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Community-based learning: The core competency of residential, research-based universities

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Abstract Traditionally, universities focus primarily on instructionist teaching. Such an understanding has been criticized from theoretical and practical points of view. We believe that *socio-cultural theories of learning* and the concepts of *social capital* and *social creativity* hold considerable promise as a theoretical base for the repositioning of universities in the knowledge society. To illustrate our assumption, we provide case studies from the University of Colorado and the University of Siegen. These cases indicate how approaches to community-based learning can be integrated into a curriculum of applied computer science. We also discuss the role these didactical concepts can play within a practice-oriented strategy of regional innovation.

Keywords Social capital · Social creativity · Community-based learning · Symmetry of ignorance · Distributed intelligence · Courses-as-seeds · Courses in practice (CiP) · Undergraduate research apprenticeship program · Transdisciplinary education · Communities of practice (CoPs) · Networks of practice (NoPs) · Communities of interest (CoIs) · Regional industrial clusters

Introduction

One of the most impoverished paradigms of education is a setting in which *"a single, presumably omniscient teacher tells or shows presumably unknowing learners something*

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they presumably know nothing about" (Bruner, 1996, p. 20). There are significant efforts are under way to change the nature of school discourse to make it more of a collective inquiry (Scardamalia & Bereiter, 1994) and to introduce project-based approaches to learning at university education (Cannon & Leifer, 1999; Kolmos, Fink, & Krogh, 2004). However, the traditional model of education is still widely practiced in our educational institutions, leading critics such as Illich (Illich, 1971) to claim that our schools and universities are *"the reproductive organ of a consumer society"* (p. 107) and that people who are hooked on teaching are conditioned to be customers for everything else.

The premise of this paper is that the traditional paradigm of education is not appropriate for understanding and learning to resolve the types of open-ended and multidisciplinary problems that are most pressing to our society. These problems, which typically involve a combination of social and technological issues, require a different paradigm of education and learning skills, including self-directed learning, active collaboration, and consideration of multiple perspectives. Problems of this nature do not have "right" answers, and the knowledge to understand and resolve them is changing rapidly, thus requiring an ongoing and evolutionary approach to learning.

As an alternative to the traditional educational paradigm, we envision courses as communities of learning in which participants shift among the roles of learner, designer, and active contributor (Rogoff, Matsuov, & White, 1998). The predominant mode of learning in this environment is peer-to-peer, with the teacher acting as a "guide on the side" rather than as a "sage on the stage." Courses are reconceptualized as seeds that are jointly evolved by all participants rather than as finished products delivered by teachers (dePaula, Fischer, & Ostwald, 2001). Furthermore, with close cooperation between universities and regional industries, networks of practice (NoPs) are established to enable mutual learning. University students can join companies' practices to gain industrial apprenticeship (Rohde, Klamma, & Wulf, 2005; Rohde, Klamma, Jarke, & Wulf, 2007).

Universities play an important role in the knowledge society (Brown & Duguid, 2000). Beyond their traditional role in research and education, they have the potential to exploit local knowledge in (regional) innovations and to provide opportunities for students to become lifelong learners. To realize these potentials, universities-specifically in the fields of applied sciences and engineering—will have to reinvent their conception of education by taking the importance of industrial practice and social networks into account.

In this paper, we first describe a conceptual framework for community-based learning. We illustrate the framework by presenting our approaches to community-based learning in two settings: (1) a computer science program at the University of Colorado, Boulder, and (2) an information systems program at the University of Siegen. Empirical data evaluating the different courses indicate potentials and problem areas. Finally, we discuss lessons learned from our efforts to transform learning and to create new educational opportunities and experiences at our residential, research-based universities.

Conceptual frameworks

We believe that *socio-cultural theories of learning* (Bruner, 1996; Lave & Wenger, 1991; Vygotsky, 1986; Wenger, 1998) hold considerable promise as a theoretical base for the repositioning of universities in the knowledge society. Learning is understood as a collective process (Rogoff et al., 1998) that is linked to a specific context of action. In socio-cultural theories of learning, learning and innovation takes place within social aggregates that share a common practice. Knowledge emerges by discursive assignment of meaning and social identification. Therefore, *community-based learning* is used here as a concept to describe processes of collective and collaborative learning, which are based on socio-cultural learning concepts and focus on the role of group membership or community participation for (collective and individual) learning.

Communities: Transcending the individual human mind

The power of the unaided individual mind is highly overrated. In most traditional approaches, *human cognition* has been seen as existing solely "inside" a person's head, and studies on cognition have often disregarded the physical and social surroundings in which cognition takes place. *Distributed intelligence* (or *distributed cognition*) (Fischer, 2006; Hollan, Hutchins, & Kirsch, 2001; Pea, 2004; Salomon, 1993) provides an effective theoretical framework for understanding what humans can achieve and how artifacts, tools, and *socio-technical environments* (Mumford, 2000) can be designed and evaluated to empower human beings and to change tasks.

Knowledge is often portrayed as an individual possession that people carry around in their heads and transfer to each other despite the fact that work is unlikely to be carried out in isolation, let alone without the aid of external artifacts. We see *knowing* as always mediated by artifacts, situated, and often distributed in the social environment. Knowledge becomes, then, people's ability to act, *participate*, and make appropriate and informed decisions.

Due to the complex nature of social settings in which knowledge is enacted, it is critical to understand the various aspects that contribute to the formation of the *socio-technical conditions* for stakeholders to accomplish their work, instead of focusing solely on the knowledge-transferring problem. Our framework is based on the concepts of distributed cognition, social networks, and information ecologies, and more importantly focuses on the role of *human agency* in enabling the work to get accomplished in the context of a *cultural practice*.

Traditionally, universities have focused on "instructionist" teaching. An instructionist understanding of teaching assumes that the instructor possesses *all* relevant knowledge and passes it to the learners (Noam, 1995). The learner is seen as a receptive system that stores, recalls, and transfers knowledge. Regional context does not play a role in these university activities. Such an understanding has been criticized from theoretical and practical points of view (Collins, Brown, & Newman, 1989; Jonassen & Mandl, 1990). In a highly differentiated world full of open-ended and ill-defined problems, it is rather unlikely that an individual (professor) or an academic organization (faculty) will possess sufficient knowledge to foster learning among students and practitioners by itself (Arias, Eden, Fischer, Gorman, & Scharff, 2000).

Socio-cultural theories of learning (Bruner, 1996) hold considerable promise as a theoretical base for the repositioning of universities in the knowledge society. Scholars convening at a recent National Science Foundation (NSF) workshop on the future of graduate education concluded that *community* is of overarching importance for the future of graduate education (Lorden & Slimowitz, 2003). We ask, however: a) Which categories of community provide good models for educational design and in which contexts, and b) What essential features of these categories promote desired transdisciplinary outcomes?

The following three models for knowledge creation communities can be differentiated: (1) the Knowledge-Creating Company (Nonaka & Takeuchi, 1995); (2) the Model of Expansive Learning (Engeström, 2001); and (3) Bereiter's (Bereiter, 2002) Model of Knowledge-Building.

Even though these models are derived from different theoretical histories (activity versus participation metaphors), are implemented in different educational contexts (work environments versus schools), and conceptualize the outcomes of learning in different terms (tacit and explicit knowledge, new activity structures, or conceptual artifacts), they all have in common a commitment to *collective knowledge creation while developing shared objects of activity*. This common essence helps to define an important core model for transdisciplinary scholarship, although we have found it useful to further differentiate this concept into *communities of practice* (CoPs), which are homogeneous, and *communities of interest* (CoIs), which are heterogeneous (Brown & Duguid, 1991; Fischer, 2001; Wenger, 1998). Such evolving research-based concepts of community provide key discussion points for a discourse on a rethinking of education, and should become key elements of discourse within a transdisciplinary curriculum.

