINDINGS

The papers in this volume present a wide range of case studies of computer-supported community-based learning, referring to primary school pupils and students in university settings; to students in school and out of school in after school programs, community centers or professional internships; to student teachers and other professionals; to people learning and instructing online, face-to-face or in blended hybrid arrangements. Therefore, the studies offer a spectrum of applications of collective learning environments, reaching from traditional educational institutions to community-based or technology-based experimental facilities. Moreover, the studies presented include global experiences from different countries and regions: American, Australian and European.

Joyce Yukawa reports on her experiences with co-reflection in dyadic interaction during an online course in action research. She analyzes and compares her chat-based communication with two students according to processes of collaborative reflection between teacher and student. Yukawa looks upon this co-reflection as a core activity of group cognition. Despite the fact that group cognition is more difficult to analyze in dyadic interaction than in group interaction, she concludes that in her online communication with students the co-construction of knowledge occurred, and she reflects about her role as teacher, facilitator, coach, mentor and even co-learner.

The community of practice of philosophers of science (PoS) is the starting point of **Johannes Strobel**'s deliberations in "Communities of Reflection-Practice." Aside from disciplines such as engineering, biology and physics, most humanities sciences do not have an established, well-defined professional practice outside the university. Therefore, scholars, teachers and students of PoS face methodological difficulties building communities of practice with experts outside their educational setting, collaborating on real-world tasks, and learning from these experiences. With regard to this lack of a well-structured real-world practice, Strobel calls these communities of (mostly humanities) scientists "communities of reflection-practice." He discusses how modern socio-cultural and constructivist learning theories and approaches could be made fruitful educational environments for these research areas. Another question addressed by the author is the multi-disciplinary nature of PoS and similar sciences: Strobel reflects on possible clashes of different disciplines' communities of practice running up against each other in multi-discipline research areas.

Like Strobel in his contribution, **Ralf Klamma and Marc Spaniol** are investigating communities of practice within the humanities. Their case study presents the MECCA project, which aims to support a community within film studies. This project is run by the interdisciplinary research center "Media and Cultural Communication" and aims to support members of different scientific disciplines (film studies, history of art, graphical design, etc.) who are researching facial semantics in movies. Klamma and Spaniol discuss, on an empirical basis, potential "clashes" of different disciplines that come together in a research community. These clashes concern different perspectives, distinct vocabularies and alternate classification schemes. These ontological differences require a concept of "semantic freedom" and "fluid archives."

Ralf Klamma, Markus Rohde and Volker Wulf discuss experiences with a longitudinal study of the course "High-tech Entrepreneurship and New Media." The course design is based on socio-cultural theories of learning, and considers the role of social capital in entrepreneurial networks. By integrating student teams into the communities of practice of local start-ups, the course offers learning opportunities to students, companies and academia. The student teams are connected to each other and to their supervisors in academia, and practice through a community system. Moreover, the course is accompanied by a series of lectures and group discussions that include extra-academic experts and people with start-up company experience.

Gunnar Stevens, Michael Veith and Volker Wulf discuss a project aimed at fostering integrative community processes by deploying computer facilities to German and immigrant primary school children and their parents. Influenced by the MIT-approach of Computer Clubhouses, the authors introduced a computer lab, an interactive course

design and a primarily volunteer-based facilitator/coaching concept to German students and Turkish immigrant pupils in Bonn, Germany. By integrating pupils and their parents and by explicitly inviting Turkish immigrant and German families to their "Come_IN club," Stevens et al. aim to foster integrative processes in the multi-cultural neighbourhood. By collaboration in cross-cultural and multi-generation project groups and on personally relevant tasks (e.g., the creation of multi-media family histories), cross-community building and intercultural learning should be established. The attractiveness of computer technologies is expected to play a role as a motivational factor and as an "entrance card" into the immigrant community. The authors present first findings of this ongoing project, indicating a very strong interest and involvement of the target groups.

COMPUTER SUPPORT

The papers in this section explicitly take up issues of technology by experimenting in specific situated contexts of community learning.

Thierry Isckia and Charles Delalonde present a case study of an online course for MIS studies. The authors evaluate course design and technological support with observations and interviews of students participating in an online course using Microsoft Excel. Their findings show evidence of an inefficient use of discussion forums and the absence of an effective (online) learning community. Isckia and Delalonde end up with several recommendations for improved course design and some rules for more efficient online interaction.

In his case study of a blended learning university course in a "small scale, multiple satellite campuses model" **Woei Hung** investigates the impact of social presence, intimacy and immediacy on learning processes and outcomes. University of Arizona South offered a course for students distributed across southeast Arizona. To overcome spatial distances and to reduce travel and organization costs, the university offered three modes of participation in the course: attendance in the in-class meeting with the teacher on a local campus, attendance in another classroom with other students to which the lecture was broadcast online using video-conferencing, and following the lecture online with videoconferencing from home offices. This educational setting is called a "blended instructional delivery method" and it was evaluated by observations in the classrooms and interviews with participants. The main findings demonstrate evidence for the relevance of social presence and information richness of the learning environment. The blended instructional delivery method proved to be a promising learning environment, even for situations in which physical presence is not possible.

As described by **Amon Millner**, the Hook-ups initiative gets children and youth in community technology centers (such as local computer clubhouses) engaged in the development of so-called "Hook-ups." Hook-ups are physical objects (like joysticks, toys, every-day artifacts, tools such as scissors, etc.) that work as human-computer interfaces by controlling games, animations and other computer programs. Based on the constructionist theory of learning and on the approach of "learning through design," ten 18-year-old youths were motivated to play with computers (digital devices) and everyday objects with which they are familiar (physical devices), and create Hook-ups by using sensors, wires and a specific kind of a Hook-up interface board to connect them to each

other and develop computer programs (by "simple scratch" programming) that can be influenced by manipulation of the physical objects. Millner presents some illustrative examples that give evidence for the success of these Hook-ups projects.

Daniel Suthers, Violet Harada, Joyce Yukawa and Viil Lid report on the Hawai'i Networked Learning Communities (HNLC) project, which aims to support teachers in enabling students in disadvantaged rural schools to attain high standards in science, math and technology. A first evaluation of a so-called "virtual community center" shows that the focused target group of teachers did not use the system frequently. Probably caused by different expectations of developers and potential users, this insufficient use of the system leads the authors to several questions concerning a redesign and/or re-launch of the virtual community center. Suthers et al. conclude that they should focus not on one community of teachers but on "nested and overlapping educational communities," including different disciplines, different schools and even broader communities of stakeholders like parents, employers and administrative representatives. Furthermore, the different kinds of practices that should be supported and the nature of the educational system (e.g., technical, socio-organizational, etc.) to be built are discussed.

NOTE

The articles in this issue were revisions and extensions of position papers submitted for a workshop at the 2004 International Conference of the Learning Sciences (ICLS). The ICLS and CSCL conference series are now sponsored by the International Society of the Learning Sciences (see ISLS.org), which publishes the new *International Journal of Computer-Supported Collaborative Learning* (ijCSCL.org) as well as the *Journal of the Learning Sciences*. The authors in this issue have all been invited to submit longer versions of these papers to ijCSCL for its 2006 premiere volume.

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Part I. Theoretical Groundings

Mediation of Group Cognition

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1. MEDIATION OF GROUP COGNITION

The term "community-based learning" can refer to a variety of forms of learning. One can, for instance, insist on an individualistic notion of learning and argue that individual learning can be enhanced by factors that may influence it from a supportive community environment. At the other theoretical extreme, one can propose a social conception of learning and claim that most important knowledge building takes place at the community level, while individual learning is a secondary matter of internalization, acculturation or increased participation in community. Here, we will stake out a middle ground: that community-based learning should be analyzed at the intermediate level of small groups of individuals within the community.[1] We point out that small groups typically mediate the relationship of communities to their members and we propose a consideration of small group cognition as an alternative methodological focus to either cognition in the head of individuals or the cultural knowledge of a whole community. This approach has practical implications for CSCL and CSCW: collaboration is taken to be a potential emergent phenomenon of small group interaction, and the computer support of collaboration is analyzed as an enabling technology whose design and use forms and transforms the nature of the interactions.

Let us consider this article's title a word at a time. *Mediation* is the most complex and unfamiliar term. In popular and legal usage, it might refer to the intervention of a third party to resolve a dispute between two people. In philosophy, it is related to *media*, *middle* and *intermediate*. So in CSCL or CSCW, we can say that a software environment provides a *medium* for collaboration or that it plays an *intermediate* role in the *midst* of the collaborators. The contact between the collaborators is not direct or *im-mediate*, but is *mediated* by the software. Recognizing that when human interaction takes place through a technological medium the technical characteristics influence—or *mediate*—the nature of the interaction, we can inquire into the effects of various media on collaboration. For a given task, for instance, should people use a text-based, asynchronous medium? How does this choice both facilitate and constrain their interaction? If the software intervenes between collaborating people, how should it represent them to each other so as to promote social bonding and understanding of each other's work?

The preposition in the phrase is ambiguous. Is *of* to be taken in a passive or possessive sense? Does the mediation *of* group cognition refer to how the group cognition is mediated by the technology? Or, conversely, does it refer to how collaboration and shared meaning are mediated by the group cognition's act of mediating? This ambiguity is not accidental: in processes of mediation, that which is mediated, that which mediates and the mediation itself tend to merge into a process of co-determination in which each is defined and refined by the others.

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[1] This paper is excerpted from (Stahl, in press), where issues of group cognition are considered at length [4].

By itself, the term *group* is quite straight-forward. In this context, we can take it to refer to a small set of people, usually numbering about three to six. But combined with the term *cognition*, it strikes many people as counter-intuitive. This is because cognition is often assumed to be associated with psychological processes in individual minds.

The usual story about cognition, at least in the Western culture of the past three hundred years, goes something like this: an individual experiences reality through his (*sic*, the paradigmatic rational thinker in this tradition is often assumed to be male) senses. He thinks about this experience in his mind; c*ognition*, stemming from the Latin *cogito* for "I think," refers to mental activities that take place in the individual thinker's head. He may articulate a mental thought by putting it into language, stating it as a linguistic proposition whose truth value is a function of the proposition's correspondence with a state of affairs in the world. Language is a medium for transferring meanings from one mind to another by representing reality. The recipient of a stated proposition understands its meaning based on his own sense experience as well as his rather unproblematic understanding of the meanings of language.

The story based on the mediation of group cognition is rather different: in this view, language is an infinitely generative system of symbolic artifacts (words, phrases, genres, etc.) that embody the cultural experiences of a community. It is a social product of the interaction of groups—not primarily of individuals—discussing and acting in the world in culturally mediated ways. Individuals who are socialized into the community learn to speak and understand language as part of their learning in order to participate in that community. In the process, they internalize the use of language: e.g., as silent self-talk, internal dialog, rehearsed talk, narratives of rational accountability, senses of morality, conflicted dream lives, habits, personal identities and their tacit background knowledge largely preserved in language understanding. In this story, cognition takes place primarily in group processes of inter-personal interaction, including mother-child, best friends, husband-wife, teacher-student, boss-employee, extended family, social network, gang, tribe, neighborhood, community of practice, etc. The products of cognition—thoughts—exist in discourse, symbolic representations, meaningful gestures, patterns of behavior; they persist in texts and other inscriptions, in physical artifacts, in computer databases, in cultural standards and in the memories of individual minds. Individual cognition emerges as a secondary effect, although it later seems to acquire a dominant role in our introspective narratives.

Most people have trouble accepting the group-based story at first and then starting to view collaborative phenomena in these terms. Let us take a closer look at the philosophical view which is sedimented in the term "mediation." It belongs to a tradition that undertook a fundamental critique of the individualistic perspective that goes back to Descartes and even Plato, and that underlies common folk theories about cognition.

2. DECONSTRUCTING MEDIATION

We can start to deconstruct the term *mediation* as used in CSCL and CSCW by looking at its use in Lave & Wenger's seminal *Situated Learning* [2]:

> "Briefly, a theory of social practice emphasizes the relational interdependency of agent and world, activity, meaning, cognition, learning and knowing…. Knowledge of the socially constituted world is socially mediated and open ended."

This theory of social practice can be traced back to Hegel and Marx by way of Vygotsky. Vygotsky described what is distinctive to human cognition, psychological processes that are not simply biological abilities, as *mediated cognition*. He analyzed how both signs (words, gestures) and tools (instruments)

act as artifacts that mediate human thought and behavior—and he left the way open for other forms of mediation: "A host of other mediated activities might be named; cognitive activity is not limited to the use of tools or signs" [5]. Vygotsky recommended replacing the exclusive focus on individual development with a "zone of proximal development" that assessed group cognition, the ability of small groups to achieve intellectual results [5].

Vygotsky attributes the concept of indirect or mediated activity to Hegel and Marx. Where Hegel loved to analyze how two phenomena constitute each other dialectically—such as the master and slave whose identity arises through their relationship to each other—Marx always showed how the relationships arose in concrete socio-economic history, such as the rise of conflict between the capitalist class and the working class with the establishment of commodity exchange and wage labor. The minds, identities and social relations of individuals are mediated and formed by the primary factors of the contexts in which they are situated.

The term *mediation* takes on a variety of interrelated meanings and roles in discussions of social theory. The point here is to start to think of group collaboration software as artifacts that mediate the cognition of their individual users and support the group cognition of their user community.

3. MEDIATION BY GROUPS

Small groups are the engines of knowledge building. The knowing that small groups build up in manifold forms is what becomes internalized by their members as individual learning and externalized in their communities as certifiable knowledge. At least, that is a central premise of this article.

Although we can see many examples of the decisive role of small groups, their pivotal function is rarely acknowledged. For instance, the two prevailing paradigms of learning in CSCL—which may be referred to as the acquisition metaphor and the participation metaphor [3]—focus on the individual and the community respectively, not on the intermediate small group. In the acquisition metaphor, learning consists in the acquisition of knowledge by an individual; for instance, a student acquires facts from a teacher's lesson. In the participation metaphor, learning consists in knowledgeable participation in a community of practice; for instance, an apprentice becomes a more skilled practitioner of a trade. But if one looks closely at the examples typically given to illustrate each paradigm, one sees that there is usually a small group at work in the specific learning situation. In a healthy classroom there are likely to be cliques of students learning together in subtle ways, even if the lesson is not organized as collaborative learning with formal group work. Their group practices may be structured in ways that support individual participants to learn as the group builds knowledge. The peer group may also resist the official educational goals; the small group defines what is to be valued as learning. In apprenticeship training, a master is likely to work with a few apprentices, and they work together in various ways as a small group; it is not as though all the apprentice tailors or carpenters or architects in a city are being trained together. The community of practice functions through an effective division into small working groups.

Some theories, like activity theory [1], insist on viewing learning at both the individual and the community level. Although their examples again typically feature small groups, the general theory highlights the individual and the large community, but has no theoretical representation of the critical small groups in which individuals carry on their concrete interactions and into which the community is hierarchically structured.

My own experience in research collaborations and in my apprenticeships in philosophy and computer science impressed me with the importance of working groups, reading circles and informal professional discussion occasions for the genesis of new ideas and insights. The same can be seen on a world-historical scale. Quantum jumps in human knowledge emerge from centers of group interaction: the Bauhaus designers at Weimar, the post-impressionist artists in Paris salons, the Vienna Circle, the Frankfurt School—in the past these communities were necessarily geographic locations where people could come together in small groups at the same time and place.

The obvious question, once we recognize the catalytic role of small groups in knowledge building, is: can we design computer-supported environments to create effective groups across time and space? In order to achieve this, we need a degree of understanding of small group cognition that does not currently exist. In order to design effective mediated collaboration, we need to develop a theory of mediated collaboration based on a design research agenda of analysis of small group cognition.

Most theories of knowledge building in working and learning have focused primarily on the two extreme scales: the individual unit of analysis as the acquirer of knowledge and the community unit of analysis as the context within which participation takes place. We now need to focus on the intermediate scale: the small group unit of analysis as the discourse in which knowledge actually emerges.

Following are some research hypotheses for a theory of small group cognition:

- The small group is the unit that mediates between individual learning and community learning.
- Community participation takes place primarily within small group activities.
- Individual learning is acquired through participation in these small group activities.
- Both individual identities and community practices are formed through small group activities.

Here are some theoretical issues to be investigated in such a research program focused on the small group unit of analysis:

- Can we make learning visible in group discourse (so we do not have to rely upon measures of indirect learning outcomes)?
- Can we identify meaning-making and knowledge-building at the group unit?
- Can we say that it is possible for a group, as such, to think, learn, build knowledge or construct meanings that cannot be attributed to any of the group members individually?
- Can processes of group cognition provide a basis for individual cognition and learning?

The size of groups can vary enormously. Our examples tend to be of small groups of a few people meeting for short periods. Given the hypothesized importance of this scale, it is surprising how little research on computer-supported collaboration has focused methodologically on this unit. Traditional approaches to learning measure effects on individuals. More recent writings talk about communities of practice. Many studies of collaboration that do talk of groups look only at dyads, where interactions are easier to describe and qualitatively different from those in larger small groups.

The emphasis on the group as a unit of analysis belongs at the foundation of a science of collaboration. It is not just a matter of claiming that it is time to focus software development on groupware and to develop appropriate techniques (e.g., for assessment of groupware). It is also a methodological rejection of individualism as a focus of empirical analysis and cognitive theory. Software should support cooperative work and collaborative learning; it should be assessed at the group level and it should be

designed to foster group cognition. For that, we need a fitting theoretical framework centered on an understanding of the role of small groups and the mediation of group cognition.

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Us, Ourselves, and We: Thoughts about Social (Self-) Categorization

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ABSTRACT

In a recent Workshop on community-based learning at the 6th International Conference on Learning Sciences (ICLS 2004), one persistent theme was the variety of terms used to describe collections of people (group, community, network, collective) and components of interaction (culture, identity, collaboration, cooperation) in group learning activities. Here, we describe some of the thinking that emerged in those discussions, not as a comprehensive literature review or completely elaborated socio-cultural theory, but rather as an invitation to further discussion. We suggest that a *group* is the most generic and general social category: all of the analytical units in the literature on collective learning - teams, social networks, and communities - are groups. We argue that these other terms have additional structural characteristics that make them distinct subsets of the generic term *group*. For example, a *team* is a group with a common task, a *network* is a group with strong social ties, and a *community* is a group with a shared culture. We propose a two-dimensional space of social organizations characterized by *shared culture* and *shared interaction*, and suggest both individuals and collectives show a developmental history through the space of collectives, moving from loose group affiliation to increasing identification with, development of, and participation in shared interactions within a shared culture. This analysis suggests, we argue, that: (a) tools to support "collaboration" may need different affordances for different kinds of collectives; (b) understanding different kinds of collectives requires different methodologies; and (c) culture plays a prominent role in the space of collectives we describe, and thus, we argue, should play a significant role in the analysis of any community. We hope that this brief discussion will lead to further work on the social entities within which group learning takes place, on the processes of learning in such settings, and on the technologies that can support such processes.

1. INTRODUCTION

They came as a group to oppose Moses and Aaron and said to them, "You have gone too far! The whole community is holy." —Numbers 16:3

1.1. Collectives as Subjects in Learning Processes

Much recent work on socio-cultural theories of learning focuses on the processes of collaborative or (more precisely) collective learning - that is, on how social collectives generate understanding through group learning activities. In such studies, the collective (classes, learning groups, lab groups, teams, learning communities, learning organizations, virtual communities) is at the center of the analytical scheme rather than individual learners in isolation. Similarly, much recent work in computer science on human-computer interaction (HCI) has focused on tools that support collaborative work and community-

building [3—5; 8; 9]. In such work, the focus is on the processes of collective action and on computational means to support it in virtual settings.

The complex interplay between collective learning, technological support and appropriate theoretical approaches for studying these issues was the topic of a recent Workshop on Community-based Learning at the 6th International Conference on Learning Sciences (ICLS 2004). One persistent theme in the workshop was the variety of terms used in these fields to describe the collections of people (group, community, network, collective) and components of interaction (culture, identity, collaboration, cooperation) that were being analyzed and supported.

In this short essay, we describe some of the collective thinking that emerged in those discussions as we attempted to clarify the relationships among different kinds of social groups and the interactive processes that define them. We present these notes not as a comprehensive literature review or completely elaborated socio-cultural theory, but rather as a summary of current thinking and an invitation to further discussion of these issues.

2. SOCIAL CATEGORIZATION AND SOCIAL PERCEPTION

In *Mind, Self, and Society*, George Herbert Mead [7] made a famous distinction between *me, myself,* and *I*, arguing that the *self* that constructs the meaning of events and our understanding of our place in social systems is composed of a socially-constructed "me" and the "I" responsible for constructing the world by self-indicating happenings as salient objects. For Mead, the foundation of the individual as a social organism is in this dual role of the self as subject and object, indicator and indicated.

Categorization (in this broad sense of the term) is thus basic to social experience - indeed, to the human experience. The reflexive construction of self depends on the identification of "me" as a certain kind of me, that is, as being similar to or different from others in some way. "We" understand "ourselves" by dividing the world into "us" and "them," into classes of individuals who are similar or different along a variety of biological, cultural, economic, and social lines: families, tribes, peoples, races, strata, social classes, genders, nations, cultures and subcultures.

The nature and formation of these socially-constructed collectives is central to understanding learning as a social phenomenon, not least because socio-cultural approaches to learning focus on enculturation and identity-formation as central mechanisms for learning and development [1; 2; 6; 15; 15]. At the same time, however, in dealing with collective subjects from an analytical perspective, researchers in learning science and human-computer interaction tend to refer to collectives in deliberately neutral terms, such as work groups, organizational units, departments, networks, school classes, or learning communities. While such generic categories may be analytically useful in some circumstances, the result is that the literature on collective learning sometimes appears less than systematic in delineating functional differences among the central descriptors for the collectives being studied in collaborative settings. Put another way: the nature and meaning of the collective itself is central to the processes of socio-cultural learning, but socio-cultural theories are loose in their use of descriptors for this central unit of analysis.