Communities of practice and communities of interest

Communities are social structures that enable groups of people to share knowledge and resources in support of collaborative action. Different communities grow around different types of practice. Each community is unique, and in our research efforts we have identified two kinds of communities (Fischer, 2001): *communities of practice* and *communities of interest*.

Communities and networks of practice

CoPs (Wenger, 1998) consist of practitioners who work as a community in a certain domain undertaking similar or at least intra-related work. Learning within a CoP takes the form of *legitimate peripheral participation* (LPP) (Lave & Wenger, 1991), which is a type of apprenticeship model in which newcomers enter the community from the periphery and move toward the center as they become more and more knowledgeable. A CoP has many possible paths and many roles (identities) within it (e.g., leader, scribe, power-user, visionary, and so forth).

Brown and Duguid (2000) and Duguid (2003, 2005) distinguish networks of practice from communities of practice. Within CoPs, members not only share a common practice, but work together and therefore need to coordinate their work with each other. For instance, a tailor shop in which different tailors work together and apprentices get enculturated by playing a more and more important role in the shop's practice make up a CoP. The members of a CoP have responsibility, at least implicitly, for the reproduction of their community and their practice. Within NoPs, members share a common practice but do not work together in an interdependent way by which they need to coordinate their work. For example, software engineers from different companies who do not work on the same project but who are occupied with similar problem sets, such as building e-commerce applications, form a network of practice.

Within NoPs, common practice offers a reference to members for their interaction. Common practice allows them to share information in a relatively effective and coherent way (Duguid 2003, 2005). CoPs are typically found inside organizations, whereas NoPs often span organizational boundaries.

Sustained engagement and collaboration lead to boundaries based on shared histories of learning that create discontinuities between participants and nonparticipants. Highly developed knowledge systems (including conceptual frameworks, technical systems, and human organizations) are biased toward efficient communication within the CoP and NoP at the expense of acting as barriers to communication with outsiders. Thus, boundaries that are empowering to the insider are often barriers to outsiders and newcomers to the group.

Communities of interest

CoIs bring together stakeholders from different CoPs or NoPs and are defined by their collective concern with the resolution of a particular problem. CoIs can be thought of as “communities of communities” (Brown & Duguid, 1991) or a community of representatives of communities. Examples of CoIs include: (1) a team interested in software development comprising software designers, users, marketing specialists, psychologists, and programmers; or (2) a group of citizens and experts interested in urban planning.

Stakeholders within CoIs are considered *informed participants* (Brown, Duguid, & Haviland, 1994), who are neither experts nor novices, but rather both: they are experts when they communicate their knowledge to others, and they are novices when they learn from others who are experts in areas outside their own knowledge.

As a model for working and learning in CoIs, *informed participation* (Arias, Eden, Fischer, Gorman, & Scharff, 1999; Brown et al., 1994) is based on the claim that for many (design) problems, the knowledge to understand, frame, and solve these problems does not already exist, but must be collaboratively constructed and evolved during the problem-solving process. Informed participation requires information, but mere access to information is not enough. The participants must go beyond the information that exists to solve their problems. For informed participation, the primary role of media is not to deliver pre-digested information to individuals, but to provide the opportunity and resources for social debate and discussion. In this sense, improving access to existing information (often seen as the major advance of new media) is a limiting aspiration. A more profound challenge is to allow stakeholders to incrementally acquire ownership in problems and contribute actively to their solutions (Florida, 2002).

Communication in CoIs is difficult because the stakeholders come from different CoPs and, therefore, use different languages, different conceptual knowledge systems, and perhaps even different notational systems. In his book, *The Two Cultures* (Snow, 1993), C. P. Snow describes these difficulties through an analysis of the interaction between literary intellectuals and natural scientists, who (as he observed) had almost ceased to communicate at all:

> *between the two a gulf of mutual incomprehension—sometimes (particularly among the young) hostility and dislike, but most of all lack of understanding (p. 4)*

and

> *there seems to be no place where the cultures meet (p. 16).*

The fundamental barrier facing CoIs is that knowledge distribution is based on a *symmetry of ignorance* (Rittel, 1984), in which each stakeholder possesses some, but not all, relevant knowledge, and the knowledge of one participant complements the ignorance of another. This barrier must be overcome by building a shared understanding of the task at hand, which often does not exist at the beginning, but is evolved incrementally and collaboratively and emerges in people’s minds and in external artifacts. Members of CoIs must learn to communicate with and learn from others (Engeström, 2001) who have different perspectives and perhaps different vocabularies for describing their ideas. In other words, this symmetry of ignorance must be exploited.

Comparing CoPs, NoPs, and CoIs

Learning through informed participation within CoIs is more complex and multifaceted than *legitimate peripheral participation* (Lave & Wenger, 1991) in CoPs. Learning in CoPs or NoPs can be characterized as "learning within a single knowledge system," whereas learning in CoIs is often a consequence of the fact that there are multiple knowledge systems. CoIs have multiple centers of knowledge, with each member considered to be knowledgeable in a particular aspect of the problem and perhaps not so knowledgeable in others. In informed participation, the roles of "expert" or "novice" shift from person to person, depending on the current focus of attention.

Table 1 characterizes and differentiates CoPs, NoPs, and CoIs along a number of dimensions. The point of comparing and contrasting CoPs, NoPs and CoIs is not to pigeonhole groups into any one category, but rather to identify patterns of practice and helpful technologies. People can participate in more than one community or network, or one community can exhibit attributes of both a CoI and a CoP. Communities do not have to be strictly either CoPs or CoIs, but they can integrate aspects of both forms of communities. The community type may shift over time, according to events outside the community, the objectives of its members, and the structure of the membership.

The different forms of social aggregates exhibit barriers and biases. *CoPs* and *NoPs* are biased toward communicating with the same people and taking advantage of a shared background. The existence of an accepted, well-established center (of expertise) and a clear path of learning toward this center allows the differentiation of a CoP's members into novices, intermediates, and experts. It makes these attributes viable concepts associated with people and provides the foundation for legitimate peripheral participation as a workable learning strategy. The barriers imposed by CoPs (and, to a lesser degree, by NoPs) are that *group-think* (Janis, 1972) can suppress exposure to, and acceptance of,

Table 1 Differentiating CoPs, NoPs, and CoIs

Dimensions	CoPs	NoPs	CoIs
Nature of problems	Same task in the same domain	Different tasks in the same domain	Common task across multiple domains
Knowledge development	Refinement of one knowledge system; new ideas coming from within the practice	Refinement of one knowledge system; new ideas coming from within the practice	Synthesis and mutual learning through the integration of multiple knowledge systems
Major objectives	Codified knowledge, domain coverage	Codified knowledge, domain coverage	Shared understanding, making all voices heard
Weaknesses	Group-think	Group-think	Lack of a shared understanding
Strengths	Shared ontologies	Shared ontologies	Social creativity, diversity, making all voices heard
People	Beginners and experts; apprentices and masters	Members of the network who share a common practice	Stakeholders (owners of problems) from different domains
Learning	Sustained engagement and legitimate peripheral participation	Sustained engagement	Informed participation

outside ideas; the more someone is at home in a CoP, the more that person forgets the strange and contingent nature of its categories from the outside.