This dilemma was one of our central concerns, and much of our discussion focused on beginning to articulate a more robust framework for thinking about the nature and properties of the collectives within which (and upon which) socio-cultural processes operate.

3. FROM GROUP TO COMMUNITY: A FRAMEWORK

3.1. "Group" as Fundamental Social Category

We suggest that the most generic and general social category is a (social) *group*, being any collection of more than one person that shares a common attribute which distinguishes them from other persons. What is crucial is that a social distinction is made between members of the group and non-members. That distinction may be embraced by the group or imposed externally (as when race is legally codified, for example), but in either case the formation of the group results in a process of *social identification* or self-categorization as group members [10; 11]. This social identity is based on the awareness that one belongs to a group, and represents the cognitive dimension of social identity; it is also typically associated with an evaluative and an emotional dimension of group identification. If a group member knows about his own group membership and if this membership is accompanied by positive/negative evaluation and emotions, this group membership becomes part of the social identity of a person.

Whether a person is aware of his or her own group membership is largely dependent on the social context and situation. According to *social identity theory* and *social categorization theory* [11—13], the concept of *salience* describes the conditions influencing the relevance of in-group/out-group categorizations for self-perception and behavior. To illustrate this concept of salience, take a heterosexual couple trying to enter a public swimming pool on "Women Only Day." In this situation, the category of sex/gender (the self-categorization of "being male/female") becomes salient to the couple, while in other social situations this differentiation might not be relevant. Thus, a social group emerges from the interaction of individuals within a context in which the distinctive attribute of the group makes a difference.

We thus suggest that *group* is the most fundamental social category, in the sense that all of the analytical units in the literature on collective learning—such as teams, social networks, and communities—are groups. However, we argue that these other terms have additional structural characteristics that make them distinct subsets of the generic term *group*. In the next section of the paper we describe some of these distinguishing characteristics.

3.2. Within Groups: Teams, Networks, Communities

A team needs a common task. We suggest that a *team* or *working group* (or conceptual derivates such as *small group* or *project group*) are groups with a common task to fulfill. Team members have self-perception and awareness of team membership that distinguishes the team from the social outside. Teams also need to have some common understanding of the work they share, a common (or at least overlapping) definition of goals and subgoals, and personal commitment to work for these goals. But these shared understandings, goals, and identities are tied to the task at hand; the shared understanding of team activities, methods, and tools is locally instrumental to the accomplishment of a particular task. When the task is fulfilled, the team disappears. In many cases, of course, teams are composed of members of some larger *community* (see below), and thus shared symbols and patterns of activity may persist as part of that larger community. Stahl (2004, in this Issue) further suggests that as a practical matter, teams are limited in size as well.

Social networks are defined by social ties. A group becomes a network when members are linked by social ties based on social contact and communication - which in *network theory* are referred to as *knots*. Within network theory, the frequency of communications within knots is taken as the main indicator for the strength or weakness of social ties. Quality of the communication is of less relevance, and *social*

network analysis uses counts of communicative acts between network knots to determine the structure of the network. We might describe a team, then, as a temporary local network organized around a particular task.

Communities need shared culture. Unlike social networks, communities cannot be characterized and analyzed only by the *quantity* of social contacts between members. Communities, we suggest, are social networks (and therefore groups) that are defined by the *quality* of their social ties. In particular, communities are networks with a shared *culture*: a set of shared norms, conventions, and meanings; a set of common practices and common symbols that create a shared semantic space.

3.3. Dimensions of Community

In our discussions, we conceptualized these different characterizations of collections of individuals as part of a two-dimensional space of social organizations (see Figure 1). In particular, we distinguished between *shared culture* and *shared interaction*, and suggest that together these dimensions distinguish between collectives such as group, team, network, and community, as described above. We added an additional category of *experts* to the diagram to account for collections of individuals with a shared culture but little interaction. (Note that the set boundaries in the figure are illustrative only.)

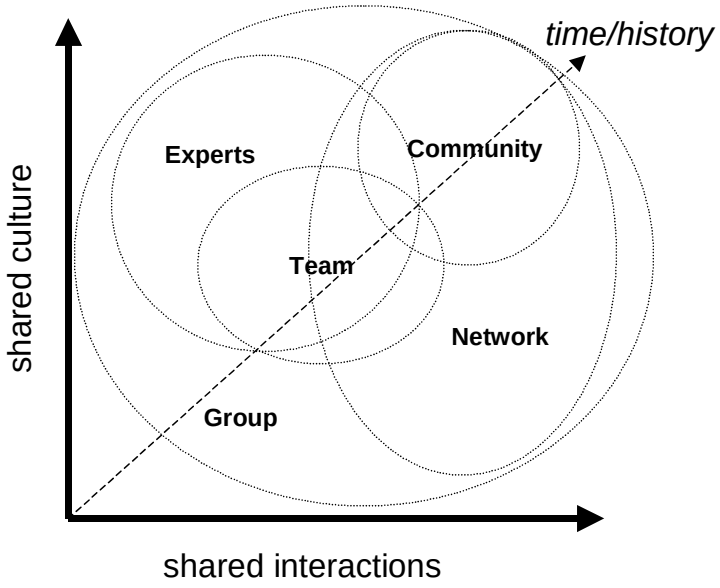

Figure 1: A conceptual map of the space of collectives; the set boundaries are illustrative only. Trajectories of development.

Our space of collectives also suggests a clear developmental trajectory over time. Lave and Wenger's [6; 2; 3; 14; 15] theory of *communities of practice* suggests that learning is a process of enculturation into the shared practice of the community. This enculturation can be described by a movement/development of newcomers from peripheral participation in the community's practice to more and more central roles in the community. On the individual's side the process can be seen as a process of social identification with the community's goals, culture, and practice.

From the perspective of the collective, we note that the community itself develops through the progressive *development* of that shared culture. The interactions over time of community members in a continuous process of negotiation and deliberation establish a common culture and build a collective

identity. The shared culture and shared interactions of communities take time to develop and establish. The concept of *shared history of learning* [14] thus applies both to the individuals in a community and to the community as a whole.

Put another way, both individuals and collectives show a developmental history through the space of collectives, moving from loose group affiliation to increasing identification with, development of, and participation in shared interactions within a shared culture.

4. DISCUSSION

It comes as no surprise that the concepts of *culture*, *identity*, and *history* are useful tools in understanding the nature of collectives such as *groups*, *teams*, *networks*, and *communities*. We suggest, however, that there may be some utility in beginning to map the relationships among such terms more explicitly. The discussion here is only a small first step in that direction. However, even this small step suggests that tools to support "collaboration" may need different affordances for different kinds of collectives. The Web is a particularly effective tool for supporting *networks* of people. Supporting *communities*, however, will necessarily involve supporting a particular culture, and thus (by definition) particular *kinds* of interactions. Different communities will, therefore, almost certainly require different kinds of tools—or tools that can be significantly customized for a particular culture.

Understanding the structural and theoretical differences between different kinds of collectives has methodological implications as well. In particular, the analysis above suggests that social network analysis may be a useful tool to quantitatively analyze social structures; but it may be insufficient to understand the work of communities, which are marked by shared culture, and thus where the quality of social interactions matters as much as the quantity.

More broadly, this analysis suggests that while the *practices* are an important component of groups, teams, and communities, what distinguishes a community is its shared *culture*. This encompasses practices, to be sure - and in the end, culture is constituted in and through practice. But culture plays a prominent role in the space of collectives we describe above, and thus, we argue, should play a significant role in the analysis of any community. Community-based learning is, in the end, culture-based learning, and group learning (whether learning by individuals in the group or the group as a whole), is, as socio-cultural theorists suggest, a process of enculturation.

In any event, we hope that this brief discussion of groups, teams, communities and the similarities and differences among them will lead to further work on the social entities within which group learning takes place, on the processes of learning in such settings, and on the technologies that can support such processes.

5. AUTHOR NOTE

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Re-presenting Collective Learning: A Generative Way Forward

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1. INTRODUCTION

Professional development is increasingly conceived as a sustained group or community process, often supported by online technologies. Yet despite the enthusiasm for online communities of practice [40], and the innovative educational contexts being developed to support them, the reality of developing and maintaining a critical mass of teacher engagement is proving to be challenging (for example, the Inquiry Learning Forum (ILF) [4]; the Hawaii Networked Learning Communities (HNLC) [37]). Teacher educators and designers of technological learning environments continually strive to maximize the value of teacher engagement in such contexts, yet the conditions under which social learning and collaboration become an appropriate strategy for teachers remain unclear [4; 19]. Furthermore, contemporary research from evolutionary psychology [27] and modeling of cultural transmission [5] suggests the likelihood that professional development in sustained groups would involve subtle yet influential *social* learning strategies. For example, decisions regarding the adequacy of a particular concept or professional behavior may be influenced by the status of the group member advocating it, the frequency of the behavior in the group, or even which idea or behavior was offered to the group first [1].

(Online) teacher communities seem to offer a potent model for professional development that aligns with contemporary understanding of learning as situated, distributed and social [21]. However, there is a need to test theoretically driven justifications of communities of practice by undertaking empirical investigations into how learning is actually occurring in these social and technological contexts [3; 11; 34]. Obviously, the task of developing strong explanatory frameworks that take us well past simple descriptions is urgent. The fields of astronomy and molecular biology became explanatory fields of science only after harnessing powerful theoretical lenses borrowed from other fields [7]. When such explanatory frameworks were coupled with advances in technology that expanded the ability to research these fields empirically, the benefits were exponential. In education, design-based research [38] and subtle but powerful technological contexts for learning may provide the strategic means to move forward.

2. BEYOND THE INDIVIDUAL AS A UNIT OF ANALYSIS

Underpinning many of the theoretical perspectives used to analyse social learning in pre-service and professional development contexts is the work of Vygotsky. Fundamental to this perspective is the notion that higher mental processes have their origin within social processes. “Any function in the child’s cultural development appears twice, or on two planes. First it appears on the social plane, and then on the psychological plane. First it appears between people as an inter-psychological category, and then within the child as an intra-psychological category” (Vygotsky, cited in Wertsch [41]). Whilst Vygotsky’s theory has problematised the notion of learning as an individual process, there is little consensus on how best to tackle an analysis of learning beyond

the individual. Many studies of online communities, based explicitly on Vygotskian principles, still maintain a unit of analysis at the level of the individual [2]. This approach may be neglecting the potential of analyzing learning *as* a group, as opposed to learning *because* of a group.

Vygotksy's notion of the 'collective life' as a source of individual learning gave theoretical impetus to 'thinking', 'voluntary attention' and 'logical memory' as group attributes [41]. Vygotsky's theory of educational psychology has thus provoked strong interest in notions of distributed cognition [18]; that is, cognition and learning that transcend the boundaries of the individual.[1] Development on Vygotsky's interpersonal plane has thus been conceived as a form of collective learning. Insights from his work have been incorporated into (amongst others) two prominent sets of ideas within educational research: Wenger's communities of practice [40] (deriving largely from prior, more general notions of situated cognition [20]) and Engestrom's activity theory [10]. These approaches help us understand learning within the complex dynamic of a community setting where there is a shared practice or activity [15]; however, neglect of the 'small group' as an important mediator between the individual and the community is a concern for some [36], given the key role Vygotsky afforded to small groups [41].

Of particular significance to the present paper is Vygotsky's recognition of the need to move beyond a purely sociocultural understanding of learning – specifically, by asserting the interdependence of the biological and sociocultural realms in ontogenesis [41]. This may act as a reminder to educational researchers of the need to be open to possible synergies with contemporary theories in other fields such as biology, neuroscience and evolutionary psychology. Perhaps he was assisting educational researchers towards a science of education through theoretical models that, at the very least, recognise the varied realms contributing to any act of learning. Fletcher asserts such "external coherence" as an indicator of a good scientific theory [12].

The biologically based generative theory of learning [31; 32] offers just such a perspective for educational research, deriving from neuroscience [8; 9] and evolutionary psychology [26]. In this view, learning is conceived as an adaptive behavior that hedges our chances of survival. "To survive in its eco-niche, an organism must either inherit or create criteria that enable it to partition the world into perceptual categories according to its adaptive needs" [8]. According to generative theory this process is undertaken through iterative cycles in which learners generate and test ideas based on their value, selecting those ideas that survive these tests [9; 26; 31; 32]. The value-driven selection that underpins this process operates through a generate-test-regenerate (g-t-r) heuristic that is identifiable at three nested levels [26]:

- At a primary level in genes, by natural selection, as genetic knowledge-gaining;
- At a secondary level in organ systems (immune systems and brains), as the selection of ideas and behavior tested against values that have been developed by individuals through their life-experience; and,

[1] There are many other seminal voices concerning distributed cognition from fields such as phenomenology (e.g., Merleau-Ponty [23]), cognitive science (e.g., Hutchins [17]), and educational psychology (e.g., Salomon [28]), including enactivism (e.g., Davis & Sumara [6]). It is well beyond the scope of this paper to discuss the implications of these diverse approaches.

- At a tertiary level in groups and cultures, again, as the selection of ideas and behaviors, but tested against communal or cultural values.

Within this generative framework, the heuristic's tertiary level proposes a particular understanding of social and collective learning: the learning of each individual in a group is influenced not only by their unique pattern of values at the primary and secondary level, but simultaneously by shared beliefs and values *at the collective level*; that is, within the group and culture in which they are operating. As suggested already, this collective level can, itself, be analyzed for learning and progression.

By suggesting a mechanism by which learning occurs at each nested level, this theory bridges the divide between the individual and the collective. As well, it opens up the possibility of ongoing empirical research that might well deliver external coherence with contemporary understanding in the sciences.

The generative theory is already proving its worth for understanding the learning of individual students and teachers [14; 30; 33] and in re-conceiving e-learning design [35]. Now, its worth in understanding collective learning at the tertiary level is being explored [13]. The context for this research is an Australian project named DESCANT (SciTech)[2]: a design-based research initiative exploring the worth of an innovative e-learning strategy for scaling up teacher development in elementary Science and Technology education within a geographically diffuse education system. In its first phase, a small number of teachers (11 in all) were supported to conceive and prototype their own e-learning environment for teacher professional development in Science and Technology education. Such support was largely undertaken through sustained online collaboration using both generic and boutique software. Following the development of the environment, larger groups of teachers will trial, modify and evaluate the e-learning environment (see http://www.curriculumsupport.nsw.edu.au/science/ftp/Folder1/scitech/index.htm for details). With its thorough collaborative research design, DESCANT has provided a significant opportunity to investigate collective learning.

3. TOWARDS A MODEL OF COLLECTIVE LEARNING

Generative learning suggests a powerful explanatory framework for collective learning. Now there is an urgent need for an appropriate model that can leverage insight from empirical data concerning this educational phenomenon. Due to the inherent complexity of a collective learning context, this task is always going to be a methodological challenge. In the DESCANT context, a model of generative learning that was originally developed for analyzing *individual* learning in technology-and-science education [31] was used as a starting point. That model identifies learning within six acts: exploring, designing, making, operating, explaining and understanding.[3]

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[2] The DESCANT (SciTech) Acronym stands for 'Designing E-learning Systems for Celebrating and Nurturing Teaching (in Science and Technology)'. The project is an Australian Research Council (ARC) funded partnership between the University of Technology, Sydney (UTS) and the New South Wales Department of Education and Training (DET).

[3] The original model that appeared in print in Schaverien and Cosgrove [31] included five acts of learning (excluding operating). This has since been revised to include the sixth act of operating.

Whilst it is beyond the scope of this paper to explain each of these acts, it is important to note that the model is synergistic with the generate-test-regenerate (g-t-r) heuristic.

The generative model was adapted for analyzing learning at the collective level by conceiving of each of the six acts as a collective or emergent phenomenon. This has proven extremely useful in providing insights into the emergence of shared understandings and values in the DESCANT teacher collective [13]. As further insights emerge regarding learning at this collective level, there may be a need to expand the model to incorporate a more explicit representation of such processes as enculturation [5] and the influence of 'collective intentionality' [25]. According to Plotkin, "collective intentionality" (after the work of John Searle), may be fundamental in understanding social force, and thus social learning [25]. Collective intentionality:

> "…is not the sum of individual intentionalities and is not reducible to them…This does not mean that [it]…hovers in the spaces between people or binds their minds through mysterious field forces. Each of us has a mind and mental life that are confined to our individual brains. But to quote Searle, 'it does not follow from that that all my mental life must be expressed in the form of a singular noun phrase referring to me. The form that my collective intentionality can take is simply "we intend", "we are doing so and so", and the like. In such cases, *I intend only as part of our intending*. The intentionality that exists in each individual head has the form 'we intend'" [25]. (Emphasis added)

Plotkin's pragmatism in dealing with collectivity emphasizes the possibility of addressing the link between the neural structures of individuals and the regulation of these structures based on social relationships. This collective regulation in ontogenesis has been described as 'structural coupling' [22] and 'co-emergence' [39], and has been used as the basis for understanding distributed cognition in an educational context [6]. While such perspectives may be of great value in developing a suitable model for empirically analyzing collective learning, the methodological dilemmas remain. For example, what counts as evidence of collective learning and how do we collect data about such emergent phenomena? Furthermore, how do we collect data on a process as subtle and implicit as enculturation: a phenomenon that may be fundamental to understanding how cultural values and shared understandings progress within a population? Yet perhaps in this regard we are in a more fortunate position than Vygotsky was decades ago.

4. A TECHNOLOGY FOR UNDERSTANDING COLLECTIVITY

Within the physical sciences, the advent of new technologies has always played a significant role in the advancement of understanding by allowing humans to engage empirically with what was previously unreachable [7]. Papert's vision of technologically rich environments as supplying 'objects-to-think-with' made a similar vision explicit for education [24]. In educational research, the explicit nature of communication over the Internet has proven valuable for studying many facets of social learning and community design. Nevertheless, within such online contexts, emergent phenomena such as collective learning remain implicit: something for researchers to carve out of the complex context based on their models or theoretical approaches. However, technologies that seek to capture this collective level are now under development. For example, in classrooms, Knowledge Forum software encourages explicit representation of learning within knowledge building communities [15; 29]. Within a professional development context,

Lessonlab technology is affording teachers a cumulative knowledge base that incorporates a dynamic mechanism for verification and improvement [16].

In DESCANT, teachers have identified both the need for an e-learning environment that makes explicit the progression of learning at a collective level and some ways this might be operationalized. This environment is currently under development and will be trialed, as the final phase of the DESCANT project, with a new cohort of teachers early in 2005. For professional development, such an environment may well supply an 'object to think with' [24] by making learning at the collective (or even cultural) level more tangible. Furthermore, with this collective realm of learning made increasingly visible and explicit, researchers may be afforded new opportunities to probe more deeply into what now seem to be mysteries of social learning, just as their counterparts in the physical sciences have done so successfully when afforded appropriate technologies.

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Can we use a Complex Systems Framework to Model Community-Based Learning?

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1. INTRODUCTION

The classroom is bustling with activity and Miss Lawson calls out, "five more minutes." Scattered throughout the room are groups of four and five students crowded around each of the five low-standing circular work desks. A palpable buzz of enthusiasm fills the air as these groups deliberate amongst themselves before hurriedly filling in the large sheets of poster paper sitting on their work desks.

Felicity, Tara, Halia, Scott and Brad, referred to as group "3-3" by their classmates, are located in the middle of room. Tara sits propped on one leg, stretching across the table, eyes trained on the 2'x3' piece of paper with the heading, "How does the length of straw affect the performance of the car?" Felicity and Scott, huddled at the other end of the round table, are working at a frenetic pace to meet the deadline. They switch back and forth between the colored markers, weaving in and out in a seemingly choreographed rhythm while avoiding bumping into each other as they both draw and write on the poster. Meanwhile, Brad and Halia stand over their shoulders, at the ready to attend to any calls for help or information. Felicity calls out, "What were the times for the 18cm straw?" Halia, leafs through the notes and replies, "for trial one it was 3.6 meters, trial two, 4.9, trial three, 4.2." Then, turning it over to the soft-spoken Brad, who in a coordinated effort was simultaneously entering the numbers on his calculator, "The average is 4.2m and the velocity is .31 meters per second."

There is a constant flow of dialog between the five. Raising her head up from drawing the "motion story board," Felicity, in a reflective tone, tries to get the group's attention, "shouldn't the net force arrow go the other way?" Her first attempt goes unattended, and she tries again, this time shifting to a kneeling pose, "dudes, I think the arrows go the other way!" Scott stops what he is doing, turns, and for a few seconds the two recreate the motion of the car through their gestures. "If the car's moving in this direction" gesturing to the left, "then the net force is also in that direction" gesturing to the left. Tara chimes in "I agree with Felicity, when the car is coasting, the net force is in the opposite direction" motioning to the right, while Halia nods in support. The conversation continues for a few more turns and then Felicity concludes by repeating their agreement, "good! When the car's coasting there is only friction force, [and] the arrow goes this way" once again gesturing the direction as she speaks.

Working on what appears to be a slightly different track, Brad, from time to time, turns and scans the wall closest to him. This wall, like all the other available walls of the classroom, is covered with presentation posters from this and other classes taught by Miss Lawson. Without an exchange of words, Brad moves to the other side of the room and

checks out more posters. This apparent unilateral action receives the full endorsement of the group who all turn when he states "Yeah, group 4-2 also tested straw length and their results are the same." Felicity and Scott flash a quick "I told you so" smile and return to writing in the last required component of the poster – the "rule of thumb" supported by evidence. Miss Lawson calls out the final "Time's up!" and the sound of feet scurrying and tables moving into position is heard as students plop into their chairs. Class period 3 is now ready for their poster presentations! It is finally time for group 3-3 to share the fruits of their labor and engage in this now familiar whole-class activity of presenting what they learned from their experimentation. They are also ready to learn from their classmates' poster presentations in this collaborative environment.

2. BACKGROUND

Over ten years ago, scholars such as Brown and Campione proposed a re-conceptualization of the traditional classroom in order to enhance the possibilities of learning in real world settings [5]. The central aspect of the learning environment was to support learning by providing a rich domain of knowledge, structure activities to use this new knowledge within that domain, guide learning by instruction and modeling of thinking and reflection, and deliberately setting aside considerable time for students to engage in explaining processes to themself and others [6]. Their approach to engineering the classroom was referred to as Foster Communities of Learners (FCL). A more generic use of this metaphor may be identified as *learning communities*, which describes other collaborative, inquiry and project-based learning environments, united by social theory (e.g., Vygotsky's *zone of proximal development*; Wenger's *communities of practice*) [19; 20]. Examples of these types of classroom and curriculum projects are found at the institutional research level (e.g., *Knowledge-Building Communities* at OSIE [18]), curricula level (e.g., Learning by Design™ physical science and earth science units [14]) and project level (e.g., science curriculum project [7]).

The success of these instances, as illustrated by the scenario above, demonstrates the importance and potential of multi-voiced/minded construction of knowledge (i.e., shared/social aspect of negotiation of meaning) while engaged in authentic activities. Some have begun to look at the various components of these engineered classrooms and what makes them successful [7; 16]. One thing is clear: we still do not fully understand how to tease apart the complexity of these learning environments to study the interactions of the social and cognitive components while still being sensitive to their emergent qualities. In short, how do complex dynamic systems made up of multiple agents and socio-cognitive/cultural affordances co-develop and change (i.e., learn) over time? And, from a theoretical perspective, how do we begin to construct models of this cognitive development, which accounts for individual (student) and collective (workgroup, and whole class) reasoning and learning, without taking a reductive approach?

In order to explore ways of understanding these settings and addressing the concerns listed above, I propose adapting a dynamic systems approach, which combines complex adaptive systems theory (CAS) with two other characteristics (timescales and history) of complex systems [3; 10]. The intention of this paper, therefore, is to merely introduce this idea and demonstrate how it may be used to understand the scenario described above (a

Learning by Design™ [LBD] classroom). I begin with a brief rationale and overview to situate the reader, and conclude with an outline of the proposed dynamic systems analytical model and its possible strengths.

3. UNDERSTANDING LEARNING IN CLASSROOMS

Increasingly, learning is viewed as the outcome of socially negotiated activity, situated in potentially rich environments, within complex communities of sometimes unequal participants [9; 15; 17]. Furthermore, from the distributed cognition school of thought, we are asked to extend the definition of cognition from individual learner to include the small group, or class as learner. Hutchins proposes: "a social group is a cognitive system that may have cognitive properties very different from those of the individuals who constitute the group" [13]. Although his research describes the cognitive practices of "well-oiled" teams, it is arguable that it also applies to the communities of learners we observe in constructivist classrooms.

One possible approach to understanding these dense and layered learning environments is to employ the analytical framework of Activity Theory, a cultural-historical theory of activity presented by Lev Vygotsky and his colleagues [8]. It suggests that cultural means, tools and signs mediate interactions between the human agent(s) and objects in the environment. Barab, Evans & Eun-Ok Baek provide an excellent example of its use as a lens through which they come to understand the design and participation activity of an online community [2]. Although Activity Theory is a powerful tool for explaining the interactions of socio-cognitive/cultural systems, I propose it is nonetheless worthwhile to explore the explanatory potential of other models such as the adapted dynamic systems model.

Advocating the use of systems models to explain social organization and learning is not a novel idea. Boyd argues for the use of elements of cybernetic theory – "cybersystemics" – to describe classrooms and other social systems [4; personal communications]. Barab, Cherkes-Julkowski, Swenson, et al., propose an *autocatakinetic* systems approach, which suggests that learning would be understood best as a "participatory process involving contextualized practice and meaning as part of an ecological system" [1]. More directly, Hurford proposes using Holland's Complex Adaptive Systems theory (CAS) as a model of individual student learning [10; 11]. He provides an excellent account of how Holland's CAS "mechanisms" can be applied to explain human learning. My use of this theory differs from Hurford's in two ways. Firstly, I am interested in describing the interactions between the three levels of learning – individual, workgroup, and class; secondly, I am particularly interested in exploring the role of what Holland refers to as a "property" of CAS, namely "Flows" [10].

4. ADAPTING HOLLAND'S MODEL OF COMPLEX ADAPTIVE SYSTEMS

A complex system is a hierarchically organized collection of a large number of coupled components defined by stated boundaries. The smallest unit of the system is referred to as

an individual "agent" operating under specified rules resulting in a higher level of organization, which exhibits *emergent* properties. Put simply, emergence is a phenomenon wherein the interaction of a system's parts (agents) results in a higher order of organization (meta-agent or system) causing the system to behave differently from what one could predict from knowledge of the parts alone, and which takes on a different set of operational instructions. According to Holland, complex adaptive systems (CAS) exhibit certain "properties" (Aggregation, Nonlinearity, Flows, and Diversity) and "mechanisms" (Tagging, Internal Models and Building Blocks), which contribute to the process of emergence characterized by the unique, amplifying (sometimes dampening), nonlinear behaviors of these systems [10].

Expanding on this description, a system's emergent properties can be viewed as patterns or recurring structures resulting from nonlinear interactions of lower level parts (agents), that are governed by specific rules and relationships. These rules and relationships are the mechanisms that afford emergence, which is the resultant state of coupling all the lesser processes of aggregation/self-organization, nonlinearity/stochastic behaviors, tagging/selection, and flows of resources. Furthermore, tagging/selection mechanisms regulated through flows of resources allow for adaptation of the system. These powerful combinations are all affected by the "history" of the system, and unfold over varying "timescales."

For this paper, I will examine only how the component "Flows" can be useful in helping us understand learning communities. "Flows" describes the process that allows the system's resources to be distributed. It may in fact be the glue that holds the system together. By carefully observing flows within a system we can identify all the relevant nodes (individuals, groups, artifacts, or environmental components) and their connectors (designate possible interactions). Additionally, if we study a system for an extended period, flows also allows us to identify the changing connectors (their appearance, disappearance), which in turn helps to explain why agents adapt or fail to adapt, as well as the development/adaptation of the system as a whole. "Thus neither the flows nor the networks are fixed in time. They are patterns that reflect changing adaptations as time elapses and experience accumulates." [10]

5. ILLUSTRATION

To illustrate my point, I will use the CAS characteristic of Flows to interpret the classroom scenario described above. It is by no means intended to represent a fully elaborated analysis using the CAS model, but instead provide a flavor of what can be understood about individual and group cognition using this single component.

To start, we identify the system as the classroom, with the workgroups and individuals as meta-agents and agents, respectively. We then identify "information and knowledge" as the major resource within the system. The obvious "agent/nodes" are Miss Lawson and the five students. And, the easily identified "connectors" are the verbal communications (Ms. Lawson's announcement - "five more minutes"; Felicity's request for information - "what were the times...?"; Halia's reply - "for trial one it was..."). For the moment, if we look exclusively at this level of interaction we can identify connectors between the

teacher and the group, Felicity and Scot, and the onlookers Tara, Halia, and Brad (see Figure 1).

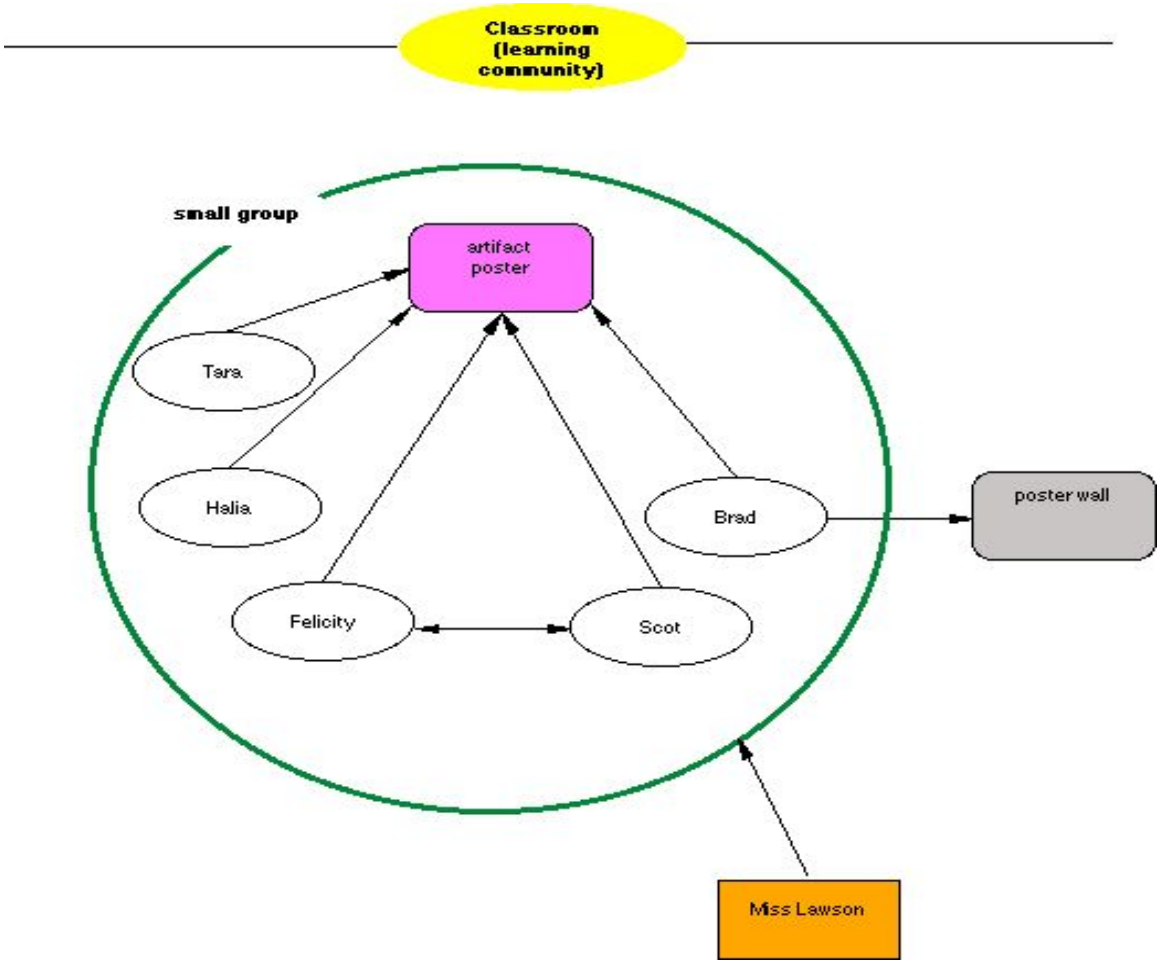

Figure 1: Initial observed interactions from the scenario described.

Studying the scenario more closely we recognize that the presentation poster (2'x3' paper and written contents) and classroom walls (poster archives) as other nodes within the system. In fact, these nodes are very significant because they contain the history of the system and the workgroups. In addition to these nodes, we also recognize a larger number of connectors within the system, such as the kinesthetic actions of the students (Felicity and Scot gesturing the direction of the force diagrams; Brad running to the poster wall), which also allow the flow of information within the system.

From this perspective, the limited initial set of interactions becomes a large network of possible interactions (see Figure 2). This lens allows us to view Felicity as a significant agent/node, whose question ("shouldn't the arrow...?") plays a central role in connecting other agent/nodes and artifact/nodes. Her initial question, which results from the flow of information within the connector between her and the poster, is amplified by subsequent flows of information within the connectors between her and the agent/node Scot; as well as flows of other coordinated activity (verbal utterances and gestures) within the

connectors. It also calls the attention of the other members of the group, demonstrated by Tara who chimes in, "I agree with Felicity", and Halia, who nods in agreement.

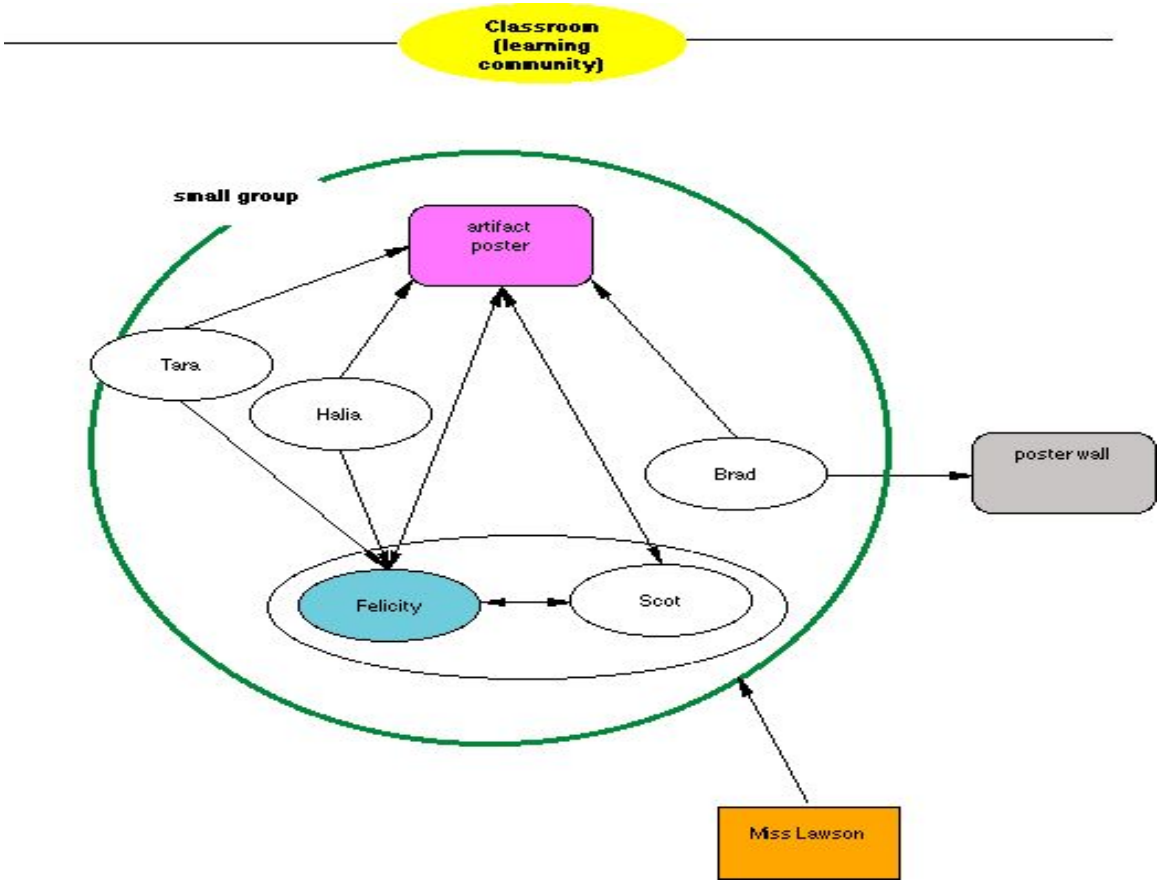

Figure 2: Closer observation of interactions from the scenario described.

What does this tell us? On the level of the individual it is reasonable to suggest that Felicity and Scot, who are directly interacting with a major node/artifact (presentation poster), are most likely actively constructing knowledge. On the level of the workgroup, this CAS lens helps to explain the role of the presentation poster as a contributor to the group's cognitive development. It does this by allowing us to view the other agent/nodes, who at first appear to be merely onlookers to this multi-modal exchange, as collaborators through their agreement (verbal and nonverbal). Although Tara, Halia and Brad do not appear to be directly engaged, the connectors between them and the temporary "cluster" node (Felicity and Scot) become more evident as the scenario progresses. And, although Brad's interaction (connector) with the wall/node (seeking missing information) does not relate to the discussion of the cluster node (Felicity and Scot's conversation), it does demonstrate that he is attending to the poster/node. Hence, possibly explaining why his individual cognitive development may be different from members of his workgroup.

6. CONCLUSION

This sample application using the lens of CAS Flows allows us to see some of the value of this model. It can account for the individual as well as the group because it focuses on the interactions rather than on any of the two organizational levels. It also accounts for the history component of complex systems (although this point is not developed). I argue that it allows us to explain the "shared enterprise" in such a way as to describe collective learning in a non-reductive manner.

This is important because we need a dynamic and inclusive model, which allows us to account for the multiple agents (student, teacher, workgroup, artifact, environment) and the product of their interactions, which may be collective artifacts, or collective knowledge. Complex dynamic systems theory provides us with such a tool, and allows us to construct models of these systems so that we may better understand them and predict the impact of changes within them, such as their adaptations, how certain features are selected, and the importance of history and timescales in the development and evolution of the learning communities.

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Pedagogical Praxis: Using Technology to Build Professional Communities of Practice

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1. INTRODUCTION

Over the past decade and a half, work in the field of education on *communities of practice* [20] and/or *communities of learners* [2] has focused on how individual development takes place within the larger context of the norms and activities of a community. Recognizing this, educators working within the sociocultural tradition have focused on documenting the practices of extant communities [12; 18--20; 35] and/or on ways in which the "community of practice" of the classroom can be improved [2; 25]. Broadly speaking, this work looks at how the traditional intellectual disciplines (such as math, science, and history) are mobilized in the context of real-world practices, or how importing more authentic practices into school settings can develop disciplinary understanding more effectively.

One problem with such approaches is that the traditional disciplines focus on knowledge rather than action. The ivory tower is deliberately isolated from the day-to-day problems of life in the world [7]. Mathematicians, historians, and research scientists clearly form communities of practice. It is less clear, however, that their authentic practices are the most useful models for the majority of students—or that the disciplines they practice are the most important ends in a post-industrial society.

In this short paper, I describe *pedagogical praxis* [33] as a fundamentally different approach to thinking about communities of practice in educational settings. Pedagogical praxis focuses on the development of useful and socially valued ways of thinking through personally and socially meaningful activity. That is, pedagogical praxis links learning and doing within the framework of communities of practice, but it does so by reframing two fundamental premises of much recent work. First, pedagogical praxis suggests that professional practices such as medicine, law, architecture, and journalism have distinct and coherent *epistemic frames* [32] analogous to the "ways of thinking" usually attributed to the traditional disciplines. These epistemic frames, rather than the traditional disciplines, are taken as the educational goal. Second, pedagogical praxis suggests that by engaging in epistemically faithful adaptations of the reproductive practices of professional communities, students can gain access to these ways of knowing—and thus, to ways of thinking that are fundamentally grounded in the meaningful activities of a post-industrial society.

2. PEDAGOGICAL PRAXIS

New technologies make it possible for young people to participate more directly in the world of adult activities, whether using software tools to develop new mathematical proofs [21], participating in the collection and analysis of real scientific data [6], or publishing work on the Internet. Thus, new technologies make it easier for students to learn about the world by participating in meaningful activity. This idea is not new; rather, it explains one way that new technologies support Dewey's vision of bringing the "life of the child" into an environment for learning [3].

Dewey argued that knowing and doing are tightly coupled, and thus learning needs to take place in the context of activity [3; 22]. Moreover, as Dewey suggested in *Art as Experience*, learning involves meeting and overcoming obstacles in the process of trying to accomplish a meaningful goal. "Resistance and check," he wrote, "bring about the conversion of direct forward action into re-flection [*sic*]" [4]. Schon argues that professionals enact this link between knowing and doing through a process of reflection-in-action: literally, "a capacity to combine reflection and action, on the spot... to examine understandings and appreciations while the train is running" [26]. Schon's work suggests that professionals learn to think in action, and that they learn to do so *through* their professional experiences. Reflective practice involves taking action and then reflecting on the results with peers and mentors.

As Vygotsky and other theorists have suggested, this reflective process is progressively internalized: the norms, habits, expectations, abilities, and understandings of a community of practice—the ways of thinking and acting of the community—become part of the identity of the individual [8; 19; 20; 36--39]. Lave and Wegner describe a community of practice as a group of individuals who share a repertoire of knowledge about and ways of addressing similar (often shared) problems and purposes. In the process of participating in the learning practices of such communities, individuals develop ways of thinking and reframe their identities and interests in relation to the community [20]. For example, journalists share common ways of thinking and working, and individuals who work in the field of journalism incorporate these ways of thinking and working into their sense of self, coming to think of themselves, at least in part, as journalists.

Different communities of practice (for example, different professions) have different epistemologies: different ways of knowing, of deciding what is worth knowing, and of adding to the collective body of knowledge and understanding. I have described these different epistemologies in more detail elsewhere as epistemic frames: the grammar of a culture of practice that binds practice, identity, interest, and understanding with a coherent epistemology [32]. In the context of professional activities, these ways of knowing are constituted in practice, and the processes of professional training are designed to link praxis and epistemology through pedagogical activity. Pedagogical praxis thus takes a *learning practices perspective* [12; 28], using the ways in which professionals are trained as a model for learning environments. This is in contrast to approaches that develop learning environments based on the activity structures of experts in professional practice in real world contexts [3; 11; 13; 17; 19; 20].

3. DESIGN OF LEARNING ENVIRONMENTS

The challenges in educational design from the perspective of professional learning practices are three-fold. First, one must uncover the structure of learning practices as they are currently constituted: the relationships among activity, pedagogy, and epistemology that different learning practices embody. Second, one has to map the relationships between the epistemologies of practice and the kinds of understanding (cognitive, social, moral, and practical) that we want young people to develop in the course of their education. And third, we have to develop techniques for adapting extant learning practices to create environments that are true both to the ways of knowing of those practices and to the central skills, habits, and understandings that young people need to incorporate given their developmental trajectory. That is, we need to know how professional learning practices work, how they relate to what young people need to learn, and how to use technology to bring those practices within young people's grasp.

Environments that develop constructive skills, habits, and associations function as coherent systems [2; 23; 31]. Any successful implementation of a context for learning depends on a clear articulation not only of "surface procedures," but also of the underlying "principles of learning" [2]. One approach to creating such coherence, explored by many designers of thoughtfully innovative learning environments, is to articulate a set of principles that will guide the design of activities and assessments [1; 2; 5; 9; 10; 13--17; 24; 25]. A challenge in this approach is that the number of principles and practical constraints multiplies quickly. Designing an environment that is practical and simultaneously addresses a complex system of requirements can be daunting.