A strength of *CoIs* is their potential for *creativity* because different backgrounds and different perspectives can lead to new insights. CoIs have great potential to be more innovative and more transforming than a single CoP if they can exploit the *symmetry of ignorance* (Rittel, 1984) as a source of collective creativity. A fundamental barrier for CoIs might be that the participants failed to create *common ground and shared understanding* (Clark & Brennan, 1991). This barrier is particularly challenging because CoIs often are more temporary than CoPs; they come together in the context of a specific project and dissolve after the project has ended.

CoPs are the focus of approaches such as computer-supported cooperative work (CSCW). They provide support for work cultures with a shared practice (Wenger, 1998). The lack of a shared practice in CoIs requires them to draw together diverse cultural perspectives. Computer-mediated knowledge communication in CoPs is different from that in CoIs. CoIs pose a number of new challenges, but the payoff is promising because they can support pluralistic societies that can cope with complexity, contradictions, epistemological pluralism, and a willingness to allow for differences in opinions.

Social capital

Social capital (*SC*) is about value derived from being a member of a social aggregate. By being a member, people have access to resources that nonmembers do not have (Bourdieu, 1985; Fischer, Scharff, & Ye, 2004; Huysman & Wulf, 2004b; Putnam, 1993. SC theories provide a conceptual base to understand networks of individuals whose (economic) interactions are embedded in social relations. Through social exchanges, people build webs of trust, obligation, reputation, expectations, and norms (Coleman, 1988; Granovetter, 1973). By explaining (economic) interactions by their embeddedness in social relations, SC is a concept that can explain access to resources far beyond the domains of knowledge sharing and social creativity (Huysman & Wulf, 2004b). For this reason, SC theories can provide meaningful concepts for the strategic positioning of research universities in many different areas.

SC theories have been applied as a conceptual base to knowledge-sharing strategies (Cohen & Prusak, 2001; Huysman & Wulf, 2004b; Nahapiet & Ghoshal, 1998). Cohen and Prusak state, in this respect:

> *Social capital consists of the stock of active connections among people: the trust, mutual understanding, and shared values and behavior that bind the members of human networks and communities and make cooperative action possible. ... Its characteristic elements and indicators include high levels of trust, robust personal networks and vibrant communities, shared understandings, and a sense of equitable participation in a joint enterprise—all things that draw individuals together into a group.* (Cohen & Prusak, 2001, p. 4)

Concerning processes of gaining and fostering social capital, the approach assumes that it is accumulating SC when it is used (productively); otherwise, it is decreasing. In this sense, SC tends to be self-reinforcing and cumulative. People gain connections and trust by successful cooperation, and these achievements of networks and trust support cooperation in the future. To gain and foster social capital, Cohen and Prusak suggest the following (organizational) investments in trust-building processes: Social capital can be gained (1) by being trustworthy, (2) by being open and encouraging openness, and (3) by trusting others (Cohen & Prusak, 2001, p. 45f).

Duguid (2003) has pointed to some distinctions between the concepts of SC, NoPs, and CoPs. SC und practice theories all focus on the importance of social networks for the exchange of knowledge. However, practice theories focus more on the human actors' capability to share knowledge. Only those actors who engage in similar or shared practices are able to share knowledge about those practices. Thus, where SC theory points to links imposed by social networks, practice theories point to potential boundaries-boundaries shaped by practice—that divide knowledge networks from one another. These boundaries may prevent knowledge sharing despite all the obligations of good will and social capital that connect them or, indeed, all the incentives that may entice them (Duguid, 2003).

Despite the criticisms of the SC approach and the limitations of Putnam's understanding (e.g., Florida, 2002), social capital seems to be useful for a pragmatic analysis of processes of community building and social networking. Since the discussion on social capital focuses on the establishment of relationships of trust, we assume that social capital represents a precondition for the emergence of CoPs and NoPs. Because CoIs suffer from a lack of shared practice, SC seems to be of special importance for their (well) functioning.

Social creativity

Social creativity explores computer media and technologies to help people work together. It is relevant to community-based learning because collaboration plays an increasingly significant role in projects that require expertise in a wide range of domains. Software design projects, for example, typically involve designers, programmers, human–computer interaction (HCI) specialists, marketing experts, and end-user participants (Greenbaum & Kyng, 1991). Information technologies have reached a level of sophistication, maturity, cost-effectiveness, and distribution such that they are not restricted only to enhancing productivity, they also open up new creative possibilities (National-Research-Council, 2003).

Our work is grounded in the basic belief that there is an "and" and not a "versus" relationship between individual and social creativity (Fischer, Giaccardi, Eden, Sugimoto, & Ye, 2005). Creativity occurs in the relationship between an individual and society, and between an individual and his or her technical environment. The mind, rather than driving in solitude, is clearly dependent upon the reflection, renewal, and trust inherent in sustained human relationships (John-Steiner, 2000). We need to support this distributed fabric of interactions by integrating diversity, making all voices heard, increasing the back-talk of the situation, and providing systems that are open and transparent so that learners can be aware of and access each other's work, relate it to their own work, transcend the information given, and contribute the results back to the community.

In complex projects, collaboration is crucial for success, yet it is difficult to achieve. Complexity arises from the need to synthesize different perspectives, exploit conceptual collisions between concepts and ideas coming from different disciplines, manage large amounts of information potentially relevant to a design task, and understand the design decisions that have determined the long-term evolution of a designed artifact.

Meta-design

Meta-design (Fischer & Giaccardi, 2006) is "design for designers." It extends the traditional notion of system design (including curricula, courses, learning environments, and software systems) beyond the original development of a system to include co-adaptive processes in which the learners become *co-developers*. It defines and creates social and technical infrastructures in which new forms of community-based learning can take place. Meta-design perspectives focus on the following requirements for socio-technical environments: they must (1) be flexible and evolvable because they cannot be completely designed prior to use; (2) evolve to some extent at the hands of their users; and (3) be designed for evolution.

The goal of making courses and curricula units modifiable and evolvable by users does not imply transferring the responsibility of good design to the learner. Meta-design is a conceptual framework defining and creating social and technical infrastructures in which new forms of community-based learning can take place and new communities of learners can evolve.

Approaches to community-based learning

The following discussion presents approaches to community-based learning that have been applied during the last few years to university education at the Center for LifeLong Learning and Design (L3D) (L3D, 2006), University of Colorado–Boulder, USA, and the Institute for Information Systems and New Media at the University of Siegen, Germany.

University of Colorado

Structure and description of the local context

The research team at the Center for Lifelong Learning and Design has been interested and has pursued activities to understand the core competency of residential, research-based universities in the twenty-first century. A deep understanding of this issue was brought into focus by developments such as the MIT OpenCourseWare project, a free and open educational resource for educators, students, and self-learners around the world http://ocw.mit.edu/). This project makes the course materials that are used in the teaching of almost all of MIT's undergraduate and graduate subjects available on the web, free of charge, to any user anywhere.

Our basic assumption derived from such developments is that the core competency of residential, research-based universities is in interaction, collaboration, and constructionist activities that take place in community-based learning environments that support "learning-to-be" and "learning when the answer is not known." Interdisciplinary and transdisciplinary efforts at the University of Colorado are supported by institutes and centers such as: (1) the Institute of Cognitive Science http://ics.colorado.edu/), which brings together all disciplines contributing to Cognitive Science; (2) the ATLAS (Alliance for Technology, Learning, and Society) Institute http://www.colorado.edu/ATLAS/), with a focus on bringing together information and communication technologies with the creative practices; and (3) the Discovery Learning Center http://engineering.colorado.edu/DLC/), with a focus on horizontal and vertical integration. The following sections briefly describe four different activities to explore community-based learning by the Center for Lifelong Learning and Design embedded in the broader context defined by these institutes.