Pedagogical praxis takes a different approach. Because professional learning practices have evolved into coherent systems over time, pedagogical praxis suggests that professions such as accounting, architecture, mediation, engineering, journalism, law, and medicine can provide particularly powerful models for developing technology-based learning environments in which young people can learn important skills, habits, and associations [29; 31]. The model of pedagogical praxis is to uncover the principles embedded in existing learning practices (a problem of cognitive anthropology and interpretive ethnography), develop technologies to help students participate in these practices (a problem of engineering and technology development), and then create experimental learning environments designed to develop life skills through participation in a community of practice (a problem of program design and action research).

That is, rather than looking to professional practices to find principles that can be used to design classroom activities to teach math, science, or history, pedagogical praxis seeks to create environments that are *thickly authentic*. Resnick and I [34] have argued that authenticity is an alignment between activities and some combination of (a) goals that matter to the community outside of the classroom, (b) goals that are personally meaningful to the student, (c) ways of thinking within an established domain, and (d) the means of assessment. Thickly authentic learning environments create all of these alignments simultaneously—for example, in the case of pedagogical praxis, when personally meaningful projects are produced and assessed according to the epistemological and procedural norms of an external community of practice.

In this vision, new technology reinvigorates Dewey's idea of learning important life skills through active engagement in meaningful activity [3]. Young people learn by working as "practicing" professionals [26; 27; 29--31]. Pedagogical praxis focuses on communities (or cultures) of practice not as a means to an end, but as an end in themselves: to help young people incorporate into their identity development a variety of ways of thinking that are used to shape the world in which they live.

The implications of pedagogical praxis are thus quite profound. They suggest that the ways in which professionals acquire their practices may provide an alternative model for organizing our educational system. Thickly authentic adaptations of professional learning practices make it possible for students to learn through participation in valued reflective practices, and thus give educators an opportunity to move beyond disciplines derived from medieval scholarship constituted within schools developed in the industrial revolution—a new model of learning for an era of dramatic social and economic transformation brought about by new technology.

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Part II. Empirical Findings

Co-Reflection in Online Learning Environments

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1. INTRODUCTION

While peer collaboration is the basis for co-learning in many groups, in the classroom the prevailing assumption is that teachers facilitate student learning, through course structure, setting learning tasks and outcomes, presentation, discussion, facilitating small group learning, coaching, and mentoring, among others. Though instructional design models have recognized that learning builds on interactions between learners and their environments (teachers have moved from “sage on the stage” to “guide on the side”), these models tend to focus on individual student learning rather than group learning.

Educational contexts are, by nature, group learning environments. Through the mediation of language, students *and* teachers acquire new understandings when individuals transform their structures of meaning in response to knowledge frameworks and the meaning structures of other individuals. Pedagogy truer to a social constructivist view of learning would shift the locus of learning toward the group to account for these processes of transformation, which according to Vygotsky are based on an internalization of social experiences that is built on higher mental functions, cultural development, and self-regulation [14]. Gerry Stahl in “Mediation and Group Cognition” proposes that these processes can best be seen operating in small groups as group cognition, with individual cognition emerging as a secondary effect [12]. In this view, group cognition is both the process and product of interpersonal interaction mediated by language.

I propose that reflection — done individually and collaboratively — is a core activity of group cognition. Using higher mental functions (e.g., metacognition) and self-regulation, individuals perceive, respond to, and integrate new knowledge gained as a result of their relations with others [1]. When learners co-reflect, their understandings are deepened, broadened, and intensified. In online learning environments, the products of cognition — thoughts — as they exist in discourse are embodied in the records captured by the computer. In this paper, I investigate the nature of reflection and co-reflection through data derived from an online action research course I recently facilitated.

2. ONLINE ACTION RESEARCH COURSE

In the spring of 2004, I facilitated an online course for learning about action research with two graduate students working toward a school library media specialist certification in the University of Hawai‘i Library and Information Sciences Program. Both Ruth and Sarah (pseudonyms) not only studied action research but also applied it to their tele-mentoring of two high school students, undertaken simultaneously with the course. Using data derived from email messages, chat transcripts, server logs, participant-created web pages, journals, interviews, and observations during our few face-to-face meetings, I

examined how the co-construction of knowledge occurs and how it contributes to an understanding of action research.

The course used the simplest online software available (wiki-style collaborative software), implemented by a learning facilitator who believes in the importance of "social capital." I based the course design on these ideas:

- Learning is a whole-person activity involving cognitive, affective, and social dimensions [1; 4; 14; 15].
- Knowledge is socially constructed [5; 14].
- Relationship building based on respect, trust, and sincerity is as fundamental to online learning environments as it is to face-to-face environments [9; 16].
- "Social capital" is basic to learning success and should drive the development of the computer software [2; 10].
- Empowerment is an important goal of learning [7; 8].

In discussing their own philosophies as teachers, the students revealed that they generally shared these ideas. Though we had taught at different levels (elementary, high school, and adult education), we aimed at empowering our students through constructivist teaching, accommodating different learning styles, and building relationships with and among our students. We also shared the service orientation of librarianship. Our relationship building during the course was facilitated by a shared professional culture as teachers and librarians.

I chose the text-based wiki software because I believed that: (1) students who create their own web pages as an integral part of the learning process are more likely to reflect and to sustain their motivation for learning in the virtual environment; (2) the products of the learning process should remain as a source of individual and community memory for shared learning and further reflection; (3) it is important for instructors to have the flexibility to adapt the website to evolving learner needs; and (4) the flexibility of the software can encourage participants to adapt their learning and communication strategies and patterns to the online environment.

The students and I interacted primarily via email and weekly chats. The students also used the software for module assignments, journal entries, brainstorming, writing drafts, bibliographies, and progress charts. I used the software to structure the course; to post assignments, student work samples and course readings; to link to external resources; and to create chat summaries, among others.

3. ONLINE "VISIBILITY"

Visibility of thoughts, feelings, and actions is the basic element upon which mutual understanding, social bonding, and group cognition are built. Despite our shared professional culture, significant differences affected our visibility to each other and our learning interactions. These included learning style preference, attitude toward technology, and the existence of a prior relationship.

Ruth, an elementary school teacher, stated that she was a visual learner who often uses graphic representations and conceptual mapping to take notes and to work out her ideas. With the exception of simple tables, the wiki software does not support graphic representations. Not surprisingly, this text-based medium inhibited her ability to express herself. She also noted that she was cautious in her online communication, as she felt it was prone to misinterpretation without the nonverbal cues and immediate feedback available in face-to-face interaction. Her email messages were generally brief and business-like. She had previously taken an online course that made her uncomfortable with online communication, particularly chat. At the end of the course, she ranked our few face-to-face interactions as more important than email or chat for her learning progress (though less important than journaling, as I discuss in the next section). Because she and I had not developed a relationship prior to the course, this signified to me the importance of including face-to-face interactions in an online course, where possible.

Sarah was a high school English teacher adept and at ease with writing. She had not previously taken an online course, although she had experienced hybrid courses in which online communication was used to support face-to-face interaction. The text-based medium, both synchronous and asynchronous, supported her ability to express herself. She openly expressed her thoughts and feelings, even uncertainties and anxieties, often thinking "out loud" as she wrote. Her frequently long emails were written in a conversational style. She and I had established a relationship in an earlier class. At the end of the course, she stated that, although she had gotten to know me far better during the course, she felt that she was able to express herself more freely because a relationship of trust had already been established.

4. REFLECTION AND CO-REFLECTION AS GROUP COGNITION

What emerged as the critical indicator of individual and group cognition was the use of reflection skills. Action research requires reflective inquiry toward the goal of improved practice. The key aspects of reflection identified in the students' discourse were: (1) being aware; (2) returning to experience; (3) attending to feelings; (4) probing experience; (5) evaluating experience; (6) making a leap of thinking; and (7) integrating new understanding. These features are supported by the work on reflective inquiry and reflective practice done by Dewey, Schon, and Boud et al. [3; 6; 11].

I propose that the reflective self can take two stances in the processes of group cognition, depending on level of interaction. Regardless of level, the reflective self operates according to Vygotsky's assumption that "human learning presupposes a specific social nature and a process by which [individuals] grow into the intellectual life around them" [13]. Immersion in intellectual life involves interaction with the thoughts, feelings, and experiences of others who may or may not be co-present in the learning group.

In the first stance, the reflective self engages in inquiry without seeking feedback. Interaction in this case is subtle. It begins with a response to others who are brought to mind through reading, memories of previous interactions, or vicarious experience. The products of this reflective process can make a valuable contribution to group cognition in online learning environments when records of thoughts, feelings, and actions remain visible to co-learners as potential sources of further reflection.

The second stance — co-reflection — is more overtly interactional. I define co-reflection as a collaboratively undertaken reflective process. Based on the concept of dialogic inquiry developed by Gordon Wells, I use the term to indicate an inquiry process at a higher level of intellectual and emotional maturity than the K-12 educational context used by Wells [15]. The nature of co-reflection is that participants build knowledge together through discourse, bringing in their experiences and the use of relevant information to achieve understanding of a topic, issue, or problem of interest. They engage in collaborative learning — meaning-making with others — in order to extend and transform their understanding through a jointly undertaken activity. Co-reflection is fostered in relationships based on respect, trust, concern, and sincerity.

Ruth exemplified the first stance and in fact used the course to develop her reflection skills. In her journals, she described a greater awareness of her perceptions, values, and teaching practices that was powerful and empowering. The emergence of a more deeply reflective self seemed to have been triggered by the course content and early focus. In an early journal entry, she notes that the course readings "heightened my awareness of the littlest things, and seemingly meaningless events have magically transformed themselves into deep connections … Taking a closer look at one's own practice allows one to not only examine how one teaches, but more importantly why particular actions were taken, what actions could have been taken, and places the focus on actions that can be controlled, your very own … It also entails coming to a deeper grasp of the questions: Who am I? What do I stand for? What do I believe in? Why did I make the choices that I did?" In her research project for the course, she investigated her own learning style through her online interactions with me and with the high school student she was mentoring. In the process, her view of herself as a teacher was transformed. In her final paper, she stated, "I am empowered by the desire to discover more and learn more about how I go about interpreting the world around me." At the end of the course, the component she ranked as most important for her learning progress was journaling. The power of her insights extended beyond herself to the learning group. Both Sarah and I read Ruth's online writings and acknowledged their value for expanding our thinking.

In contrast, Sarah came to the course with well-developed reflection skills. She co-reflected with me as her primary partner. For her research project, she examined the online questioning strategies she used with her tele-mentee for "building a relationship in a virtual setting." We actively exchanged email messages throughout her process of focusing her topic, clarifying action research concepts, coding email messages with her tele-mentee, analyzing data, and writing her final paper. As she was writing her paper, she engaged in a significant co-reflection activity. To gain a deeper understanding of action research, she re-read, reflected on, and responded to all 11 of the chat summaries I had created to date, giving me further food for reflection. Importantly, she indicated how online communication supports the internalization of group-mediated learning: "When I went into the chat that night I was a little lost. During the chat, my confusion cleared and I started to feel I had a handle on my ideas. Later, when Joyce listed out my claims, evidence and possible warrants [in the chat summary], I almost did a double take — she had made everything seem so clear and at the same time, I don't think my notes from the chat were this clearly set out. I'm so thankful that the wiki enables us to return again and again because if she had just said these things to me, they would now be lost."

As well as being a learning facilitator, coach, and mentor, I was also a co-learner about the art of teaching. Sarah and I had an extensive discussion about the nature of constructivist teaching/learning that resulted in a multifaceted view combining our different approaches. Sarah initiated: "My main question with constructivist teaching is how do you give the student the freedom yet provide the framework so the learning is rigorous? Is the rigor in the final product that the teacher assigns? This doesn't seem true to constructivism — it seems the student must determine the assignments?" She noted that she was "too new at independent and action research" to feel confidence in herself as a constructivist learner.

This struck a chord with me: "All semester I've also been thinking about 'freedom and chaos.' I reorganized the wiki during spring break because it was getting chaotic. The reorganization was based on what I learned WITH you and Ruth throughout the semester. You've sparked an idea for me — I think constructivist learning is successful only with the proper balance of structure and freedom. The structure can come from the course; it can also come from the students — inside their heads based on prior experience and thinking."

Sarah responded, "Although you might have seen the course as chaos, I never really did because… I trusted you to guide me through whatever needed to be done. I was too busy trying to understand the readings and think of my research question to consider if things needed to be more structured. I think I was in my own little world." She also acknowledged the value of her previous experiences for understanding action research, "There have been many times during the course that I felt lost, but I framed the information in regard to my teaching and considered how it was true or how it applied for me in the classroom." She added that finding the balance of freedom and structure must be challenging in large classes, "I'm sure you can see that Ruth and I are at different places in our learning and that we react differently to the readings. Imagine if you had a class of 25-30. How does the teacher create this balance then, in a constructivist setting?"

I realized the need for more course structure while still valuing individual initiative to drive inquiry learning: "I now definitely see the advantages of having more structure in the course from the beginning, with the freedom to deviate from that structure along the way if necessary. You mentioned 'being in your own little world.' That's precisely where you should be. I have a quote taped to my bookshelf that inspires me about teaching, from Martha Graham: 'It is that openness and awareness and innocence of sorts that I try to cultivate among my dancers … it is not a question of putting something in but drawing it out, if it is there to begin with ... I would like to feel that I had, in some way, given them the gift of themselves.'"

Sarah responded, "I like this quote from Martha Graham — especially the part about education is 'drawing it out as if it is in there all the time.' I think I wouldn't have agreed with this quote even about five years ago because I think that education is about exposing students to new ways of thinking or approaching the world, but now I see that it is true in the sense that in order for the learning to be meaningful for the students, it needs to make sense to them and be personally relevant."

This discussion helped me clarify my understanding of constructivist learning — that the freedom to co-construct knowledge relies heavily on how an individual learner's

structure of meaning interacts with disciplinary frameworks and with the meaning structures of others. Because of this, teaching is a process of invention.

5. CONCLUSION

While it may be more difficult to identify indications of group cognition in dyads than in larger groups, similar processes seem to be at work. This paper proposes that reflection is a core activity for meaning making and knowledge building at the small group level, whether dyadic or larger. Reflection skills enable learners to perceive, respond to, and integrate new perspectives, and co-reflection achieves a broader and deeper understanding than is possible through individual reflection alone. The students in this study used their reflection skills differently to understand and apply the ideas and tools of action research, but the products of their differentiated learning contributed to group cognition.

These products are embodied in communication that is permanently captured and always accessible online. As Stahl states, "The knowing that small groups build up in manifold forms is what becomes internalized by their members as individual learning and externalized in their communities as certifiable knowledge" [12]. The online medium enhances the ability to externalize knowledge and thereby strengthens the potential for internalization by individuals.

What factors may influence group cognition in learning environments? The first is whether the intent to learn as a group exists, related to the instructional model used. Other factors include learning style preference, attitude toward technology, and the degree to which trusting relationships are built.

Regarding technology support for group cognition, this study suggests that "visibility" and "humanization" are vital in the online medium. Lacking nonverbal cues to indicate understanding, confusion, joy, delight, frustration, or anxiety, online communication needs explicitness about thoughts, feelings, and actions to offset the potential for misinterpretation of messages. The computer software and social capital (respect, trust, concern, and sincerity) should support a high degree of expressiveness, both verbal and visual. This raises other questions. What tools and representations should be built into the software? How can the software allow individuals the freedom and flexibility to create and co-create while providing structure, rhythm, and visibility in an efficient manner? What is the optimum balance? And finally, how can we assess the quality not only of individual cognition but also of group cognition? How do we identify not only individual empowerment but also group empowerment?

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Communities of Reflection-Practice and Clash of Communities: Thoughts on the (Re-)Design of Classes in Humanities

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1. INTRODUCTION

Grounded in constructivist instructional philosophy [5] and a view that the purpose of schooling is to prepare students for a changing workplace [7; Partnership for 21st Century Skills, www.21stcenturyskills.org], learning scientists turned to communities of practice (CoPs) to get inspiration for the design of learning activities in classrooms that resemble the 'authentic' and 'real-world' situations found in CoPs outside of schools. For domains that are naturally close to the workforce, like domains in the sciences, technology, engineering, math, and others, it seems a perfect match and classroom environments are transformed to resemble CoPs [4; 6; 9].

How would a similar attempt work with domains traditionally not as close to the workforce and situated in the humanities, and how would domain-differences play a role in the design of CoPs within formal in-school education? The purpose of this position paper is to provide a preliminary examination of the complexity of transferring the ideas of CoPs into the re-design of humanities classrooms. The context of this position paper is an on-going process on re-designing classes that lie in the core of humanities, particularly classes in the Philosophy of Science (PoS) and several classes in Religious Studies.

While studying the PoS, one engages in questions such as: “What is the nature of science, scientific explanation, and scientific knowledge?”; “What are the underlying theories of truth in science?”; “What are conceptual consequences modern science imposes generally on basic philosophies of knowledge and nature?”; and “What makes an investigation scientific?” In short, PoS asks questions on the assumptions of scientific belief and practice.

Religious Studies is a humanistic discipline that uses a variety of methodologies from other disciplines like sociology and anthropology. A widely accepted definition of religion states that it is "a system of symbols which acts to establish powerful, pervasive, and long-lasting moods and motivations in [people] by formulating conceptions of a general order of existence and clothing these conceptions with such an aura of factuality that the moods and motivations seem uniquely realistic" [3], but as an hermeneutic discipline it is better to be cautious, for as Smith (1998) says "One re-defines religion every time one studies it" [10].

2. TYPES OF COMMUNITIES

2.1. Communities of Practice

For a number of scholars, the design of instruction is the same as the design of practice fields, which means that "designing a learning environment begins with identifying what is to be learned and reciprocally, the real world situations in which the activity occurs" [1]. Learning outcomes are derived from these situations with authenticity as their most valued attribute; they need to have similar "cognitive demands the learner would encounter in the real world" [1]. In practice fields, students are engaged in domain-related practices around domain-related problems like how to design a bridge, rather than around school problems like well-structured story problems involving right/wrong solutions to formula-driven problems.

In their critique on the shortcomings of practice fields and their call for CoPs in education, Barab & Duffy argue that schools have inherent problems to becoming practice fields because the activities are still connected with grades - which makes them unauthentic - and they are solely practice-oriented and not oriented towards real contributions to a community outside of their school [1].

2.2. Communities of Reflection

Both approaches - practice fields and communities of practice - have a strong underlying assumption that these CoPs are communities *practicing* or *doing* commonly performed tasks. It is safe to say that there is a wide acceptance of the fact that communities of practice in chemistry, for example, are full of people actually *doing* chemistry and being engaged in a CoP. The situation looks different for the particular approach to practice advocated by a field like the Philosophy of Science. There are not a lot of communities *practicing* these approaches outside of academia. Because most practitioners are professional philosophers employed by schools and universities, there are no well-defined CoPs for the Philosophy of Science.

There are, however, a lot of practitioners actively engaged in scientific CoPs practicing science. They operate under assumptions within their scientific field, and therefore, in Barab's and Duffy's sense, can be seen as a CoP for the field of Philosophy of Science [1], i.e., a CoP of practicing chemists engages in reflection-in-action as part of their practice as "reflective practitioners" [8]. However, people engaged in the CoP of chemistry are not necessarily as equally involved in the practice of reflection as they are in the actual practice of chemistry. Reflecting on their assumptions and engaging in a meta-discourse of their own practice does not form the center of their day-to-day work; these may be under-articulated, and tacit elements. I propose a distinction between the overall CoP and the sub-community of reflection (CoR). This distinction might help us to better focus on different elements, functions, and goals of qualitatively different communities within a larger CoP. A field like PoS can help to make reflective components and tacit elements of a CoP more explicit. Under-utilized fields or fields which are perceived to have less value for a larger CoP, like PoS, become more important and necessary for broader issues when designing CoPs in classrooms.

2.3. Communities of Reflection-Practice

So far, this paper has distinguished between a community of practice and a sub-community of reflection. In the CoP of chemistry there is a practice of chemistry and a practice of reflection on doing chemistry. These intertwined communities have well-defined boundaries that are set by professions, widely accepted forms and modes of contribution to a larger community, and they inform each other in their practice.

Let's examine if the proposed distinction is useful, or if we need further refinement, by beginning to focus on the domain of Religious Studies. When we try to build a CoP in classrooms, who are the practitioners we focus on in the field of Religious Studies? We cannot start with religious professionals like church workers or medicine women. This focus would be too narrow and would include only areas of theology, ministry, or religious education, which are not the same as Religious Studies. The aim of Religious Studies is much broader, and is described earlier in this paper.

If we are not focusing on 'religious' professionals, there are no other professions outside of academia and we have to turn to a much larger spectrum to find an example of practice. Human beings and/or different cultural systems at large come to mind. Religion is a worldwide phenomenon and depending where individual researchers draw their definitory lines, religion seems to be everywhere. This multitude of 'cultural' CoPs are different from the CoPs described in earlier sections of this paper: the practice is not defined by professions and by well-set boundaries. Other aspects are similar: there are commonly shared practices, well-accepted forms and modes of contribution to a larger community, and there is a practice of reflection within the different CoPs.

Does the introduction of cultural CoPs help us to build CoPs in Religious Studies classrooms? Engineering professors and students can engage in the building of bridges and can reflect on their practice and the practice of engineers outside of classrooms who are building bridges, and it would be an 'authentic' activity. Religious Studies scholars would find it difficult and artificial to build religious communities or cults and establish rituals and other religious activities in their classroom. Religious Studies scholars and their students are not producing sacred texts and their time for research and teaching is not referred to as sacred time. Religious Studies scholars, rather, are engaged in comparative studies, ontological development, reflections on the nature of religion, and reflections on the impact of religions in other areas of culture such as politics.

Religious Studies is consistent with CoPs that deal with a variety of different CoPs and is not necessarily the reflective sub-community of one particular CoP. The practice of Religious Studies scholars is solely reflective and does not necessarily influence the practice of the CoPs it is reflecting on. I propose a distinction between a community of reflection which is a sub-set of the community of practice, and a community of Reflection-Practice (CoRP).

3. CLASH OF COMMUNITIES

The search for instructional strategies and design models for communities of practice in school environments revealed several appealing methods, including inquiry-based, discovery-based, real world case-based, and problem-based scenarios, an involvement of

out-of-school experts and contributions to communities surrounding the school or remote ones through Information and Communication Technology (ICT).

For subject areas that draw their examples from defined jobs, tasks, and problems like engineering or biology, the design of 'real-world' challenges is hard but rather well-structured by definition. Medical and business students are engaged in case studies, often with real patients or clients; engineering students build bridges in parks and environment-friendly houses; bio-technology students unveil genome structures to design genetically altered food together with a bio-tech company; journalism students are regular contributors to news media; and instructional design students (re-)design training and support systems with human development departments.

Designing learning environments that are oriented towards 'real-world' challenges for PoS, Religious Studies, or other similar disciplines is harder and ill-structured, especially if it is not even clear what these might be or how they could be staked out.

Often, the connection with real world problems added complexity and richness into classrooms, which were both seemingly missing from textbook learning or simplified school examples. For the students though, it is more that the problems add an engagement with responsibilities, procedures and constraints that they are likely to discover in the jobs they seek outside the classroom. The change that came with a stronger emphasis on the implementation of recent developments in learning sciences was welcomed, not only due to the fact that the field of learning sciences responded to a need, but also because the development of newer learning theories was deeply rooted in the fields of Science, Technology, Engineering, and Mathematics (STEM) and other workforce-oriented fields.

How do these developments look when applied to the humanities and related fields? We experience a clash of cultures when we bring models and approaches of the learning sciences together with subject areas for which they were not developed, i.e., in which models are implemented rather than developed. The implementation can result in emerging struggles to negotiate data structures and ontologies [4], in inappropriate use of methods, and in conflicts between scientific inquiry methods and hermeneutic ones in historical contexts (see example in [2]).

When the learning sciences meet a subject area like PoS, with its community of scholars (instructors and practitioners) in the field, questions arise and need to be addressed, such as: “How does the learning sciences community interact with the other community?”; “Are they building a new community?”; “Are they supporting each other or interfering with each other?”; and “Are they supporting or objecting to images of the community instead of the community itself?”

I am far from putting value behind the different ways change can appear from the interaction between different communities. Change can be (not) wanted, (not) desired, or even (un)desirable. However, the interaction and the change still need careful attention.

4. CONCLUSION

Using some classes in humanities as lenses to look at CoPs, these preliminary thoughts question an uncritical use of the term CoP to describe and prescribe communities without

differentiating between different types and functions of communities. The implications of the distinction between communities of practice, communities of reflection, and communities of reflection-practice and their intertwined relationships as well as the potential and experienced clashes of communities are numerous: concepts, models, and theories developed in the learning sciences might not work as well in some communities as in others. Still, it is in the interest of both, the numerous learning sciences communities and the communities of humanities scholars, to engage in projects that have the goal to enrich students' learning experiences beyond the school walls.

Note: The author is grateful for comments by Gerry Stahl on an earlier version of this paper.

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Supporting Communication and Knowledge Creation in Digitally Networked Communities in the Humanities

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1. REQUIREMENTS FOR COMMUNITIES OF PRACTICE IN THE HUMANITIES

Scholarly communication in the humanities heavily depends on the discursive nature of knowledge creation and the media that is in use. This communication has changed over the centuries due to the evolution of media, altering not only the communicational culture of scholars regarding their archives and text production strategies but also the communication situation in society, leading to scientific, artistic, and societal revolutions. The change from scroll to book in the edition of the Babylonian Talmud is a good example of such a medium revolution. The interdisciplinary collaborative research center "Media and cultural communication"[1] was founded in 1999 to research the nature and impact of media on the discourses in cultural communication. Historically, and by creating new interdisciplinary workplaces for scientists in the 21st century, our subproject analyzes the impact of networked information systems on cooperation and knowledge organization in scientific communities and public debates.

Knowledge creation processes, also known as learning processes, can be researched by socio-cultural constructivist theories of learning like those advanced by Vygotsky, Piaget, and Bateson [1; 8; 11]. Because knowledge creation in science is often a collaborative and communicative endeavour that is based on shared experience and practice involving the apprenticeship of student researchers, we deploy approaches where knowledge emerges in communities of practice (CoP) by discursive assignment of sense [6; 12]. For historical and actual communities of practice in science we make the basic assumption that there are two disciplinary structures for the archives of the discourses [10]: goal and forward-oriented ('linear') structures on the one hand, and discursive and displaying ('non-linear') structures on the other. In the linear case, the 'old knowledge' is left behind, vanishes in the archive, and is replaced by newly published knowledge. In the non-linear case, 'old knowledge' can be introduced into the ongoing discourse at any time. This type of knowledge is kept in disciplinary dynamic archives and contextualized in the historical process. In the mediation process, 'old' knowledge is not subsumed in the creation of 'new' knowledge, but is transcribed and displayed [3; 4]. The process of displaying this knowledge is inherently linked with the knowledge creation process and, therefore, is a media problem on its own. The hermeneutical process is nerved by self-

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reflective loops of insight and mediation. The appropriate IS metaphor for these processes is the model of multimedia hypertext or hypermedia.

Supporting communication and knowledge creation in digitally networked cultural science communities represents a specific challenge for the development and organizational-structure of hypermedia information systems due to at least three reasons. First, the discursive nature of knowledge creation in the humanities is based on an intense exposure to hypermedia artifacts and underlying theories that require the support of different digital media to be combined with (almost) arbitrary metadata, constituting the situational background of an artifact. These digital artifacts have special semantics for each user and each community of practice. Dynamic context management concepts for digital hypermedia artifacts supporting a high degree of *semantic freedom* are thus needed for discourses in the humanities. Second, *open repositories* are an indispensable prerequisite for scaling such hypermedia systems beyond the purposes of one community of practice. Scientific discourses in an informed society would then not be isolated to the ivory tower. Modern systems should allow clients of any kind to check out and modify archives and bring them back into the discussion again, fostering discourse and simultaneously assuring intellectual property. We are aware that this is not only a requirement of a class of systems but that it will be accompanied by the transformation of the humanities themselves.

A naive multimedia understanding - e.g. that hypermedia can transport knowledge - isn't sufficient, as complex interrelations between media exist as well as complex cultural interfaces to these media [7]. So, advanced hypermedia management strategies (*fluid archives*) are a crucial factor in science and learning processes instead of old-fashioned de-contextualization strategies propagated in state-of-the-art information systems.

Learning in communities of practice needs to bridge the gap between semantic freedom in (almost) arbitrary metadata annotations, scalable repository technologies and fluidity. The success of collaborative hypermedia systems heavily depends on the discursive nature of knowledge creation. Information systems that assist cross-disciplinary communities of practice should be able to capture, visualize, and support the ongoing scientific discourse in order to keep participants informed and committed to the knowledge creation process. Toward this end, we present a case study, using the MECCA discourse support system for a movie research community.

2. MECCA: THE CASE OF A COMMUNITY OF PRACTICE IN THE FILM STUDIES

The CoP in this case is composed of people cooperating with our collaborative research center who are conducting multidisciplinary research concerning facial semantics in movies. The CoP is physically distributed throughout the departments of film studies in three German cities. Members of the CoP have diverse educational backgrounds, e.g. film studies, history of art, graphical design, and have varying levels of professional experience. The community members already have different interests and point of views, due to their educational and cultural background. Their joint enterprise is to analyze the semantics of facial expression in movies by classification of and comment on movie

scenes in four dimensions: the beautiful face, the dramatic face, the portrait, and mass faces. By the nature of their research tasks, the community members very often have different points of view on a shared multimedia artifact, and these differences are expressed through the use of distinctive vocabularies. When trying to find a common level of communication the community is very often forced to restrict their vocabulary to a minimum or else to make use of terms that are irritating to other members having another background or research focus. One example is the meaning of the term "text." An art historian stated that she would never use the term "text" for movies, while the other members wanted to use the term in the broadest sense possible.

A major aspect influencing the CoP is its distribution among several universities in Germany. For that reason, a collaborative information system and a collective server to share multimedia files is of great importance to them. Using a collective multimedia artifact server would not only foster collaboration among researchers, but it would also enable students to supplement rare on-campus screenings. Obviously, the knowledge creation process displayed is discourse-oriented collaboration on the basis of movie samples covering their research topic. So, they learn by having screenings together in order to classify and comment on them. Here, we detected that a crucial aspect of the CoP was the need for almost arbitrary classification, re-combination, and annotation features of multimedia artifacts to be made accessible to the community members. This implies that aspects of *semantic freedom* need to be embedded into the system, allowing the almost arbitrary re-contextualization of multimedia artefacts. However, another requirement was derived by the demand to protect their individual property because in research communities the risk of plagiarism should not be underestimated. In addition, another, previously unmentioned, aspect is the commentary relationship of the media themselves, as information cannot be regarded as independent from the medium through which it is transmitted. That means, a media theory considered as an isolated information carrier of content is not sufficient; the result is the need for a system that carries (at least) metadata about the situational context (background) of its own creation. Nevertheless, metadata only are not able to carry the needed information without any graphical representation. For that reason, the CoP needed a system expressing semantic relationships between various media artifacts by hiding the complexity of storing and retrieving the information. To meet the requirements of the community we have searched for an alternative to let them express these relationships in an understandable and intuitive procedure similar to common working practices. Therefore, we agreed on an enriched video editing system tool able to visualize relationships between media. Even the commentary relationships of media, however, didn't resolve the terminological conflicts after a common classification scheme was created.

Another system requirement of creating individual reference collections was derived (branched) from the core classification scheme that is common in paper-based work in the cultural sciences. To progress scientifically, it is necessary not only to externalize individual findings by a classification schema (which is fine for things such as dissertational work) but also to share and align the findings with the other members of the CoP in a common classification schema that promotes the project needs (which is particularly necessary for the research of facial semantics in movies, independent of the need in general). Naturally, the views of individuals and the CoP as a whole are often conflicting, offering innovative potential for research insights and new research

questions. Scientists want to discuss their different point of views and the resulting productive disturbances in the epistemological process. Furthermore, for writing research papers reflecting the discursive process of knowledge creation, the CoP needs a system that allows the logging and back-tracking of decisions rendered in the common classification creation process, which allows for a better understanding of the overall process. The underlying classification scheme caused such difficulties in interpreting and understanding the other members' views on certain aspects that exchangeability and recoverability were other aspects the CoP needed in order to make the emerging difficulties productive for their continuous learning process.

A major deficit of existing collaboration systems in the humanities is the restrictive administration of reference collections. In general, reference collections (*fluid archives*) are possible by branching off from the community archive at a certain point in time. However, incorporating modifications performed individually or in collaboration into the previously checked out data set in the system is basically impossible. On the one hand, existing collections might be refined and rearranged almost infinitely [2], but don't allow the creation of an individual index in terms of the categorization scheme. On the other hand, systems like WEL [9] allow users to check out the overall terminology in order to modify the common index for individual purposes, but block its re-insertion into the established community-wide system. To allow parallel processing of hypermedia in reference collection annotations, categorizations and dependencies can be checked out and compared for similarities and differences. The visualization of the results is then a consequent step in supporting the discussion process that makes the emerging difficulties in the semantic capturing productive. It allows user adaptation of the underlying classification scheme as well as assigning hypermedia artifacts to certain categories. Additionally, recovery and loading features are included to exchange and discuss the categorizations within the CoP and to compare their development over time.

The focal point for collaboration in cultural science communities is a collective multimedia artifact repository because it represents the basis for all activities within the CoP. This requirement makes a logical united repository essential. However, this might lead to problems in cases of the CoP having only part-time access to web resources. Personal and group collections can also be used, but here the need for protecting intellectual property and branching data sets in reference collections can lead to conflicts as well. This leads to more or less fine-grained community self-organization issues, particularly in regard to the protection of intellectual property. This disturbs, somewhat, the theory of a community of practice, but it is inevitable because of the tendency of individual researchers to follow their own career plans instead of the plans of the shared practice. To ensure the intellectual property rights of the individual members of the community - again, a centralized component - a method is needed to identify a CoP as itself, and to identify roles within that community. Based on the role of a community member within the system, an individual might be allowed to perform only a limited set of actions or might not be allowed to access all the documents stored within collections. Another aspect is the search and retrieval features to find previous hypermedia artifacts and the comments pertaining to them not only on the global hypermedia artifact set, but on shareable group collections as well. Discourses in the humanities commonly start with research on the results achieved in former discourses. Following Foucault, we can say that the discourse creates the things it is talking about. Researchers aim at refining the

underlying theory that is to be applied to hypermedia artifacts as a result of their discourse. The retrieval and re-contextualization of previous discussion stored in collections and hypermedia structures is of even greater importance than before.

In 2002, the MECCA system built from the discussed requirements was introduced to our colleagues as a multimedia screening environment designed to foster scholarly collaboration in a distributed setting as well as an environment that empowers students to take screenings at home instead of being limited to rare on-campus screenings. The basic idea has been taken from the original project "Berliner sehen" developed at MIT by Kurt Fendt and Ellen Crocker [2]. MECCA itself is specially designed for the community of researchers and students that has been described in this paper. Technical issues of the systems are discussed in other publications [5]. The MECCA case study demonstrates that knowledge creation discourses involve a lot of "re-writing" of discourse artifacts within or across media. Hence, the systems should support the full richness of media usage while making careful choices about which media-related activities should be captured and archived. Interfaces tied to multimedia metadata description standards like MPEG-7 no longer make an integration of rich media and formal models an exotic adventure that cannot be scaled over the boundaries of one community of practice. We are currently working together with the Institute for the History of Urban Planning at the RWTH Aachen on a project for the re-building of scientific structures in Afghanistan. A collaborative hypermedia repository with information about historic sites and monuments aims to help the scattered community of scientists related to the preservation of cultural heritage to share knowledge and to build new scientific relations, especially between the pre-war and post-war generation of scientists. Lessons learned from the MECCA case study can be applied in the construction and management of the new system. Research in the cultural science center "Media and Cultural Communication" will focus in the future also on the distributed agency of people performing discourses.

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Supporting Communities of Practice in Applied Computer Science Studies

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ABSTRACT

The authors discuss the experience of a longitudinal study of the course "High-tech Entrepreneurship and New Media." The course design is based on socio-cultural theories of learning and considers the role of social capital in entrepreneurial networks. By integrating student teams into the communities of practice of local start-ups, we offer learning opportunities to students, companies, and academia. The student teams are connected to each other and to their supervisors in academia and practice through a community system. Moreover, the course is accompanied by a series of lectures and group discussions. So far, the course has been conducted three times at RWTH Aachen and the University of Siegen.

1. COMMUNITY-BASED LEARNING IN APPLIED COMPUTER SCIENCE

The course "High-tech Entrepreneurship and New Media," now in its fourth year of existence and held at two German research universities, is the result of the unhappiness of the authors with classical and "new" e-learning teaching efforts in applied computer science at German universities. Among others, we made three observations that we want to address here: 1) Even though many students worked as software developers in local entrepreneurial and established companies, their practice was not reflected in university teaching at all. In singular cases the work led to successful joint diploma thesis projects and excellent job offers. Our idea was to establish a course that stabilizes the reflection of student practice and to move the newest ideas of software engineering from the university into practice. 2) Local high-tech companies, founded mostly by university graduates, were only loosely linked to their birth-giving universities. Compared to US universities, the level of interaction between academia and industry is too low. The innovation potential and the needs of the companies are not addressed in a sufficient way. Our main idea was to offer entrepreneurs a platform to reflect about their experiences, to sensitize students for entrepreneurial activities, and to let students work on real-world problems instead of fabricated lab examples. 3) The way new teaching technology is introduced

leads to disappointing results in computer science. Often technologies only mimic classical teaching methods or mask the pedagogical disorientation in applied computer science between the curricula of the natural sciences and engineering. Our idea was to apply socio-cultural theories of learning and identity building [1; 11; 17—19; 21], following our enquiries of US entrepreneurial education and networks around the MIT (Massachusetts Institute of Technology, Cambridge, MA) area, and suitable collaboration tools to small connected groups of computer science students working on real world problems in local companies.

Because we rigorously documented and evaluated the course from its early days until now, we have a huge amount of data which, for several reasons, we constantly linked to the applied theories. On the practical side, we re-designed and adjusted the course in reaction to the analysis made and the overall dramatic change in the German university teaching system (Bologna process). On a theoretical side, we tried to overcome our naïve understanding of socio-psychological theories [3; 4; 12], especially communities of practice [2; 10; 20], and to formulate a more realistic understanding of shared interactions and shared cultures in groups, community and networks [6; 15]. The course design and several evaluations were reported in various places [8; 9; 13; 14]. Therefore, we will only introduce this topic very briefly. In this paper, we primarily want to reflect on the long-term effects our study's ramifications may have on students, our teaching practice, the entrepreneurial networks and technology.

2. COURSE STRUCTURE AND IMPLEMENTATION

In the course, several groups of computer science students each work on a concrete project task for a start-up company. The courses are accompanied by a series of lectures in which university lecturers and practitioners present topics relevant to entrepreneurship and media. The cooperation of students and practitioners in carrying out a common real-world task should allow the establishment of a shared practice and, therefore, mutual learning. Group-oriented learning processes, especially among the student teams and between them and their academic advisors, ought to be facilitated by a community system. Thus, the instructors put task-relevant learning materials on the community system. Moreover, it was supposed to work as a forum of discussion among students and guest lecturers from industry and academia. The system supported cooperation within and between working groups. Additionally, it has been used as an archive for lecture and project materials.

In the first meeting, the students interested in the course were introduced to the basic concept of this type of courses; the tasks were presented briefly and project groups were formed. The students then chose one of the presented project tasks and formed appropriate working groups. Following this, students took an intense two-day tutorial on software engineering methods, project management techniques and other relevant issues. The students had meetings with their start-ups in order to gather information about their objectives, projects and working methods. The project groups and tutors compiled and agreed upon concrete project aims for the execution of the practical tasks, and a realistic project plan that was to be examined in the first review. With regard to the accompanying lecture, speakers from academia and practice rotated. The students got perspectives from

management consultants, venture capitalists, software developers, and personnel specialists, who supplied topic-referred empiric reports and were available for discussions and critical inquiries. In the reviews, the project groups mutually presented each other their results and discussed the further procedure together with the lecturers and experts. These review sessions also served to exchange experiences and offered the possibility of one group benefiting from the progress and findings of another project group. At the end of the term, students, lecturers, and entrepreneurs had a final meeting. The project results were presented by the project groups and discussed.

3. EVALUATION METHODS

The authors follow the idea developed by Gerry Stahl that community-based learning should be analyzed at the intermediate level of small groups of individuals within the community [16]. Therefore, we mainly observed the performance of the students within the groups. The materials were created, collected, and analyzed by advanced students of psychology under the supervision of a trained psychologist. We used different qualitative methods for the enquiries: 1) the lecturers composed several lecture analyses, which stated progress, discussion with students, and other characteristics. For extern lecturers, these protocols were composed by university members; 2) explorative semi-structured interviews with students and supervisors from academia and industries were conducted. All interviews have been recorded with DAT-recording and fully transcribed. In the evaluation, the answers were transformed into a table categorized by the role of students and academic and entrepreneurial supervisors. The interviews have been analyzed descriptively; 3) interaction within the community-system was recorded, as was email-exchange between students and their cooperation partners in the start-ups; 4) as part of the final arrangement and subsequent to the presentation of the project results, a 45-minute open discussion took place between students, lecturers, and cooperation partners from the start-ups, where students especially were asked to give feedback concerning the concept and structure of the lectures. The course of discussion was recorded.

4. COMMUNITIES OF PRACTICE (COP), SOCIAL IDENTITY, AND SOCIAL CAPITAL IN ENTERPRENEURIAL NETWORKS

To find evidence that our ideas had overcome the observations we noted in the first section, we compared our empirical analysis with the analysis we made while studying the entrepreneurial teaching and networks around MIT in the United States. Our recent research disclosed four types of networking mechanisms in the entrepreneurial scene around the MIT Entrepreneurship Center [5; 7]:

- Type 1: Matchmaking events like informal beer-and-pizza meetings or formal dinners to reduce risks of contacting possible business partners.
- Type 2: Social families such as shared dormitories, classes and research labs (peer group effect).
- Type 3: Personal reputation networks for economic action gained through personal expertise and experience.

- Type 4: Inter-organisational relations between start-ups, the university, and venture capital firms by means of intellectual capital management.

These four types of networks are not independent from each other. For balancing lock-in syndromes, transactional openness, value injection, trust, and solidarity all four kinds of social networks are needed. If we assume that the situation in the Boston region is far better than in Germany, and if we assume that we can improve the situation locally by fostering learning among students and among other members in the network, we can analyse what our impact was and is. We have reported elsewhere about design flaws and practical problems in the course and how we dealt with them. Here, we want to concentrate on the question: *Did the students learn how to network?*

We know from our study of entrepreneurial networks in Boston that newcomers have only faint ideas about networks and networking, but experienced players know how to make use of social capital in the networks. The CoP between the students can be compared with peer group effects found in the MIT study. Students within the groups build up social capital (or not) leading to relationships beyond the scope of the course. Still, the lab students do joint work in other contexts like course homework or master thesis work. We can monitor that the students still use the community system, especially for downloading materials not stored elsewhere, like taped videos of the review sessions and personal information about other lab members. Some of them have the same cultural background, but we can also observe cooperation between students from different countries but the same year. The group structure was developed, self-organised and described as non-hierarchical. Most important, the barriers for the establishment of a CoP between university students and start-up companies are limited resources (time and persons) and cultural differences. The differences, especially in cultural background and historical experiences, between the "student" and "entrepreneur" groups might make processes of social identification more difficult, and therefore successful community-building less likely.