Our courses at the University of Colorado–Boulder are focused on creating a new understanding of design, learning, and collaboration as fundamental human activities that interact, and on how to support them with innovative computational media (for examples, see http://l3d.cs.colorado.edu/~gerhard/courses/). The goals of these courses are:

- To engage students in actively exploring technology projects of *personal interest in a self-directed way*, contributing knowledge derived from their own work;

- To support *peer-to-peer learning* and the *emergence of a community* by providing opportunities and rewards for participants to learn from each other in discussions and by working on collaborative course projects;
- To provide opportunities for *transdisciplinary collaborations* by supporting horizontal (e.g., students from different disciplines) and vertical (e.g., undergraduates, graduates, post-docs, professionals) integration;
- To *seed the course environment* with relevant information and to provide the technical possibilities and social reward structures for all participants to contribute; and
- To explore the *unique possibilities that computational media* can have in impacting and transforming these activities by transcending "gift-wrapping" and "techno-determinism" in order to create true innovations.

Courses-as-seeds

Courses-as-seeds (dePaula et al., 2001) is an educational model that attempts to create a culture of collective inquiry that is situated in the context of the university courses and yet extends beyond the temporal boundaries of semester-based classes and traditional prefabricated class materials. The essential aspects of the model are that students take an active role in their own learning processes (Fischer, 2002) and that these learning processes are embedded in collaborative activities supported by innovative technologies.

The subject areas we want to investigate do not contain answers that can be found in textbooks or derived in a semester, but instead are complex, vague, and open-ended problems. Within our model, students are *designers* and *reflective practitioners* who must frame the problems they will investigate (Schön, 1983). The knowledge to understand, frame, and solve design problems does not exist a priori, but is constructed and evolved by exploiting the power of the "*symmetry of ignorance*" (Rittel, 1984) and *"breakdowns*" (Winograd & Flores, 1986). Central to the notion of design as a model of collaborative work and learning is the construction of a publicly accessible artifact (Bruner, 1996) that serves as both a reification of shared understanding and grounding for the creation of new understandings.

Collaborative technologies are providing new ways to conceptualize what such a shared artifact can be. In the past, a physical artifact was separate from the discussions and decisions that helped shape it. Modern collaborative technologies allow these discussions and decisions to be captured and considered as part of the artifact. For example, hypertext technologies enable students to create artifacts that link and extend each other's contributions to express new understandings. The result of such knowledge-building is an information space that can serve as the starting point for future students, who bring new perspectives and framings to the problem. It is this sense of ongoing, collaborative learning through design that we wish to support with the courses-as-seeds model.

Courses (examples can be found at http://l3d.cs.colorado.edu/~gerhard/courses/) taught from the courses-as-seeds perspective have the following *objectives*:

- To engage students in *authentic, self-directed learning activities*;
- To embed learning and design activities in the context of *real-world activities*;
- To encourage *collaboration* based on the interdisciplinary nature of real-world problems;
- To support *peer-to-peer learning*;
- To practice *horizontal* and *vertical integration* by having undergraduates, graduates, post-docs, and additional faculty members participate in the course;
- To enrich the educational experience of the students by having *guest lectures*;

- To encourage students to exercise judgment and *self-assessment*; and
- To exploit *new media* and new technologies in innovative ways.

Courses-as-seeds explores *meta-design* in the context of university courses by creating a culture of informed participation (Brown et al., 1994). It explores how to supplement community-based learning theories (Rogoff et al., 1998) with innovative collaborative technologies. Participants shift among the roles of learner, designer, and active contributor. Learning is mutual and involves all stakeholders, and the teacher acts as a *"guide on the side"* (a meta-designer) rather than as a *"sage on the stage."* The output of each course contributes to an evolving information space that is collaboratively designed by all course participants, past and present. As in all meta-design activities, the meta-designer (i.e., the teacher) gives up some control; there is little room for micro-managed curricula and precise schedules. Because it is impossible and undesirable to precisely determine the direction and outcome of learning in the courses-as-seeds model, learning is conceptualized as an evolutionary process of *"design without final goals"* (Simon, 1996). From this perspective, breakdowns in understanding do not cause embarrassment to instructors and frustration to students, but rather provide opportunities for learning and new directions for inquiry. The courses-as-seeds model requires a mindset in which plans conceived at the beginning of the course do not determine the direction of learning but instead provide a resource for interpreting unanticipated situations that arise during the course (Suchman, 1987).

Learning to be: Undergraduate research apprenticeship program

The Center for LifeLong Learning and Design (L3D) established an Undergraduate Research Apprenticeship Program (URAP) (URAP, 2006) in 1998 in an effort to provide a means for engaging undergraduate students in real research environments. The underlying philosophy of the URAP is based on the fundamental objectives of complementing *"learning about"* with *"learning to be"* (Bruner, 1996). Specifically, research teams have a vertically and horizontally integrated structure: they are interdisciplinary by nature and include undergraduate apprentices, Ph.D. students, post-docs, research scientists, faculty, and industry partners from various fields. URAP emphasizes the importance of learning-by-doing: each apprentice has a personal mentor and works on ongoing projects. Our model emphasizes a long-term working relationship in which apprentices receive close guidance at first, but over time are expected to engage in more self-directed research as well as serve as mentors for newer apprentices.

Transdisciplinary education

Our focus on *transdisciplinary competencies and mindsets* addresses abilities and attitudes required for successful lifelong and transdisciplinary learning that we believe are important for all students in all disciplines and that should be acquired *in addition to and along with* in-depth knowledge in particular specialties. We use the term *transdisciplinary* (National-Research-Council, 2003) instead of *interdisciplinary* to emphasize that interdisciplinary collaboration may create new knowledge domains outside or in between disciplines, and in the process fundamentally transform the disciplinary identities of the collaborating researchers. Interdisciplinarity requires accepting different opinions in addition to ours, but transdisciplinarity requires that we are willing to change opinions and beliefs (Snow, 1993).

The capability of *crossing different knowledge spaces and nourishing a fertile middle ground* between disciplines is crucial for society's problems that are far too complex for one point of view. The capability of transferring methods from one discipline to another is necessary, but *mutual learning* and the capability of *collaborative problem framing and problem solving* in a suitable socio-technical environment are crucial. Transdisciplinary research focuses on imaging entirely new possibilities for what disciplines can do. This is achieved by transcending a distinction between designers and consumers (or providers and clients) into a relationship of peers and collaborators by exploiting the symmetry of ignorance as a source of creativity and mutual learning.

Most significant real-world problems are framed and solved by multicultural and transdisciplinary communities and organizations rather than by individuals. Human creativity emerges from activities that take place in contexts in which there is interaction among people and artifacts (e.g., tools, technologies, designs, represented ideas) that embody knowledge from various constituent communities (Bennis & Biederman, 1997; Csikszentmihalyi, 1996; Engeström, 2001). Hence *goals* for transdisciplinary education must include preparing citizens and professionals to live and work productively in a world in which intelligence is *distributed* across networks of humans and artifacts (Salomon, 1993).

Transdisciplinary education also has a critical social dimension. Theorists writing about interdisciplinary learning and collaboration have long recognized that achievement of excellence requires conceptual collisions and epistemological pluralism (Turkle & Papert, 1991) brought about by controversy and debate. Competing ideas are essential for knowledge growth, but taking advantage of them requires norms and communication practices that invite openness and lead to analysis and integration. Yet people working together often do not address communication processes openly, and they may remain unaware when communication processes are deficient (Derry & Fischer, 2005). Working and learning across time, space, people, and tools, especially when different disciplines are involved, requires a community-wide social intelligence that is often not present in working groups' epistemological pluralism.

Social networks: Lifelong learning

The goal of our research is to explore the strengths and weaknesses of community-based learning while addressing the following question: *What and how should students learn in order to be educated citizens and to find and do interesting and important work in the twenty-first century?* Our research agenda has been grounded in the basic belief that lifelong learning is more than adult education: it forces us to rethink the core function of formal education in schools and universities. We are convinced that one of the most fundamental aspects of education at a residential, research-based university is to create a lifelong bond between the students and the university. This objective was articulated by George Norlin (1871–1942) in 1935 as president of the University of Colorado in a speech to graduating students that contained the following remarks:

> *You are now certified to the world at large as alumni of the University. She is your kindly mother and you her cherished sons and daughters. This exercise denotes not your severance from her, but your union with her. Commencement does not mean, as many wrongly think, the breaking of ties and the beginning of life apart. Rather, it marks your initiation in the fullest sense into the fellowship of the University, as bearers of her torch, as centers of her influence, as promoters of her spirit.*
>
> *The University is not the campus, not the buildings on the campus, not the faculties, not the students of any one time—not one of these or all of them. The University consists of all who come into and go forth from her halls, who are touched by her*

> *influence and who carry on her spirit. Wherever you go, the University goes with you. Wherever you are at work, there is the University at work*. (Norlin, 1935)

These arguments and objectives create the following implications for community-based learning: (1) the necessity for *lifelong learning*, and (2) the understanding that *"outreach"* is more than asking alumni for money—it is a unique opportunity to integrate alumni into the fabric of community-based learning. Contrary to the times of Norlin's speech, we have now *fundamental new possibilities* provided by modern communication and information technologies by which alumni can stay involved and participate and be with the university not only in spirit.

University of Siegen

Structure and description of the local context

The program in Information Systems (IS) at the University of Siegen is grounded in an interdisciplinary curriculum that involves the disciplines of computer sciences, business administration, and information systems. IS groups in Germany are labeled "Wirtschaftsinformatik," and are mostly parts of the departments of business administration.

The establishment of project groups of university students and company practitioners (courses in practice, or CiP groups) is part of the practice-oriented education in the IS curriculum and is one research focus of the Siegen IS group. The approach aims to strengthen regional networks of practice between university and regional industry by connecting industrial CoPs with those in academia. Therefore, the academic education program is accompanied by a number of measures of networking and social capital-building activities initiated by the university.

Supported by research funds from different government sources and industries, the IS group comprises ten staff members (faculty and research associates) and a similar number of students working as research assistants. Research is organized around specific, typically externally funded projects, and practice emerges within these projects or groups of them. To initiate regional learning, the Siegen IS group tries to build social capital and foster NoPs between the university and software and media industry.

Courses in practice: Enculturation of students into regional industries' CoPs

In Siegen, opportunities for enculturation into specific communities of practice are considered to be a major instrument of education at the university level. This approach complements *"learning about"* with *"learning to be."* So far, experiences have been primarily gained with enculturation processes into two different types of communities of practice: those within the research group and those within regional information technology (IT) companies.

With regard to the latter, we offer learning opportunities to students by integrating student teams into the CoPs of local IT companies. To host teams of two to three students, IT companies define projects close to their core business. The student teams work on these projects in close cooperation with mentors from the companies. The goal of these courses is to allow the students to enter the companies' CoPs and therefore to enable processes of enculturation, mutual knowledge transfer, and the gaining of apprenticeship.

When working in industries, the students are closely coached by members of the research group. Each group is supported by an academic supervisor during the whole CiP duration. Furthermore, there are regular meetings of students, supervisors, and the professor. Coaching the CiP groups very closely is crucial for our concept. The student teams are connected to each other and to their supervisors in academia by means of a community system.

With regard to the setup of the CiP, the Siegen IS group could refer to the experiences of some of the group members with a similar CiP at the University of Aachen. Based on these former experiences, the initiative in Siegen aimed at establishing longer-lasting relationships between university and industry, to involve more stable companies (instead of very young start-ups), to build up “strong ties,” to establish social capital, and therefore, to succeed in more than short-term effects and real “regional learning.”

After nearly one year of building up relationships with regional companies, the first CiP at the IS faculty of the University of Siegen was announced for summer term 2003. The course design is illustrated by Fig. 1. The Figure shows the design of a CiP, in which two CoPs are established, consisting of university students and company practitioners (relation to the regional market). These CoPs are accompanied by a supervisor within the company and instructors from the university and supported by digital media (groupware, cooperation platforms etc.).

Since 2003, three instances of the CiP have been conducted and evaluated. Table 2 shows the distribution of students within six different practical projects. Two of the companies (Company A and Company C) participated in two instances of the course. The number of students assigned to the CiP project groups shows that we are working with a concept of small groups, which we expect to enculturate within the companies’ practice during the project.

Fifteen IS students of the University of Siegen participated in our CiP, cooperating closely with at least an equal number of employees at the local companies. Each project group was accompanied by at least one academic supervisor and one company supervisor. During the CiP, about five presentation and discussion meetings among students and academic supervisors took place, followed by a public presentation of results at the end of

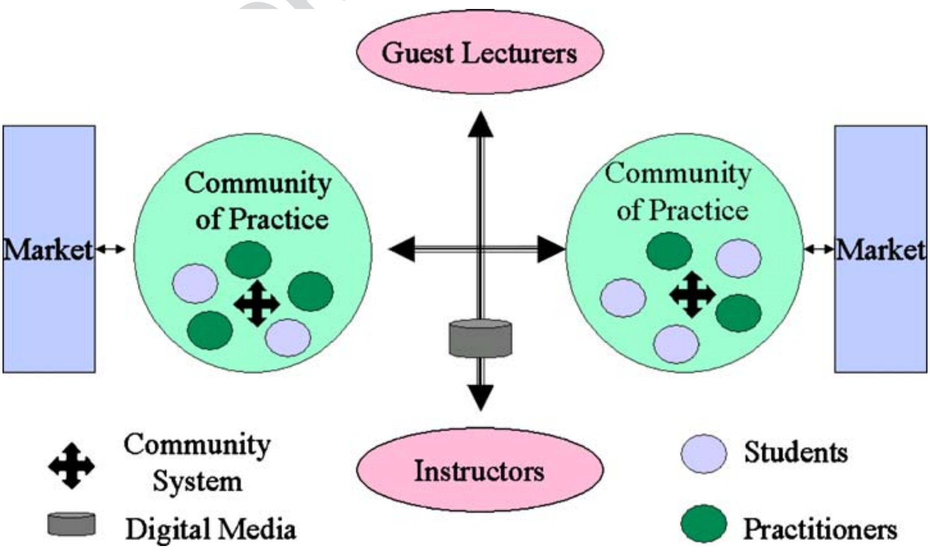

Fig. 1 Design of the computer-supported course in practice at the University of Siegen

Table 2 Project groups, tasks, and number of students

	Project task	No. students
Company A1	Developing a toolbar for a community-portal	3
Company A2	Developing a web-based application to count the usage of click-per-view ads	3
Company B	Designing an offline reader for a newspaper archive	2
Company C1	Analyzing software publishing processes in a mid-size software company	2
Company C2	Developing an electronic payment tool for business software for SMEs	3
Company D	Analyzing procurement processes within a producer of caravan equipment	2

(The companies' names are coded as Company A to D; the designation Company A2 means that a second project was conducted by the same Company A; *SME*=Small and Medium Enterprises)

each course. Representatives of the local government, employees of other companies, journalists, members of other faculty departments, and others were invited to these presentations. Furthermore, an official meeting attended by the student team, the company supervisors, and the academic supervisors took place in the middle of each project.