Nevertheless, good personal relationships and rich social capital were established between some students and practitioners. Self-organized and non-hierarchical structures supported the building of social capital within the groups. In all groups, learning mechanisms of legitimate participation proved successful, especially if the students reported on high-intensity learning as part of their collaborative practice in the groups. In particular, a Thai student in the third instance of the course at RWTH Aachen was asked to prepare her master's thesis in computer science for the very same company with which she did the course project. Moreover, her mate was also able to get a thesis topic in the company. In such situations it is hard to analyze to what extent the reputation building process of the course has contributed to the final result. We see this as an indicator that we were successful in establishing networks of reputation in the region (type 3).

The personal reputation of the supervisors from the university within the entrepreneurial networks has been leveraged by the courses. The supervisors are included in information exchange networks and are invited to start-up related events like business plan competition, company fairs and so on. In particular, the contact between the course supervisors and the local university entrepreneurship center from which lecturers were invited to present in the course lecture series helped to establish stable relationships and social capital within the reputation network of the high-tech/new media cluster (type 3).

The events are part of type 1 networks, which foster initial matchmaking and reduce risks of cold calls by opening informal meeting opportunities. Seldom, if ever, do computer science master student visit these events. Most of the attendees from the university are PhD students or alumni. This is very different from the situation around MIT (add to that the fact that the number of events is a magnitude higher in Boston). The use of social capital in this network type is thus limited. To overcome this situation, students should be motivated to visit these events on a regular basis.

The fourth network type is very different in the US and in Germany, due largely to different legal regulations concerning intellectual capital and a different venture capital culture. Intellectual capital issues were raised selectively in the course, but it never approximated the signature of a non-disclosure agreement like it was usual to do in the entrepreneurship lab at the MIT Sloan School of Management. Furthermore, the start-up representatives never discussed seriously with the students the role of intellectual capital and the possibilities of an actual start-up. Neither side was very experienced in these topics due to the non-existence of a comprehensive entrepreneurship curriculum at the university. No real money was on the table, thus the use of intellectual and social capital in this network type was not comparable to the situation found in Boston. But both the handling of intellectual capital and the venture capital culture has changed dramatically during the past several years in the direction of US-type regulation. Intellectual capital handling by the university has become much tougher over the last year, and always includes royalties for university inventions made in such courses.

To conclude, we can say that the type 2 and 3 networks are being supported by the course directly but because of regional differences the support for type 1 and 4 networks can be leveraged in the future. This is important because type 1 and 4 networks can prohibit members of type 2 and 3 networks from social and cognitive lock-in situations. First, we provide a general openness of the network for newcomers. Second, we ground actions into reality. To follow the careers of students we need to install a long-term monitoring system which allows us to keep track of the student's development. This should be a function of the community system that is in place.

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Come_IN: Using Computers to Foster the Integration of Migrant Communities

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1. OVERVIEW

Modern western societies are facing the challenges of immigration and integration. The main criterion for social participation and democratic collaboration is the successful integration of immigrants. A lack of social as well as cultural integration, especially among young immigrants, seems to be the consequence of a low level of education and unequal opportunities. Immigrant children who are enrolled at primary schools, for instance, show significant deficits in tests of German language acquisition in comparison to German pupils on the one hand, and even to other immigrant pupils of their parent's generation, on the other.

Moreover, corresponding to this drop of linguistic competence, the social gap seems to be growing along the so-called digital divide. Thus, in the last years, several attempts have been initiated to enable underprivileged social groups to access computers. The concept of Computer Clubhouses (CCH) is of special interest in this regard.

Motivated by discussion about the concept of the CCHs and the theoretical learning approach of the Communities of Practice (CoP), the concept for the intercultural computer club Come_IN has been developed and put into practice. This year it has been opened officially in "Bonner Altstadt," one of the city of Bonn's multicultural neighborhoods. Come_IN reframes the concept of the CCH to fit the German context.

1.1. The Bonner Altstadt Neighborhood

Come_In has been built up in cooperation with St. Marien, a catholic elementary school in the neighborhood. The school implements the aims, values and methods of the reform-minded pedagogical learning paradigms of Maria Montessori. The school is considered exemplary in realizing innovative pedagogically didactical practice. The curriculum focuses on open- and work-oriented lessons, e.g. in small groups, workshops, and projects. Each classroom is equipped with two or three computers that can be used as resources in the daily work. For more than a decade, pupils are taught in classes with mixed age-groups. The pupils of the St. Marien School come from very different social and cultural circumstances. About 35% of all pupils are of Turkish origin and have been poorly educated. There are a considerable number of other immigration children as well.

The district where the project takes place has a population of about 10,000 inhabitants. The social and cultural structure of this district can be characterized as a colorful mixture

of different communities[1]. Today's situation in the quarter is a result of post-war urban development. In the 60s and 70s, many better-off inhabitants moved away and the housing conditions deteriorated. Later, they were replaced by people searching for new and cheaper accommodation, namely immigrants and students. Some statistical data characterize this situation today: the quarter has a high rate of immigrants (22.7% of the population of the district, compared to 12.5% of Bonn's total population) and a low education rate (35% have a Hauptschulabschluss[2] and 32% of those employed are workers).

2. COMPUTER CLUBHOUSE APPROACH

Initiated in 1993, the concept of Computer Clubhouses was put into practice. In cooperation with the former Computer Museum, the MIT Media Laboratory opened the first computer club for young participants coming from a lower-class background with a low level of education. The pedagogical concept is an extension of the constructivist learning paradigm. In constructivism, learning is a process of constructing individual cognitive structures. Papert extends this idea by stating that these cognitive structures have to be put into practice by constructing artifacts [7]. Thereby, a way is found to externalize implicit and tacit knowledge. This is called constructionism [7]. Furthermore, Chapman argues that the artifacts need to be put into social context [1]. By doing so, they can be shared with and critiqued by others. Other learners are able to learn from and with the artifacts, while the constructor learns from those dealing with the artifacts. Shaw enriches this theory with a socio-cultural aspect indicating that constructional learning is also social learning [10]. Besides the artifacts themselves, social connections are built into the process of constructional learning. As a result, social capital is part of the underlying concept of the CCH. Highly innovative ICT is used to stimulate the learning process of the target group at short notice. From a long-term perspective, the CCH tries to provide better access to working life for the youth [8; 9].

The core principles of the clubhouses are as follows: a) to support learning through design experiences; b) to help youth to build on their own interests; c) to cultivate an "emergent community"; and d) to create an environment of respect and trust [9]. Hayes et al. demonstrate the difficulties of bringing this espoused model of the CCH into practice [4]. That team also shows how it collides with the actual needs of its members.

Communities of practice (CoP) are an interesting way of explaining learning and knowledge acquisition processes [6; 12]. This idea follows from socio-cultural learning theories, which understand learning as a collective process. This process is linked to specific contexts of action. Learning in a CoP is defined by the relationship of groups of *old-timers* and *newcomers* that are inside the community. By means of legitimate peripheral participation, newcomers are confronted with the practice of old-timers, which

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[1] A slogan of a local pressure group emphasizes this point clearly by proclaiming "Vielfalt Altstadt" meaning 'diversity in the old town center.'

[2] Hauptschulabschluss is the German equivalent to the certificate of completion of compulsory basic secondary schooling.

built the core of a CoP. This situation has some similarities to the principle of cultivating an emergent community in the CCH.

As newcomers interact, work, and communicate with old-timers, their experiences increase. This phenomenon indicates that learning in a CoP is a process of growing into the community. Furthermore, CoPs are characterized by common conventions, language, tool usage, values, and standards. A CoP is inseparable from issues of (individual and social) identity. Identity is mainly determined by the negotiated experience of one's self in terms of participation in a community and the learning process concerning one's membership in a CoP [12].

3. INTEGRATION AND THE ROLE OF ICT

The aim of integration and full participation is difficult to reach if immigrants stay separated. Particularly in towns and cities where autonomous immigrant communities are emerging, the problem of isolation can become significant. This can lead to the condition that both parents and children acquire too little linguistic and intercultural competency to communicate with members of other communities.

In the following sections, we will focus on the role of ICT. Because we deal with social phenomena like integration and communication, the perspective on this role is more socially oriented than in traditional approaches. To make our argument easy to follow, we present a broader but simplified view of ICT to the reader. Of course, such a view does not pay full tribute to the complexity of the topic:

3.1. Cross Community Building and Intercultural Learning

From a superficial perspective, the problem described above is a problem of a lack or a gap in education. So, in a terse manner, the problem would be easy to solve if computer programs transferred knowledge, and thus, filled the gap in education. However, considering socio-cultural learning theories, it seems obvious that the source of the problem lies deeper – namely on the level of identity. In Germany, over the years Turkish immigrants developed and stabilized functional and self-organized ethnic communities, which formed their own identity separated from other communities [3; 11]. These communities have their own traditions, due largely to the fact that their community parameters (such as cultural and social values and language) are at most only weakly influenced by the parameters of other communities. For many within these communities, there seems to be no need to interact with other communities at all. From our point of view, the main challenge for integrative work in society is to establish additional identities besides those of the different ethnic communities. These identities should to be built on shared practices. While learning by doing, the members of these intercultural CoPs will realize integration through unintended motivation.

3.2. Participation of Parents in the Learning Process

We assume that the participation of more than one generation in computer-supported project activities will encourage intercultural communication. The more generations that are involved in this process, the more likely it will appear that socio-cultural and linguistic barriers can be surmounted, as experiences of numerous generations can build

up a richer common identity. Besides that, one specific insight from the practical context of the primary school St. Marien is that targeting only the children of immigrants. This obstruction of the learning process is possibly based on the parents' disinterest in schooling, in both its practical and theoretical classes. There is a gap in social learning that cannot be solved by increasing the intensity of only classical schooling. The process of integration has to be considered integrally, which means that parents (as they are part of the social context) have to be included. By doing so, socio-cultural learning is fostered. As a further result, participation allows the parents to benefit from their children's learning progress.

3.3. ICT as a Door Opener into the Communities of Immigrants

So far, we mainly discussed the social environment in which we want to use computers to foster integrative community processes. However, we did not answer one important question: Why does ICT (for our purposes, computers) play an important and highly specific role in the process of integration? To answer this question, we want to explain the role of computers by drawing an analogy to the implementation of a corresponding development aid[3] project. The comparison between integration work and development aid is justified, as both deal with the problem of how a modernization process can be promoted from the outside of a community.

The underlying purpose of the development aid project was to teach female Tunisian farmers the capability of western cattle owning and breeding techniques [2]. But besides the transfer of pure technical knowledge (know-what and know-how), there was also a focus on the transformation of identities that were linked to the technology. By doing so, the learning was supposed to become a sustained progress. Dersch describes the structure of this transformation as follows:

> [It] shows that the transformation process takes place on two different levels and at different speeds. Modern technical, economic or institutional innovations are more quickly and easily adopted by a traditionally oriented culture than are changes in normative behaviours and social attitudes [2].

The characterizing role of technology in this transformation process lies in its ability to integrate people from foreign communities into the process of technical knowledge acquisition. This opens opportunities where a *common working practice* - which is related to a specific technology - can be transferred to a community of practice. In this respect, the concept of the CCH is turned upside down: *The existence of a community is not necessarily obligatory to start learning processes. Rather it is the other way round. The motivation to acquire technical skills can be used to set cross community processes*

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[3] We follow Dersch's definition of development aid:

> Extension within the framework of development has the function of supporting culturally traditional (indigenous) people as they move towards modernisation. The person-centred extension focuses on the personal autonomy of the client with the objective of teaching the clients to become responsible for themselves, to make their own decisions, and to take an active part in their changing world [2].

in motion. However, community building is a social process, so it is not guaranteed that a common interest in technology will lead to a community of practice. But, we believe that the learning process will be sustained if the transformation from common practice to a community of practice succeeds.

When we transfer this insight to the concept of *come_IN* we can show that ICT can fulfill the role of an attractor or motivator for participation. Motivation to learn about computers functions as some sort of entrance card or an impetus for the integrative transformation processes.

3.4. The Come_IN Project

Based on the considerations presented above, we developed the concept of an innovative computer club. In cooperation with the elementary school it became possible to put this concept into practice. In addition, by examining the workings of the club we were able to get first insights into its potential.

After a preparation period of 18 months, the Come_IN computer club was opened officially in March 2004. Since its opening, it has been running each Wednesday from 5pm to 7pm. The intended target groups show strong interest and active participation in the club. The successful start of the club is mainly based on the work of several volunteers from the district. With the help of several donations it became possible to obtain initial hardware and software equipment. Again, the support for the project groups is mainly provided by volunteers from the quarter.

3.5. Children Together with Parents

Education is not only a public affair. Parents have to care about the education of their children, as well. Schools and parents should work together to promote the learning of their children [5]. Improving this cooperation and integrating parents into the schoolwork of their children was one of the major reasons the elementary school was interested in participating in this project.

Thus, as a rule, a child may only come to the club if accompanied by at least one of her parents. This regulation ensures the inclusion of parents with the learning process of their children. Children learn from parents and vice versa. In addition, it is hard for elementary school kids to manage complex projects themselves. So, opportunities are given to the parents to realize their own ideas. Foreign and German parents communicate with each other. Again, the computer plays an important role in this process as it builds the fundament of shared practice in the club community. Especially in the Turkish community, it is seen as an opportunity to achieve (further) social success.

3.6. Working on Projects

Current topics, latest news and daily problems influence the establishment of new projects. Relevant topics are put into local and regional contexts to provide a platform for a multicultural dialog. Mainly socio-cultural and ecological questions that influence the pupils' everyday life and their experiences are discussed. As a first project focus in Come_IN, a multi-media documentation of a multicultural family history of the quarter is set up. Right now, the third generation of Turkish immigrants lives in the district, which emphasizes the motivation for this project. The goal is the creation of a shared

multicultural history. Especially the first generations of immigrants, who came to Germany as guest workers and have collected a lot of experiences, have local interests that have not yet been documented at all. This German-Turkish history shall be set into contrast with the German family histories in the district. So, the project will help to create a common practice that has a shared history. Such a shared history may support the growth of a shared identity across the different communities. Naturally, success can only be achieved by involving all generations and all ethnic communities. The result of the project will be a collection of multi-media materials that will be the common ground for further exhibitions.

Learning in this context does not appear in a behaviorist manner, but more likely through a process of constructing. Supported by computers, all participants in the project get the opportunity to search for historical and social sources within their personal context. Others may learn from the resulting artifacts. Based on an emergent common identity, it is possible to reduce prejudices (yet, we assume that this already happens during the process of constructing). As a result, integration in this context is not a social utopia but the product of common and shared practice that includes respect and comprehension.

3.7. Playful Acquisition of Computer and Media Skills and Competences

By the playful computer-supported acquisition of media competences, participants learn how to work practically with innovative tools in a natural manner. This naturalness will allow both the children and their parents to master new challenges more easily. It provides occupational chances for the children in the future whereas parents may achieve further social development and participation in their social life. Furthermore, children get the chance to explore their own interests. They will externalize these interests by constructing multi-media artifacts, which again may help others in their own learning process. Intercultural barriers will be surmounted. This effect, plus the attraction of computers and new media, will safeguard the survival and further success of the computer club.

4. THE FUTURE

Actually, the current state of Come_IN must be seen as a success. One indicator for that is the high rate of participation from the German and the Turkish community. But, for a deeper and more precise evaluation it is still too early. We will examine the future progress of the club with the help of ethnographical studies over a longer period. The results will be the basis for the further development of the concepts. With regard to the common practice within the club, an evaluation will have to deal with the following issues:

(1) What role does computer-supported project work play in regard to social networking, intercultural communication and identity building within the quarter? What are the underlying mechanisms of computer-supported project work? What impacts do specific features of the concept have for the common practice, such as learning across different generations?

(2) How will the different members of the club acquire computer skills? What are the requirements for appropriate computer applications and what type of technical innovations are necessary?

(3) How will linguistic as well as computer competencies of the participants interfere with each other?

(4) Which local and regional criteria influence the establishment of an intercultural computer club? Which preconditions have to be fulfilled in order to increase the chance of long-term success?

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Part III. Computer Support

Student Communities in a Distance-Learning Environment

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1. INTRODUCTION

Distance Education (DE) is becoming increasingly important as its rapid growth rates demonstrate. However, recent statistics on DE show low retention rates and a poor return on investment (ROI) in various programs. We need a better understanding of what are the critical success factors for DE environments for all constituencies (students, instructors, and institutions). We still misinterpret the reality of this kind of practice, both from the teacher's and the learner's point of view [1]. In this article, we focus on the collective dimension of the learning environments. In fact, entering a virtual learning community appears as a rational choice for the students to retrieve information more rapidly [3] and examine with available peers the actual content. But, students occasionally express a natural anxiety about sharing their difficulties with strangers, which partially explains the barriers in establishing trusting and caring learning communities [2]. Well-sequenced pedagogical courses and frequent contacts with the professor seem to strengthen the cohesion and integration of the students in a group. Consequently, educational choices and the global architecture of the course, by influencing the formation of these groups, try to compensate — at least partially — for the deficiencies of DE. The goal of this paper is to propose solutions to overcome low retention rates and ROI in order to deploy an efficient DE program using the key solution of a web-based course in an American public university.

2. METHODOLOGY

To collect the data for this study, we interviewed students enrolled in an introductory MIS course taught exclusively online. Each semester, over 1200 students register for this 16-week course. They learn about management of information systems and Microsoft Excel. The students were placed in sub-groups of 30 members to recreate a classroom environment and facilitate emerging learning communities. The professor enforced strict rules with regard to this course, including assignment posting in discussion groups every other week and numerous Excel / MIS exams. To reduce student requests, a "*three before me*" rule was established: to question the professor, students must have first tried to get answers for their question in three other ways (syllabus of the course, discussion group, chat with a peer).

3. OBSERVATIONS

3.1. Group Discussions are not Utilized Effectively

Discussions groups have not been utilized effectively. Each sub-group had its own discussion group (discussion group 1,2,…,40). Students had to post answers to their assignments in this location. Access to these forums was restricted to the 30 members. Additional forums were made public by the professor including:

- **Main -** a *one-way* forum utilized by the professor to give announcements and information to the whole student body at once,
- **Excel Issues -** a forum utilized to post questions regarding Excel assignments.
- **Technical Support -** a forum utilized to post questions regarding any technical problem encountered during the course.

The group discussions, the most adequate place to develop a sense of community, were not utilized. The only messages posted in these forums were replies to assignments. These groups were rarely used to ask questions to other students. As Celina mentioned: "*There really was* no posting *in our group as far as problems: there is only one posting*."

Most of the messages posted in the sub-group discussions were assignments or forced replies to other students. When they needed to ask questions students used the Technical issues and Excel support discussion groups. Consequently, the discussions on these two forums were not focusing on Excel or Technical Issues, but on any problem that the students might have encountered (Figure 1).

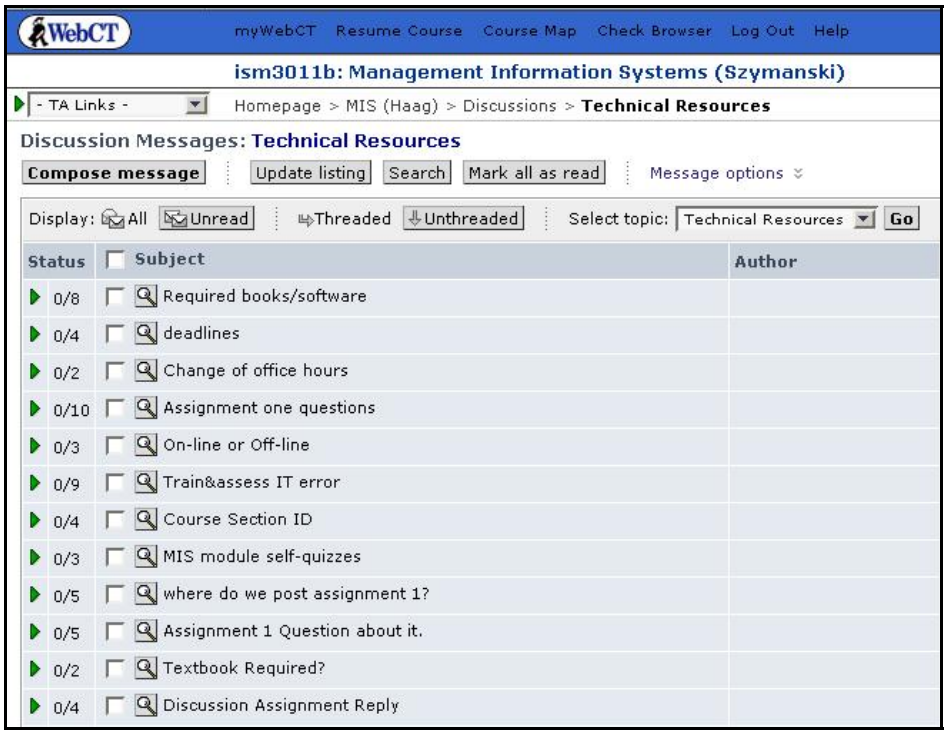

Figure 1: Examples of subjects discussed in online forums.

3.2. Redundant Messages

Messages posted in the discussion groups were simple and could be easily answered by the students themselves if they would read the content of other members' postings. Messages posted in the discussion groups and interviews clearly demonstrate aggravation from students whom have read the content provided in the course. Yet, the worst aspect of these redundant messages was the confusion they created for certain students. Paula argued in the Excel issue discussion group: "It is frustrating to hear the same questions over and over. I wonder though if there is confusion on this one because the course reminder keeps showing 'News' with subtitle 'one quiz must be submitted soon', even after exam one is taken?"