Learning to be: Enculturation of students into faculty research CoPs

We have reinterpreted the following elements of the IS curriculum to offer opportunities for students to participate in our research practice: seminars, project groups, and diploma theses. With regard to each of these elements of the curriculum, we define tasks that were relevant to the research agenda of our group (e.g., elaborating the state of the art of a new research area by means of a seminar, implementing specific software components in the framework of a project group, or building a prototype as part of a master's thesis). We also offer research assistant positions for students to work within our externally funded projects.

Students not only assist in IS research, they also take over tasks as their own responsibilities, closely coached by research associates. Engaged students can co-author scientific publications, and they quite often accompany the IS researchers to national and international conferences and present the research findings at the conference. Most diploma theses thereby find their way into (international) conference or journal publications.

Because these tasks are relevant to both students and researchers, an important precondition for processes of enculturation is met. Enculturation processes into the research group are becoming more likely and intense as students follow up on more than one of these learning opportunities. Some of the best students are offered employment by the IS research group after their diploma thesis—if money permits—or are recommended to other research groups. Therefore, learning as a process of diffusion from the periphery of the Siegen IS group's CoP into its center is not only possible, but seen as rather normal for the best of the IS students.

Transdisciplinary education: Interdisciplinary courses for students from different backgrounds

Within the IS group at the University of Siegen, researchers from different scientific backgrounds—specifically, computer scientists, information systems professionals, a psychologist, a historian, a linguist, and an ethnographer—are working together. Because most research projects of the IS group in Siegen are focused on designing for different social settings, the cooperation of scientists from a range of disciplines is required.

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For university courses in Siegen, there are two methods of realizing transdisciplinary teaching:

- The IS group itself provides interdisciplinary courses and lectures (CSCW, computer-supported cooperative learning (CSCL), participatory design, etc.); and
- Several courses are organized as common teaching programs for two or more departments (e.g., media sciences).

Students who attend IS courses are obviously mostly those from information systems; moreover, the courses are attended by students from other departments, such as computer science, business administration, and media sciences. Within these different types of courses, students work together and learn from each other. In this regard, Siegen, being a rather small university, can draw on a tradition of mutual acceptance of courses and transdisciplinary programs among the departments.

Social networks: Regional learning between academia and different firms

The building of trust and social capital is a crucial success factor to foster networks between academia and industry and among regional companies of the software and media industry. According to the approach of social capital, different cooperative activities between the university and the regional industry were expected to lead to trustful relationships.

Siegen is located in a region of Germany characterized by older, down-turning, mainly iron- and steel-related industries, and is therefore challenged by the necessity of structural change. The University of Siegen tries to play a role in this process by facilitating regional development. In this context, the IS research group is trying to network the regional software and media industries, which consist of mainly small- and medium-sized enterprises, to strengthen the market position of these companies. Taking the knowledge-creating character of communities and networks of practice seriously, the Siegen IS group expects to learn from the regional software and media companies as well. Innovative design concepts and methods can be evaluated, software practice under market conditions is perceived, and market trends are closely watched. The vision behind establishing such a close cooperation with regional industries is the creation of a "learning region" in the software and media domains.

To this end, the Siegen IS group cooperates with the region's business development department. A series of networking events was set up jointly, labeled "Lyz Media Breakfast," directed toward chief executive officers (CEOs) of regional software and media companies. Following an invited talk in the early morning (8.30 A.M.), there is a joint breakfast for the participants to network with each other. Coverage by the local newspapers helped to announce the new initiative within the region.

The region's business development department was also instrumental in providing us with funding from the European Structural Fund. The funding is directed toward fostering a network of practice among six regional software and media companies. The activities of the network-building process cover joint meetings among the CEOs, meetings with the IT departments of strategic clients in the region (e.g., a brewery, a producer of switchboards), and joint public relations. These activities focus around marketing and management practice within software and media companies.

Furthermore, the IS group is in the process of establishing a joint research center in the field of interactive television (iTV). The center will focus on research and development of innovative technological features and suitable formats of iTV. This activity is jointly pursued by a regional software company, the administrative body of the region, and the university. The software company has participated for two years in CiP projects and also takes part in the regional network. This initiative, therefore, was grounded in a longer history of cooperation among the different actors.

Finally, the IS research group has developed research proposals together with different member companies of the regional network. Because many university programs in Germany and Europe require participation from industry, the research proposals could be, on the one hand, grounded on an already rather established cooperation between university and industry. On the other hand, the opportunity to receive public funding via the university's activities stabilized the regional networks.

Complementary approaches to community-based learning

Although the approaches to community-based learning refer mainly to the same set of socio-cultural theories on learning, the educational programs of the IS group at the University of Siegen in Germany and the L3D Center at the University of Colorado in the United States differ in some aspects. These differences in underlying community concepts, educational focus, and perspectives of networking are due to differences in the specific historical contexts in Germany and the United States and to different national regulations and cultures in education and research. However, the approaches can be considered to be complementary.

According to the didactical approaches and the learning concepts mentioned above, Table 3 illustrates the similarities and differences between the Siegen and Colorado programs:

Empirical findings

This section presents selected findings from evaluations of the different didactical approaches. Due to the distributed setting, the long-term nature of our efforts, and the

Table 3 Comparison of Universities of Siegen and Colorado

	University of Colorado	University of Siegen
Theoretical foundation	Socio-cultural theories Social creativity	Socio-cultural theories Social capital
Dominant community concept	CoI	CoP and NoP
Course concept	Courses-as-seeds: involve all stakeholders as active participants	Courses in practice: Enculturation of students into regional industries' CoPs
Learning to be	Undergraduate Research Apprenticeship Program	Enculturation into faculty's research CoP
Transdisciplinary education focus	Mutual and cross-cultural peer-learning of collaborators	Interdisciplinary courses for students from different backgrounds
Social networking concept	Lifelong learning in a bond between students and university	Regional learning between academia and different regional firms
Evaluation methods	Qualitative and quantitative methods: interviews, questionnaires, personal portfolios, self-assessment	Ethnographic and qualitative methods: (participatory) observations, in-depth interviews, evaluation workshops

breadth of didactical concepts, the evaluation methods applied are heterogeneous, and the density of the empirical material varies.

University of Colorado

The University of Colorado has offered ten courses (based on two different themes) emphasizing community-based learning for the last 10 years (examples are documented at: http://l3d.cs.colorado.edu/~gerhard/courses/). Over time, we incrementally increased the embedding of these courses within the conceptual frameworks described in this paper (see the "Conceptual Frameworks" section) and improved the socio-technical environments (see the first portion of the "Approaches to community-based learning section) supporting these courses. Table 4 briefly summarizes responses from students related to concepts and issues discussed in the earlier sections of this paper. Data were gathered from several questionnaires over the course of a semester, including self-assessment accounts by all students.