Instructions and answers for this question could be easily found by the students on the course pages, but the number of redundant messages triggered confusion. Learners did not realize that posting a message without reading others was rude and is comparable to asking the same question over and over in a traditional classroom setting. In a traditional educational situation, this would not be tolerated. It is an accepted part of floundering online communities, as it was in the case of our course. In fact, prior research has indicated: "norms that lead to good online etiquette are a stepping-stone to social capital" [4]. Consequently, students lost confidence in the question/answer system that was not providing them with the desired response. Questions accumulated in the technical and Excel question forums and discussion groups.

3.3. Absence of Community

The lack of community and trust was evident during interviews. Students did not utilize the help from others in their ISM groups. They chose to go out of the course to find peer support (friends, co-workers). In fact, they were reluctant to interact with the professor following guidelines (three before me rule), and did not want to post in the intimidating large discussion groups. One student actually mentioned: "*basically, I know one thing this class taught us is how to network* ". To succeed in this course, learners had to organise themselves in study groups: "*Every Friday, we meet up in the Magruder lab, and we start to go over the Excel and Assignment*" (Lucetta L.).

4. ANALYSES

Discussion participation and student interviews clearly indicate the necessity to update our pedagogical method. We ought to find in existing online communities technical and organizational solutions. In this part we are going to consider the concept of learning communities from an examination of best practices. At first sight and from a purely structural point of view, the pedagogical approach that we observed at UCF is similar to that of a learning community. To be precise on this point, we can say that in a "*community of practice*" partnership refers to tacit knowledge combined with considered practices and associated with purely professional problem-solving activities. On the contrary, in a "*learning community*" exchanges among members revolve around explicit knowledge that is restricted constantly in a given domain. These are exactly the objectives of the community we studied. It is designed to learn about Excel and to

construct operational knowledge associated with this tool. But before going any further let us observe the elements which make up a learning community.

When a group of people has become a community they display a caring attitude with regard to each other [4]. Here, it is useful to mention that this type of behavior does not appear so much on the forum as in the direct exchanges between the students. The students who attend the classes are required by the teaching module to ask two questions in the forum and likewise to respond to two of the questions asked by their fellow students. If the purpose of this requirement is to prime the pump and launch discussion, it has a perverse effect in regard to group dynamics and the underlying learning processes. In effect, if the rules are to ask and respond to two questions, why go any further? In fact, the teaching module requirements obliterate the learning dynamics at the heart of the community. An analysis of the exchanges on the forum do not exhibit features of co-operation or caring, which are considered to be essential characteristics of learning communities, except in a watered down, artificial manner.

The most significant point about this was revealed during student interviews where many of them explained that they had arranged to meet frequently and regularly both on and off campus. For example, those who lived far from the university would plan to meet in the local public library to discuss their difficulties, find solutions to their problems and help out other members of the group. Others told us that they regularly asked their friends or members of their family more familiar with Excel to find answers to their questions and then shared the information with other members of the group. In other words, the "community" was created outside the established learning module tools because these were considered too inflexible.

Members of these groups also told us that they had preferred to stay in touch and exchange information using their own electronic communication tools. Therefore, it seems that communities were created outside of the learning module and without utilizing the communication tools provided. In our opinion this phenomenon illustrates the difficulties of managing interactions "mechanically" between members of a community. It seems that to impose too rigid a regulatory model on a learning community will dash any nascent spontaneity.

This is related to the more general question concerning the directing or managing of communities and the associated pedagogical "devices." On this point, and more specifically concerning communities of practice, Wenger says, "*Just because communities of practice arise naturally does not mean that organizations can't do anything to influence their development*" [6]. Guérin comments on this saying that, "*Wenger's argument is itself potentially contradictory, in wanting to preside over the fate of a spontaneous phenomenon*" [5]. We can represent the pedagogical implication in a learning community by a triangle whose points represent respectively, the community (the group), the learner (a student), and the person who facilitates the encounter between the subject to be learned, the student and the group (a teacher). The subject to be learned sits at the center of the triangle. We noticed little communication both within and between groups, and that the students rarely interrogated the tutor (respecting the rule of "three before me"). In the end, we observed a rearrangement of the pedagogical structure and its technological tools outside the formal framework of the institution. This is indicated in our schema by the dotted lines connecting the learners with their peers

(friends, family, etc.), who replace the original tutor or professor (Figure 2). The rearrangement of the central, social links of the learning community results in the emergence of ad hoc groups at the heart of the community from the very beginning and, in addition, the perimeter of these groups rarely coincides with the form initially envisaged by the teaching module.

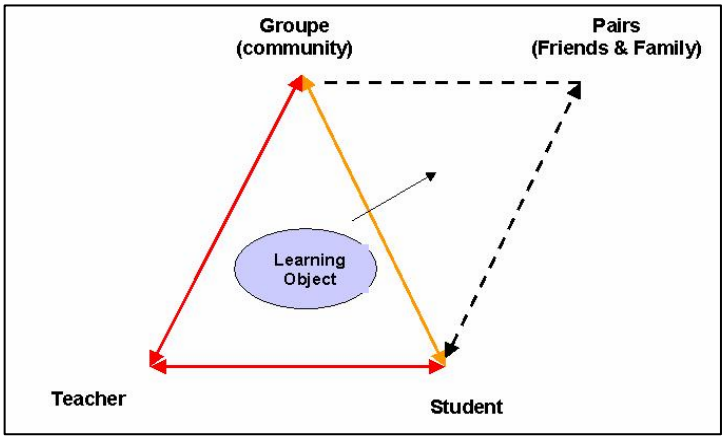

Figure 2: Schema of the rearrangement of the pedagogical structure.

5. RECOMMENDATIONS

The pedagogical organization of this course is deterministic. Spontaneous student activities were difficult to express. The students did not have the right virtual environment to meet using the technical tools provided. Clearly, the structure of the course, the strict guidelines students had to follow and the heterogeneity of the student body prevented learning communities from emerging. We recommend a better organization of our discussion groups to take advantage of our diverse student body.

At the beginning of the semester, students had to complete a practice quiz to access the first module. This first evaluation should be used to assess the level of our students. Instead of asking twelve similar questions, we suggested ten website related questions, ten MIS related questions, and ten Excel related questions. This test should be administered in the “add and drop” period. The result of this test would help us better segment students in categories: regular users and power users. The number of power users should be divided by the number of groups. Then these power users should be placed equally in each sub-group. The rest of the students should be added in the various discussion groups. This recommendation relies on the belief that caring among users is necessary and "contagious" [4]. We believe that students, if provided with the correct incentives, will help and care for each other.

After grading the pre-test, we identified the power users. Part of the grading for this course included posting MIS related responses and replies to two other students. The power users could then be offered the following trade: instead of participating in the discussion groups by responding to other students, they had to help others in their group to provide technical answers. At the end of the semester, if the other students participate in the discussion groups, the power user will be rewarded accordingly. We believe that

certain behavior is contagious: the fact of seeing power users help other students will cause learners to be inclined to participate and help their peers.

This proposition suggested that the two discussion groups (Excel Issues and Technical Issues) be disabled. In effect, we wanted to concentrate the discussions/questions that might arise from students to their individual discussion groups only. This should tentatively help us to avoid the propagation of unnecessary messages in public discussion groups. Yet, we might observe similar questions within different discussion groups. We enjoyed in the past when students replied to other's questions in the "largest audience" discussion group, *i.e*., *Technical Issues* or *Excel Support*. In this new organization, if the professor realizes that it is necessary to inform the entire classroom of an issue, he will use the main discussion group (a one-way discussion group where only the professor can post messages – student's messages are automatically discarded). This relies on the idea that community enhances students' experiences and learning. In addition, we believe that a smaller student group and the participation of power users will provide a fertile environment for emerging communities.

5.1. Various Recommendations

5.1.1. Ice-Breaker mandatory

We suggest including a simple ice-breaker where students can introduce themselves: Major/Birthplace/Hobbies. Obviously, this short message has to be restricted to the group place.

5.1.2. Explicit title

The postings from the students on the discussion groups should be very explicit. In fact, we cannot force it, but, we might propose that discussions without a clear title should not expect an answer. Explicit titles would be presented at the beginning of the semester including [EXCEL] for an Excel related question or [TECH] for a Tech related question. Assignments should also be titled properly such as [ASSIGNMENT].

5.1.3. Contextual help files

The professor suggested that we should create a "hyperlinked" Web page that would send the user directly to the associated "help files." This technological enhancement provided to the user must have with it restrictions on redundant postings, perhaps by taking points off grades for infractions. For instance, if a student asks a question on the discussion group that has already been asked in the past he loses points. Students will then think twice before carelessly questioning their peers. The help files should also be developed using drop-down menus and presented separating the content: Excel help, MIS help, etc. The help files should be numbered. In fact, we want power students to refer to these files by number (after a question from the student, the Power User might propose to look at help file # 24). The help files will be designed using the most frequently asked questions from previous semesters. A voting system will have to be implemented at the end of the help file to find out if the help file helped the student or not. The top three could be posted in the Home Page or in the Main discussion group.

6. CONCLUSION

The entire E-learning or DE project placed the student in the middle of the learning experience, and aimed to *horizontalize* knowledge transfer (student-to-student rather than professor-to-student), involving the student in his learning experience. Yet, results are not satisfying and students are progressively loosing confidence in this pedagogical concept. After observing and interviewing students from an online web-based course we realized the importance of caring learning communities in knowledge creation. We recommend segmenting students according to their level and give various guidelines to correctly administer large online classrooms.

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Building Learning Communities by Enhancing Social Presence: Implementing Blended Instructional Delivery Methods

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1. INTRODUCTION

Lewis, Snow, Farris, et al. stated in the National Center for Education Statistics that "distance education appears to have become a common feature of many postsecondary education institutions and…it will become only more common in the future" [3]. In the wave of migration to new instructional delivery modes, it is necessary for us to critically examine some issues that have arisen, in order to reach an optimal solution for both the students and the instructors. One of the inevitable tradeoffs in an online learning environment is a decrease in the quality of social interaction. Social interaction is innate in traditional face-to-face classrooms. It is not only a critical element in helping the learners to develop a sense of belongingness within a learning community, but also determines the dynamics of the learning community, which greatly influence the students' learning outcomes. Among the essential components of a community, interaction between the members is deemed to be the one crucial factor that makes a community alive. Researchers agree that helping students develop a sense of community is an important aspect in promoting positive learning experiences and better learning outcomes in distance learning environments [7].

The decreased quality of social interaction in online learning environments is usually attributed to the decreased degree of social presence. Social presence is defined as "the degree of awareness of another person in an interaction and the consequent appreciation of an interpersonal relationship" [9]. Short, Williams, and Christie argued that social presence is essential in person-to-person communication [6]. As the degree of social presence declines, the communication is perceived as more impersonal. According to Argyle and Dean [1] and Wiener and Mehrabian [11], the two components of social presence are intimacy and immediacy. Intimacy refers to physical proximity, visual cues (such as eye contact, body language), and topic of communication. Immediacy regards the psychological distance that is set by the signaler to the receiver in an event of communication. Immediacy could be verbal and nonverbal, such as physical proximity, facial expressions, formality of dress, or body language.

A factor that contributes to determining the degree of intimacy and immediacy is information richness. Daft and Lengel [2] described information richness as the capability of information to alter or clarify understanding within a given timeframe. Information richness is usually used to classify media's capacity to deliver intimacy and immediacy. In terms of degree of information richness, face-to-face is the richest medium for communication, and impersonal written documents contain low degrees of information richness [10]. Face-to-face communication affords the richest information for the receiver to determine the degree of social presence. The reason for that is not only because of the

face-to-face medium's capability to provide immediate feedback or the visual cues that the signaler exhibits, but also because of the ambient cues from the environment. That the two physical and psychological measures - intimacy and immediacy - share a common indicator of physical proximity also provides a theoretical explanation for the high degree of social presence in face-to-face communication.

Present formats of classrooms can be roughly divided into two main categories: traditional face-to-face settings and online courses. In the order of degree of information richness, online courses can be further classified as (1) with videoconferencing capability, (2) with audioconferencing capability, (3) with synchronous chat room capability, (4) with asynchronous discussion board capability, and (5) instruction and content display only. Whiteman [10] suggested that information-rich media facilitates communication by increasing opportunities for overcoming different frames of reference possessed by the members of the communication event. Also, the higher capacity for processing and decoding complex, subjective messages in information-rich media helps an individual more easily interpret the psychological aspect of the message. Therefore, the face-to-face classroom setting is the most ideal media for affording optimal social presence because of its capability of providing full-scale intimacy and immediacy. Online classroom settings could provide various degrees of social presence depending upon their capability for information richness.

As mentioned earlier, social presence is a critical factor that affects the quality of social interaction within a group, and consequently influences the dynamics of the group. Creating a learning environment with a high level of social presence not only benefits the learners' need for social interaction, but also provides opportunities for collaborative learning. Collaborative learning enhances learning by providing the learners with multiple perspectives on the issues under study from each of the members in the learning community and promotes active engagement in the learning processes [5]. Moreover, collaboration is a core component in the establishment of a learning community. The learners' development of a sense of learning community will be greatly influenced by their perception of the social presence of other members.

With respect to the low social presence of online learning environments, there is a call for an effort to create a "human touch of attentiveness to their students" in distance learning [8], and facilitate online learning experiences that more closely resemble traditionally accepted practices [4] when implementing online courses. The low social presence in online learning environments creates an invisible obstacle that hinders the development of a sense of a learning community among the online learners and, in turn, sometimes decreases the learners' desire to take online courses or undermines their learning outcomes. Thus, the question of how to increase the two major components of social presence: intimacy and immediacy, is an important issue in distance education research [9].

2. THE CASE

The University of Arizona South is a branch campus of the University of Arizona, located in Sierra Vista, southeast of Tucson. In response to the demand of serving a large population of students from rural areas, and the difficulty students have in traveling long

distances to attend classes, the university implements a "small scale multiple satellite campuses model." This model turns traditional schooling around so that instead of the students traveling from all over southeastern Arizona to the headquarter campus, the same courses are offered in multiple locations throughout southeastern Arizona. The students can choose to attend the classes held on a campus that is close to their homes or workplaces. This model capitalizes on the students' willingness to take classes from the university, and therefore, promotes enrollment. However, this model is a double-edged sword: offering multiple sections of a course in multiple locations can reach and serve a larger student population (particularly in rural areas), yet, at the same time, this practice increases the number of instructors needed to teach at the different locations, which increases the financial burden of the university with costs such as salaries and travel funds.

In order to solve this dilemma and still keep our promise to provide equal quality education opportunities to our students, we have developed a blended instructional delivery method to satisfy the students' needs and to balance the cost of offering courses at multiple locations. The blended instructional delivery method we use is a combination of in-class and virtual class meetings. Instead of employing multiple instructors or an instructor who teaches at different locations at different times for one course, the course is taught by one instructor with multiple sections. The multiple sections of this course take place at the same time but at different locations. The instructor is on one campus leading class sessions with students in a computer lab, other students are in a computer lab on another campus, and still other students participate from their offices or homes. All students are equipped with the necessary hardware and are able to run a videoconferencing system via a high-speed Internet connection. All students may choose to physically attend class (either on the site where the instructor is or at the site where only the students are attending), or to participate in the class virtually from their homes or offices.

The main rationale for choosing and implementing this method of instructional delivery is to optimize the students' learning outcomes and experiences by finding a balance between the quality of students' learning communities and the limitations of the university. Developing and delivering instruction totally online is an easier solution. However, enhancing the quality of learning is more important than seeking a convenient solution. In this case, helping students develop a sense of a learning community in online learning environments by promoting the quality of social interaction is our focus for reaching the goal. Social presence is a critical factor in determining the quality of social interaction. In this case, under the practical considerations and limitations that we have, the blended instruction delivery method provides a viable solution to solving administration problems, and at the same time, maintains maximum quality of education for the students. In the order of intimacy and immediacy, the degree of social presence in these three types of classroom settings in the blended instruction delivery method is: (1) the classroom with the presence of the instructor and the students, (2) the classroom with the students only, and (3) virtually participating in class. The first setting, without doubt, provides the maximum quality of social interaction. The second setting is a compromised solution that provides less than perfect quality of social interaction for the students. The third setting, participating in classes virtually from home or the workplace, provides the

students who are not able to physically attend any of the classrooms due to geographical or time restraints with the opportunity to take the class.

The two physical class meeting sites are two computer labs on two campuses. In these two computer labs, each workstation is equipped with BITS synchronous online collaboration software, a set of headsets with a microphone, a webcam, and a T1 connection. The BITS collaboration system has the functions of text-based chat, videoconferencing, application sharing, and messenger. The students who choose to participate in the virtual class meeting have to install the BITS system and the necessary hardware themselves. The BITS system requires a broadband Internet connection due to the high bandwidth demand for conducting a videoconference during the class sessions. Because this blended instructional delivery method was implemented in our program for the first time this year, we were interested in what impact the technology imposes on the students' learning in terms of building a learning community as well as individual learning. We were particularly interested in how this blended learning environment (face-to-face plus semi-face-to-face plus totally virtual,) affects (1) their interest and motivation to learn and participate in the class, and their perception of the interaction with the instructor and other students (physically present or virtually present), (2) the degree to which social presence affects students' interest and learning outcomes, given that students choose whether or not to participate virtually.

Based on informal observations of the students' attendance and interactions both online and in the classroom throughout a semester, and interviews with the students, we found the blended instruction delivery method to be an effective means for enhancing social interaction among students. The following describes what we learned from the implementation of this class.

Our observations confirmed that the degree of social presence is a critical factor for increasing the quality of social interaction. Given the choice of participating in the classes by having to come to the meeting sites or by meeting with the class virtually from home or a workplace, a majority of the students chose to come to the meeting sites, either with or without the instructor's presence. This indicated that intimacy and immediacy do play an important role in formulating a more accepted mode of social interaction. Videoconferences could provide the learners with more face-to-face intimacy and immediacy, however, the lack of ambient environmental information in the videoconferencing environment degrades the learners' (both signalers and receivers) perceptions of social presence due to its limited affordability of information richness. In the need to seek psychological and social support from the learning community, the students felt that forming a real-life learning community was more important than their own convenience.

One tradeoff of the blended instruction delivery method was that the degree of social interaction in the classroom decreased compared to face-to-face classroom instructional delivery due to the physical setting of computer labs and the format of interaction. Even though the students were present in the same physical location with or without the presence of the instructor, the class sessions proceeded in a form of terminal-to-terminal communication, rather than face-to-face. This could have resulted from two factors: the setting of the computer lab or the students' adaptation to this new instructional delivery method. The physical arrangement of the labs had the computer terminals arranged in

straight rows with the monitors on top of the desks. Furthermore, because this blended instructional delivery method was implemented in our program for the first time, both students and the instructor were probably still habituated to the typical online class mode. The main classroom interaction among the students and the instructor leaned more toward a typical online classroom; that is, communicating through computers instead of face-to-face (even when they were physically present in the same location). Yet, some face-to-face interaction was observed. For example, the students would seek clarification about unclear points or concepts directly (face-to-face communication) from their fellow students who were in the same computer lab. This type of communication was seen less between the students and the instructor. There might have been a psychological barrier that the students (and perhaps the instructor as well) unconsciously imposed upon themselves. The students and the instructor might have failed to seek alternatives and limited themselves to thinking that because the class session was proceeding on the computer and everyone was sitting in front of a computer, all communication should be via the computer interface. As a result, they may have overlooked the higher degree of social presence that was available to them and did not take advantage of it.

One of the advantages of the blended instructional delivery method over a complete online delivery method is the minimum number of technical skills required of the students. The physical meeting sites eliminate the demands on students who are unable to deal with technical issues, such as installing necessary software, setting up headsets and cameras, calibrating audio and video settings in the program, as well as unexpected technical problems. An online course that utilizes audio/videoconferencing meeting modes requires that learners possess a certain degree of technical knowledge and an ability to troubleshoot. The fact is that not every student is technologically capable. Most importantly, the focus of the class should be on learning the subject matter, rather than on training the learners how to use the technology. Therefore, the technology should be transparent enough so that the learners can devote all their energy to learning the subject. The blended instructional delivery method provides the students with facilities equipped with ready-to-use technology and on site technical support staff. This way, the students do not have to deal with the hardware and software issues, and are able to concentrate on their learning.

An observation we had throughout the semester was that the students turned off the video windows after only a few weeks of the class. One interpretation for this phenomenon is the immaturity of the technology, which hindered the communication, and as a result, undermined the students' desire for obtaining higher degrees of social presence. Even though each student's Internet connection was at the speed of a T1 or DSL, the transmission of video was not smooth and sometimes slowed down the interactions in other modes of communication, such as audio or application sharing. The capability of technology noticeably decreased the students' willingness to use the video function during the class. Until this problem can be solved, synchronous online classes will still remain primarily based on text and audio communication. In terms of providing high degrees of social presence in online learning environments, there is still a great deal of room for improvement.

The blended instructional delivery method appears to be a promising method that will provide students with an optimal learning environment under constraints that many

institutions and students are facing. Building a learning community is not only important in traditional face-to-face classroom settings, but also crucial for online learning environments since the social presence is inherently low in these settings. The blended instruction delivery method is a method that takes the advantage of both face-to-face and online classroom settings, and provides a viable solution to various dilemmas. The intention we had in utilizing the blended instructional delivery method was to seek the best possible medium for students' needs, as well as the institution's resource management needs, rather than to make a claim for the superiority of blended instruction. This report is the result of a preliminary observation of the implementation of a blended instructional delivery method in graduate courses. More research is needed to systematically evaluate the method and provide more insights for educators.

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The Hook-ups Initiative: How Youth can Learn by Creating their own Computer Interfaces and Programs

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1. INTRODUCTION

This paper introduces the Hook-ups initiative. In this initiative, young people learn by designing and constructing "Hook-ups" - physical objects that can control games, animations, and other computer programs which they create. Hook-ups can be inspired by traditional computer interfaces (e.g., joysticks) or are entirely new types of interfaces (e.g., a spaceship steering wheel). In creating Hook-ups, young people work with objects and materials that they have a strong interest in exploring. Youth become designers capable of integrating virtual media with materials from the world around them. By engaging in Hook-ups design processes, learners gain confidence and motivation to explore topics within areas such as interface design, programming, and physics.

This investigation draws primarily from research focused on learning through design. Specifically, it addresses the integration of physical and virtual design. There are four main ideas on which the Hook-ups initiative is based: (1) design is a good context for learning; (2) learners become more deeply engaged when they have personal connections to design materials; (3) design activities should take learners' individual styles into account; and (4) supporting design-based learning in environments with less structure than traditional schools is challenging yet possible.

This paper begins with the relevant theory and work that guides Hook-ups' development, followed by a description of the project's design, which includes details of current Hook-ups materials and activities. Scenarios of Hook-ups being created are then offered. Different approaches to introducing Hook-ups to youth are analyzed. The paper concludes by discussing the initiative's future directions.

2. THEORETICAL GROUNDINGS: LEARNING THROUGH DESIGN

The constructionist theory of learning suggests that young people learn best through the process of constructing artifacts [3]. Kafai's Game Design Project is an example of a learning environment guided by this idea [2]. Kafai created an environment where fourth-grade students created video games to help younger children learn about fractions. Her game design tasks ranged from creating game packaging to designing user interfaces [2]. The Hook-ups initiative extends Kafai's work into the domain of input device design. Additionally, the Hook-ups initiative focuses, beyond game design, on other contexts such as interactive art.

Unlike Kafai's Game Design Project, Hook-ups activities do not start from a pre-defined subject matter. Hook-ups project subject matter is typically the result of free exploration. For instance, a learner can start a project by modeling the physical behavior of a familiar item in a simulation or game - buttons on a toy steering wheel can be connected to a computer to control virtual racecar programs, for example. As learners progress through their projects, they explore concepts in physics, electronics, and programming in order to realize their interface design ideas.

2.1. Integrating Physical and Digital

Recent research initiatives have provided preliminary indications that integrating both physical and computational design can offer engaging educational experiences to diverse sets of learners [1; 4]. Programmable Bricks, an initiative started at the MIT Media Lab, adds computation to physical objects that many people are familiar with: LEGO bricks. Programmable brick researchers believe that young people learn powerful ideas through participating in engaging design experiences both on and off the computer. Commercialized versions of programmable bricks are pocket-sized LEGO bricks (with tiny computers embedded) called "Mindstorms." To operate Mindstorms, users create programs and transfer them to a brick. An example program could activate motors to drive the wheels of a miniature car. The program could also read sensors to see if the car is near a wall – making activities like maze exploration possible.

Programmable bricks control physical objects. In contrast, Hook-ups control virtual objects. A Mindstorms powered car that is programmed to explore physical spaces has to be constrained by physical forces such as gravity whereas a virtual car does not. A person who is excited about learning in the context of space exploration may have difficulty launching a Mindstorms creation into orbit. Through Hook-ups activities, they can design and create a tangible control panel to maneuver an on-screen spaceship through a virtual universe.

3. DESIGNING HOOK-UPS

Hook-ups are user-created devices that influence the behavior of computer programs. They have one or more sensors that collect information from the world and send it to computer programs (that present the data to users as numbers). For example, a light sensor can continuously report the amount of light in a room. The user can write a program that adjusts the brightness of a digital image in response to the data received. Sensor input is captured via a Hook-ups interface board (HUB). This board connects sensors to computers through the kind of wire one can find on discarded headphones. Hook-ups can be designed for a multitude of interface boards and software packages. The Hook-ups described in this paper interface with a graphics-based programming environment called Scratch [5] that already supports an early version of the HUB.

The primary creators of Hook-ups are 10--18 year old members of community technology centers (CTCs). As a starting point to creating Hook-ups, young people are encouraged to work with objects or materials they like. Wilensky suggests that

developing personalized connections to objects engages student thinking, feeling and learning - not only about the object itself, but about other objects - and ultimately facilitates insights about self by the learner [6].

Subsequent sections show examples of how the process of designing custom, tangible interfaces can help youth develop personal connections to a range of materials, use materials in unexpected ways, and become comfortable with expressing themselves with new design tools. Hook-ups can include materials such as: discarded everyday items (paper plates, cardboard boxes); simple electronic components; deconstructed electronic toys; custom-made circuit boards; output from leading-edge personal-fabrication tools, etc.

3.1. Hooking into a Community's Diverse Interests

Hook-ups are introduced to communities that range in age, demographics, learning styles, and interests. All learners approach design activities with a different set of experiences and preferences. A challenge that Hook-ups will face is engaging youth who had previously been disinterested in (or frustrated by) design activities. To meet this challenge and engage diverse learners, the Hook-ups initiative introduces new design tools, provides support materials, and makes example projects available.

Hook-ups enable newcomers to initially explore the type of design with which they feel most comfortable, begin designing, and eventually try out other types of design. Ultimately, the objective is for participants to gain the ability to move fluidly back and forth between physical and virtual design as they desire. Young people who have learned to program their own games may become interested in designing customized controllers using simple sensors (i.e., switches and sliders). Conversely, young people who have learned that objects around them have electronic components that can serve as sensors may become interested in programming their own interactive programs. Hook-ups research will focus on choices made by youth, projects they construct, connections they establish with materials, and perceived increases in programming proficiency.

4. INTRODUCING AND DEVELOPING HOOK-UPS DESIGN ACTIVITIES

Hook-ups activities at CTCs can be introduced in several ways in order to provide research opportunities for comparison and contrast between various approaches. Hook-ups are currently being introduced in two ways at local Boston CTCs (local Computer Clubhouses and the South End Technology Center). The first introduction approach involves conducting Hook-ups work extensively with a few young people. The second approach includes working with larger groups in semi-structured workshops. Youth choose to work alone, in pairs, or in groups, and the effects of the design processes for each case can be analyzed. The next section highlights multiple approaches to introducing Hook-ups.

4.1. The Need for Flexibility in Introducing Design Activities

Hook-ups activities are designed for informal learning environments that depend on the voluntary participation of youth. In such circumstances, incorporating their pre-existing interests and activities is especially important. The following passage, taken from my field notes, provides an example of a flexible approach to introducing Hook-ups that resulted in a learner using design tools and materials in new ways.

> I started Scratch on my laptop to gauge if onlookers would become interested in using it. I showed a sequence of sample projects - some with Hook-ups - to the members who asked me what I was doing. A fellow mentor/researcher then sat with a group of 3 members that opted to learn Scratch programming. I took approximately 8 other members interested in Hook-ups to a table that contained items I brought such as wire, scissors, and push-buttons. The youth then added to the table materials they found such as water bottles, plastic bags and paper plates. After 20 minutes of group tinkering, a latecomer approached the table with a unique idea. He grabbed two wires and requested the scissors. He did not cut the wires; instead he taped a wire to each handle. He explained that when a person was cutting, the wires would meet and trigger an explosion [on the screen]. Another member used Scratch's image editor to draw graphics depicting explosions. The visit concluded by my building an example program that tied together the scissor interface and the explosion animation.

The Hook-ups initiative will also explore the balance between structure and flexibility in informal learning environments. As shown in the passage above, human support, basic materials, and project examples are provided. Project examples are carefully selected based on their ability to demonstrate how multiple simple elements come together to make engaging projects. Participants have the flexibility to use elements of provided materials in conjunction with elements they bring to the activities.

Simple Scratch program examples can quickly be deconstructed and rebuilt to show how basic programming concepts work. Some learners are able to see an example rebuilt and begin manipulating programs right away. For others, designing a physical interface to a program makes the programming task more approachable. For example, the following passage presents such an instance of a learner overcoming a perceived inability to program. As a result of becoming deeply involved in the construction of a tangible interface, the learner found the motivation to become involved in the programming of a Scratch project.

Six 12-year-old participants attended a 2-day mini-video game design workshop. They decided to collaboratively create a game about violence and television. Each participant volunteered to lead one aspect of the game's design. No one volunteered to build the Scratch program to integrate all of the parts (hesitation is understandable given the complexity of the task and the limited amount of time available). The workshop leaders gave the group an introduction to Scratch programming yet some members did not catch

on. One member named Jack was unable to understand the basic programming concepts and began to lose interest. Jack was presented with a box full of scissors, tape, wire, and old toys and asked if he was interested in creating a controller for the group's game. With a small amount of adult assistance, Jack created a one-button remote control to flip past violent channels on a virtual TV. With a desire to program something that would respond to his remote control, Jack became motivated to program. He retained and reused concepts in conditional programming to achieve his task. He even faced the challenge of programming the TV to loop back to channel 1 after reaching the highest channel.

5. FUTURE DIRECTIONS

The Hook-ups initiative is in its very early stages. Future Hook-ups research will establish new activities that integrate multiple types of design. By doing so, a better understanding will be gained of how young people learn when they are engaged in flexible design processes. The Hook-ups initiative will continue to investigate: (1) how input device design is a good context for learning; (2) how learners become engaged in physical and virtual design processes when connections to different design materials are established; (3) how design activities adapt to individuals' learning styles; and (4) how the structure and flexibility of Hook-ups design activities contributes to youth learning ideas from areas such as programming, interface design, and physics.

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Supporting and Changing Practices of Nested and Overlapping Educational Communities

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1. INTRODUCTION

Applications of information technology to support systemic reform in public school systems have taken several forms. Instructional applications include attempts to more effectively convey information to students, to empower students' own agency in accessing information and constructing knowledge, and to aid teachers' classroom management, lesson preparation, and assessment. Technology has been proffered as a change agent in itself: teachers will need to change their practices in order to use technologies designed for doing authentic inquiry and communicating or collaborating with others [10]. Information technology can also support professional development through access to online courses, and enable participation in distributed communities of practice. The work reported in this paper has taken this latter strategy. Because today's school systems operate in an environment of constant change, professional development requires a paradigm shift from a scripted training approach to a more fluid approach that encourages the incorporation of networks, coalitions, and partnerships. The capacity to network with other professionals is essential to the notion of communities of practice. McLaughlin and Mitra argue that sustaining large-scale theory-based reform efforts "requires a community of practice to provide support, deflect challenges from the broader environment, and furnish the feedback and encouragement essential to going deeper" [7]. Barab defines a community that advances ongoing and open-ended professional development as a "persistent, sustained network of individuals who share and develop an overlapping knowledge base, set of beliefs, values, history and experiences focused on a common practice and/or mutual enterprise" [1]. These communities change the relationships among teachers, breaking the isolation that most teachers have found so confining.

Over the past several years, Hawai`i Networked Learning Communities (HNLC), a National Science Foundation Rural Systemic Initiative (RSI), has been supporting communities of educators in Hawai`i. The goal of HNLC is to empower educators to prepare students in economically disadvantaged rural schools for life and careers in today's complex and dynamic technological world by enabling them to attain high standards in science, mathematics, and technology (SMT). HNLC is the result of collaboration between the Department of Information and Computer Sciences (ICS) of the University of Hawai`i at Manoa (UHM) and the Advanced Technology Research Branch (ATRB) of the Hawai`i Department of Education (HIDOE). One component of our work is a "virtual community center," realized as a dynamic website (hnlc.org). We chose to use Internet technology to build and sustain a community of rural educators because they work in small and isolated schools separated by island geography. This website targets educators at two levels: teams of educators who are formally involved in

HNLC, and the broader community of educational stakeholders in Hawai`i. The website includes a community forum for sharing news and stories of any nature deemed appropriate by members, and a database of Hawai`i-based resources for education. Two additional tools are specifically intended to support the work of HNLC school teams: a template that guides unit planning, and an "artifact-centered" discussion tool for sharing and discussing work.

In the spring and early summer of 2003 (about 12 months after hnlc.org was first released), we undertook our first evaluation specifically targeted at determining levels of teacher use of our online community tools. This evaluation is summarized in Suthers, et al. [13]. At the time of the evaluation, our work was focused on getting small teams of teachers to collaborate, online as well as face-to-face, in order to plan standards-based, assessment-driven and student-centered inquiry units. Overall, respondents had positive attitudes about the use of technology in general for a range of purposes, but as of summer 2003 they had not made significant use of hnlc.org outside of sponsored events, with the exceptions of school teams preparing for those events and the initiative of a few individuals. Focus groups indicated some differences in the expectations of developers and users. The results of this study challenged us to rethink our efforts to use Internet technology in support of systemic reform. In this paper we summarize the most important portion of our deliberations concerning the *community* and *practices* to be supported.

2. WHAT COMMUNITY SHOULD BE SUPPORTED?

Although our ultimate goal is increased *student* performance and participation in SMT, we want to accomplish this in a sustainable manner, which requires that we change the practices of those directly responsible for student learning rather than working directly with students ourselves. Therefore we reaffirmed that we want to support the work of teachers. Our working assumption from the outset has been that if teachers experienced the use of technology in their learning they would better understand how to use it for their students' learning. However, as discussed below, we found that we cannot neglect designing technology for use by students.

HNLC has been working with school teams formed for the purpose of representing each school to HNLC and developing an integrated unit plan as a model of how education could be done in their school. These teams may or may not be constituted of prior collaborators. An alternative approach is to identify existing communities within the schools rather than leaving team formation up to school administrators [6]. Regardless of how they are formed, school teams should enable educators of different disciplines or at different grade levels within a school to work with each other towards continuity in the students' learning experience across classes and grade levels.

We also recognize that relevant communities can extend beyond the schools. Teachers specializing in a given subject or grade level may want to network with each other across schools, forming *communities of practice,* the second "knit" of a double-knit organization [14]. They may wish to discuss specific math and science projects being implemented on multiple campuses as well as applications for curriculum resources being used in various classrooms. There are also groups defined by administrative structures such as the HIDOE complexes (high schools and their primary and intermediate feeder schools).

Collaboration within a complex could improve the educational experience from the students' point of view if innovations at the primary and secondary levels were coordinated. Finally, we considered whether our HNLC colleagues within the HIDOE should be the primary targets of our technology support. The ATRB team members plan the HNLC professional development program and carry it out in scheduled events, school visits, and online instruction. Although ATRB staff suggested that we focus on teachers, we recognize the need to work closely with the ATRB staff to ensure that the affordances of our technologies mesh well with their plans for professional development. For example, we found that because participants will most likely try new tools and practices at face-to-face training sessions organized by ATRB, we need to design for transitions between face-to-face and online use.

Also of interest for our systemic reform agenda is the statewide community of SMT educators within HIDOE, and the even broader community of stakeholders and interested parties that includes parents, employers, and representatives of other federally funded programs that have an educational outreach component. The expectations and resources of these stakeholders are critical for shaping and sustaining the future of education.

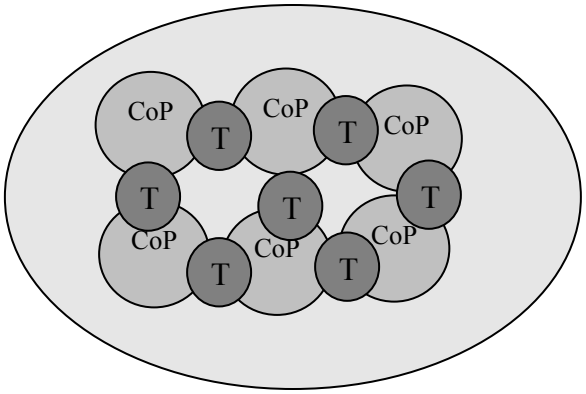

Figure 1: Nested and overlapping communities. Members of school teams (T) interact with disciplinary peers via communities of practice (CoP), all nurtured by the broader community of stakeholders (large ellipse).

Our efforts would be diluted if we tried to support all of these communities at once, but nor can we focus only on school teams and ignore their context. We now believe that hnlc.org must selectively support *nested* and *overlapping* communities of practice [9; 14] that extend beyond the schools and into the general community. We need to focus on teachers as those primarily responsible for student achievement, but not neglect the larger community context of education. Our primary focus in the design of hnlc.org is now on both the school teams and on inter-school collaborations (communities of practice) in which educators and ATRB staff share ideas and advice (Figure 1). Our secondary focus remains on the larger community that forms the environment of resources and expectations within which our primary communities grow. Our working hypothesis is that it is *essential* for the sustainability of systemic reform that we not only address the needs of the practitioners whose work immediately impacts upon student performance, but also initiate change in the broader community that places expectations on the school system as well as provides the resources to meet those expectations.

Discussions in the Community-Based Learning Workshop held at the 2004 International Conference on the Learning Sciences reinforced our view of the importance of nested communities and provided us with some fresh ideas about how we can support these communities. One way is through fostering a common identity and a culture of shared meaning and practices. A recent redesign of hnlc.org recognizes the importance of

community awareness. Personal profiles displaying each member's community contributions serve to build their reputations within the community as well as facilitate finding other contributions by the same member [5]. Allowing the members to personalize their online presence by sharing information about themselves creates opportunities for finding others with similar interests or complementary skills, thus facilitating the forming of new collaborative connections and groups [4].

The concept of small group cognition helps clarify our focus on teacher teams. Small groups are the unit that mediates between individual learning and community learning, and therefore are the appropriate unit of action for systemic reform [11]. Yet small groups do not exist in isolation: they form out of and are supported by communities. We are initiating a new effort to mobilize and support new members from the statewide community, with the expectation that this effort will foster new small communities of interest and that they will leverage resources provided by the larger community. We intend to study the interaction between the larger community, small communities and groups, and individual teachers in our target population to determine the effect of embedding in nested communities and how this is mediated by our technology.

3. WHAT PRACTICE SHOULD BE SUPPORTED?

Having clarified the overlapping and nested spheres of communities of practice that we intend to support, we are still faced with the question, "What practice?" Should we design our system to meet practitioners' immediate needs and working practices (as conventional wisdom in human-computer system design suggests), even if that meant supporting the existing teacher-centered forms of instruction?

We would be neglecting the systemic reform's objective of *changing* practice if we merely focused on supporting existing practice. Systemic reform requires that something sustainable change in the *system* beyond an immediate impact on this year's cohort of students. Furthermore, systemic reform means change, and that may mean trying to get educators to do things other than that which they think they most need. We need to change their practices as well as support them. The objective of this reform is a reflective-action form of practice – akin to action research – in which teachers use embedded assessment to examine the effects of their instructional interventions and the learning opportunities they create for student performance, and adjust those interventions and seek new opportunities as needed to improve performance. If *this* were the prevalent practice of our user community, then the tools that they need, and indeed demand, would be different than at present.

What role does technology play in driving the change process? Can we offer technology (integrated with professional development) that meets the demands of this imagined community of practice of the future, and thereby perturb the present activity system to change towards that future? This strategy will not work if educators don't use the tools, and they won't use tools that don't meet their present needs. Also, this approach presents a triple challenge: by asking teachers to (1) work collaboratively, (2) via online technology, and (3) to plan and engage in student-centered inquiry learning, we are asking them to do three things that most of them are not accustomed to doing. If teachers

have not engaged in reflective discussion even in face-to-face settings, it is unrealistic to expect this behavior in an online environment [6]. Where do we begin?

Our hope is that the distinction between supporting and changing practice may be artificial or irrelevant, if the tools we offer are amenable to supporting both practices in teachers' current zone of proximal development as well as more reflective practices of the future. Strategically, we need to build tools to support current practice, gain acceptance, and then build on this base to change the practice along with and through the tools. This process could be supported by technology serving as a collaborative workspace with functions to enable socialization and interpersonal connection [2].

A related question is how teachers will learn to use technology. We began under the assumption that educators could learn to teach with technology by first learning to learn with technology. However, through surveys and focus groups as well as informal experience we found that HNLC educators tend to view technology as resources for use with their students, and are more likely to be inspired by their students' use of technology than vice-versa. Yet they also acknowledge that technology is an important resource for their own professional development. Perhaps the resolution to this apparent tension between teacher-first versus student-first use is to shape professional development so that participants use the tools in the way students would be asked to use them in inquiry-based learning. They would thereby gain simultaneous training in the practice of inquiry-based learning and the use of technologies as specifically applied to the inquiry activities of themselves *and* their students.

4. WHAT DO WE BUILD?

We have so far considered what we can do to support present and future practices of multiple communities and teams. A deeper problem arises if many of these communities of practice do not already exist. Then the question becomes, "What do we build – the community, the practice, or the tools?" Communities of practice need to be built from a complex array of factors and in a manner that is timely and unique to each group. A community design cannot simply be proffered to a group [3]. Kling and Courtright contend that it is easier to foster technology *supported* community development than to nurture technology *initiated* communities [6]. Communities evolve within groups around their particular needs and for purposes that they value. Program planners must face issues of sociability as well as usability in developing a design that links to and supports people's social interactions [2; 8]. Fostering trusting and respectful relationships is paramount. This is the basis for community building, and, once established, each community of practice then directs the development, adoption, and use of technology for its specific needs. The process combines both bottom-up and top-down efforts to answer the questions we pose here. When multiple, nested communities of practice are involved, our responsibilities for attentiveness and technological responsiveness are correspondingly increased and should be clearly prioritized.

5. CURRENT RESEARCH

Our continued research is organized around two major issues: (1) technology-supported communities and systemic reform (as discussed above), and (2) the affordances of technology as a mediating artifact in supporting these communities [13]. We raise the following questions to guide our investigation. (1) What strategies can encourage time-pressed, technology-hesitant teachers to use technology for their own learning and collaboration? Once technology has been adopted for collaboration, how do the new relationships and communities so formed influence classroom practices towards genuine inquiry? How are new relationships formed via technology or via a mixture of face-to-face and online interactions? Does the embedding of small groups within the context of a statewide online community lead to the formation and enhancement of small group work? Do technology-mediated groups or communities change the operation of the organization in which they are embedded? (2) How is technology used not only as "communication channel" but also as a medium within which questions and problems are identified and shared solutions are negotiated? How can design of representational notations influence such collaborative inquiry? How can workspaces be adapted to users' needs?

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