The following two subsections discuss cultural change, risk-taking, and student reactions to the "community-of-learners" concept in more detail.

Cultural change and risk-taking

Introducing a new educational model involves *cultural change* by all participants (Fischer, 1998). Regardless of how well classroom activities are designed, or how sophisticated the supporting technology, these elements will not by themselves change the culture of education (Bruner, 1996). Cultural change requires that participants critically reflect upon and possibly change their behaviors, goals, values, and attitudes toward education. Despite a growing body of research on collaborative learning, changing an instructionist classroom (in which students passively listen to a lecturer) into a community-based learning environment requires a focus not only on the role of collaborative learning in expanding students' learning experiences, but also on the cultural change needed to enable collaborative learning to take place in educational settings. Students reacted to our course with the following questions:

- "Why should I learn from a peer when the faculty member knows the answer so much better?"
- "Why should I pay fees if the teacher is not willing to provide me with the answer?"

There is overwhelming evidence in the students' self-assessments, the faculty course questionnaires, and from many of their reactions in class that a course of this kind was a "culture shock" for almost all students. The rationale for this reaction can be found in that most students' behavior is grounded in the following beliefs:

- They consider themselves as consumers of education (confirming Illich's argument that "schools and universities are the reproductive organs of a consumer society" (Illich, 1971));
- They believe that problems have an answer and that the teacher has to know the answer;
- They are at best not interested, and at worst unwilling, to engage in peer-to-peer learning (which should not surprise us in a culture of education in which collaboration is mostly treated as "cheating" (Norman, 2001));
- They are driven to learn primarily by the desire to get a good grade rather than by interest, passion, or enjoyment derived from intrinsic motivation in learning (Gardner, 1991);

Table 4 Selected responses from students related to our conceptual framework t4.1

Concepts	Selected responses from students	t4.2
Transcending the individual human mind	"The people presenting were in the same position we were all in, new to their topics and presenting everything they learned starting from nothing. They presented in a manner that we could understand and relate to."	t4.3
CoPs and CoIs	"It helped us see computer science from new angles (be a part of a diverse community, not a bunch of isolated hackers)."	t4.4
	"The point of this class is to 'collaborate.' By doing this, we see perspectives we wouldn't ordinarily account for, and this helps us grow in our acceptance of other ideas."	t4.5
	"For some people the course was not technical enough; for some other people, the course was too technical."	t4.6
Social capital	"One big difference was that we had the opportunity to present our work to the entire class, which was a great incentive since we knew our work would have a purpose (teaching others)."	t4.7
Social creativity	"Have more diverse viewpoints, keep groups small so they can perform well, make sure people are satisfied with their groups and can find a way to be effective contributors."	t4.8
	"We were so grateful to have an outpouring of positive feedback and suggestions from fellow classmates after our first progress report that this is an aspect of the class structure that should really be explored."	t4.9
Meta-design	"I did get a chance to further explore areas I was interested in. However, I had never done serious, self-directed research before, and found that I wasn't able to explore in the directions I was really interested in, for fear of diverting too far away from the rest of the group."	t4.10
Confidence	"I also would have liked to have participated more in the class discussions. I tend to be a quiet person in classes anyways, so it wasn't very unusual for me."	t4.11
Horizontal integration	"This was a good idea to some extent, but was also frustrating, as the majority of non-CS people were teachers, and I wasn't particularly interested in the learning component of the course, and thus, there was a bit of a mismatch between my priorities and the priorities of most of the students of other disciplines."	t4.12
Vertical integration	"As an undergrad, we have limited experience in general things that the grad students already have gained. Their insights were useful because as undergrads, we tend to be closed-minded overall because all we've been exposed to is structured curriculums."	t4.13
Collaboration ("in defense of cheating")	"I am currently not comfortable with people having access to all my work before the actual termination of the assignment. I enjoy being able to let people see only the polished product. I also feel that some students could take advantage of the trusting nature of the swiki and I am not comfortable with that."	t4.14
Importance of face-to-face interaction	"I learned more from group presentation because they're more interactive than posted documentation. You can ask questions and get immediate feedback."	t4.15
Socio-technical environment	"The swiki seemed to emerge largely as a submission mechanism and document repository for this class, and I felt there was little to no actual interaction among users. ... I like the idea [that] it will stick around, but can't immediately envision a burning need in the future for any of the information posted there. I think the biggest thing I might come back for would be participants' contact information."	t4.16
	"I don't feel that people in this class used the swiki to its potential. It was more of a place to post work than to really discuss or bounce ideas."	t4.17

- They are *not* used to being assessed by anyone other than their teachers and therefore they need to learn how to self-assess (which, like any other skill, takes time and experience to develop).

Risk Taking Cultural change will not take place without learners and teachers taking risks as a consequence of different cultures clashing with each other. Risk taking can be illustrated with the following example: the *"mismatch problem"* between teachers and learners in teacher-driven/instructionist versus self-directed/constructionist learning environments (as summarized in Table 5). The major mismatches that can be derived from this table are: (1) dependent, passive learners take courses with non-directive teachers; and (2) self-directed, discovery-oriented active learners take courses with directive, authoritarian teachers. The experience from our course was a mismatch of the first kind with at least half of the student population in the course.

Student reactions to the "community-of-learners" concept

A surprising result was that the students' course assessments resulted in a *bi-polar distribution* that we have not experienced before. Students were either enthusiastically positive, giving faculty and the course A's on the faculty course questionnaires, or totally negative, giving a substantial number of F's.

This reaction is best illustrated by two comments, quoted from the students' self-evaluations:

1. A negative comment: *"I will not ever take a course of this nature again in my undergraduate career, and I hope to find a more structured graduate program with an adviser that is more forthcoming. I will reinforce my strengths by continuing to study in the method that I have developed over the past 15 years, I will redirect my weaknesses by avoiding unstructured class environments. I believe that the type of self-directed learning that this class wished to promote is better done during independent studies and thesis work.* (*I am involved in both of the above in a very self-directed environment, I am doing well and the concept works much better there.*)"
2. A positive comment: "*When I signed up for this class I had no idea what it was going to be about. Once I started understanding the material, however, I was extremely thrilled and interested to be a part of one of the most progressive courses on campus. I'm not sure what specifically to say except that I rank this class in the top three that*

Table 5 Typology of teacher/student roles concerning risk taking

Teacher	Student	Example
Authority ("sage on the stage")	Dependent, passive	Lecture without questions, drill
Motivator and facilitator	Interested	Lecture with questions, guided discussion
Delegator	Involved	Group projects, seminar
Coach/critic ("guide on the side")	Self-directed, discovery-oriented	Self-directed study group, apprenticeship, dissertation

(This table is a modified version of a table that appeared in: Gerald O. Grow (1991/1996). "Teaching Learners to Be Self-Directed." *Adult Education Quarterly*, 41 (3), 125–149. An expanded version is available online at: http://www.famu.edu/sjmga/ggrow) Q1

> *I've taken at CU. The self-directed nature of the work ensured that I wouldn't be bored or unchallenged, and the interplay between all of us was a lot of fun. After four and a half years in college, I can honestly say that this is one of the first courses where I was treated as an adult, a fact which means more to me than I can describe."*

What can we learn from the student reactions? The interesting question to ask is: What can be learned from this event for innovating and changing our university to provide an exciting, challenging, and rewarding intellectual environment for our students and our teachers in the next millennium? Here are a number of hypotheses:

- *Cultural change* beyond the introduction of new learning approaches and new technologies is of critical importance.
- *Risk taking* by teachers is not necessarily rewarded by the students. With current assessments (such as *faculty course questionnaires* serving as primary instruments), risk taking is not rewarded by the institution, and as a result is potentially a dangerous undertaking by young, untenured faculty members.
- *Change agents* are needed, but they must be aware that they take risks. These risks may "force" especially young faculty members to accommodate the existing system and conduct business as usual.

Issues to be aware of To change a culture is risk taking. Universities need to reward risk taking, and using faculty course questionnaires as major instrument for assessment in most cases will punish risk-taking. New media and new technologies provide us with exciting possibilities to rethink our mission. But almost all serious educational reformers believe that new media and new technologies on their own cannot transform universities to meet the demands of the future. Technology is only one part of cultural change. This implies that goals such as (1) *"supporting innovations in learning, including both undergraduate and graduate education,"* and (2) *"using technology to improve teaching, learning, research, and management"* have to be tightly integrated. Cultural change implies that all stakeholders participating in the process of change have to reflect and possibly change their behavior, their objectives, and their values. In the days where the future of universities is seen by many as occurring in the virtual world, and where education is often reduced to a commodity, we need to understand *the core competencies of a residential, research-based university.* Some of these core competencies should be centered around the notion that instructionist learning will be complemented with self-directed learning in learning communities, and that students of all ages will be involved in apprenticeship-like relationships that will allow them to become members of the community of scholars, researchers, proficient professionals and educated persons.

In summary, cultural change beyond the adoption of new technologies is required in our current system in which students have been taught to take on the role of consumers of education. This change will require risk-taking by faculty members. The university needs to reward such risk taking rather than punish it. Shaking up students' habits and mindsets is more risky, and will be met with more resistance than dispensing knowledge.

University of Siegen

To complement the Boulder experiences, this section focuses on the evaluation of CoP- and NoP-related approaches to community-based learning at the University of Siegen.

Research methods

To evaluate our activities, we have conducted a series of semi-structured interviews and additional observational studies during a period of 3 years. The interviews and observations were conducted by researchers who were not involved in the courses. Moreover, our findings are based on experiences gained by the authors when setting up the regional networks and carrying out the community-based course program.

We conducted 25 explorative semi-structured in-depth interviews with students, supervisors from academia and industry, and officers of the regional administration. Fourteen students, six company practitioners, three academics, and two officers were interviewed. During the interviews, which lasted between 60 and 180 min, students were first asked about their personal backgrounds, their educational backgrounds, and their motivation for participating in the lecture. After that, students were questioned on personal impressions and assessments of the course and its single components. Students were also asked to suggest improvements. Lecturers were asked about their personal background, and high emphasis was placed on assessments of the lecture-components held by them. The regional officers were asked about their activities to encourage competition in the regional software and media industry. We were specifically interested in their experience in establishing regional networks and their evaluation of our joint activities in fostering regional networks of practice between local industry and the university.

Each person was interviewed in an individual session. All interviews have been recorded with a DAT recorder and fully transcribed. In the evaluation, the answers were transformed into a table categorizing the role of students, academic faculty, and industrial supervisors. The observational data were structured around the different events and documented in the form of written notes. Interviews and observational data have been analyzed descriptively according to our heuristic approach. The process was informed by the experiences gained when carrying out the different measures.

Courses in practice

Since 2003, a series of three courses in practice (CiPs) have been conducted. In total, six projects had been carried out and evaluated by spring 2006 (see Table 6). Two of the local companies (Company A and Company C) have been engaged in two projects (in two different years with two different project tasks).

With regard to the evaluation of the three CiPs, the interviews brought evidence for some factors that influenced the success of the project groups and the learning of lab-group members:

Long- versus short-lasting activities Some of the project tasks were embedded in longer-lasting activities within the companies' practice, whereas others just were defined for the project and its duration. Some interviewees stated that it was important that their project task was embedded in longer-lasting activities for the degree of involvement of company practitioners, for cooperation structures, and for the success of the project. Longer-lasting activities in the companies' practice does not mean that the university was engaged in these companies for a longer term, but that the projects' tasks and results took place within longer-lasting intern processes and projects of the company itself.

Collocation/physical presence Collocation of students and company practitioners had an influence on the establishment of cooperation structures between students and company practitioners. Students who were not collocated with the companies' practitioners, but

Table 6 Typology of projects—Structural differences and outcome

	Company A1	Company A2	Company B	Company C1	Company C2	Company D
Long-lasting activity	?	+	+	+	–	–
Collocation/ physical presence	–	+	–	+	–	+
Relevance of the project task	–	+	+/–	+	+	+
Fulfilment of the company-defined tasks	+	+/− (not finished during CiP time, but later)	+	+	+/− (project finished but criticized by company)	+
Enculturation	–	+	+	+	–	?

(The companies' names are coded as Company A to D; the designation Company A2 means that a second project was conducted by the same Company A. A plus (+) means that the specific criterion was fulfilled, a minus (−) means that it was not fulfilled, a plus/minus (+/−) means that it is unclear whether the criterion was fulfilled within the project)

worked on the project tasks at home or at the university were less likely to build trustful relationships and social capital with the companies.

Relevance of the project task Some of the project tasks defined by the companies' executives had strategic relevance for the company and its product development, whereas other projects were defined more according to the company's peripheral interests. It showed that involvement, success, and enculturation are influenced by the strategic relevance the project task has had for the companies' practice.

Success of the projects regarding task fulfilment The success of projects can be measured by the fulfilment of the project task according to the assessment of the companies' supervisors. In terms of project success, one project has been evaluated as not successful. A second was finally successful but could not be finished within the originally envisioned time frame. The other four projects have been assessed as successful by the companies according to task and goal definitions.

Enculturation in the companies' practice Successful enculturation into the companies' practice is one hint for gaining apprenticeship and therefore for socio-cultural learning. These enculturation experiences were made by students who collaborated in teams within the companies and felt integrated into the companies' practice. In the three CiPs, a successful enculturation of university students into the companies' practice even means that the students continue their relationship with the companies after the CiPs end. In three cases, CiP practitioners have been employed by the companies after the project.

Table 6 seems to suggest that the mentioned issues of long-lasting activities, relevance, successful fulfilment of the project task, and physical presence in the company may influence the probability of successful enculturation.

Often, team building among the students had to be influenced to secure sufficient capabilities within the different teams. So the team's capabilities almost never led to problems. Almost all projects met the companies' expectations. However, the enculturation processes into the companies' CoPs varied considerably. It turned out that the students' dedication toward future work in such companies was as much a success factor as the companies' cultures and behaviors toward the students.

Table 6 shows a typology of projects according to the structural differences and outcomes mentioned above (University of Siegen).

Issues to Be Aware Of: When trying to set up CiPs, the empirical findings suggest that:

- Facilitating or engaging in regional networks of practice (NoPs) helps to find companies that will offer their CoPs for teaching.
- Reputation and personal networks are most important to get access to companies' CoPs; alumni may play a role in the future:

> *The most important point with these cooperation[s] is the personal contact. It is very important that good personal contacts emerge. ... it might be due to the person of {Prof.}: He acts very open towards the companies and generates project issue. He is very supporting and demands for cooperation between university and industry. [a regional official].*

- Enculturation can suffer from the relatively short duration of the CiPs, which typically take about four months. The short period of time can prevent the students from drifting from the periphery to the center of the companies' CoPs.
- The specific identity of students and their teams can prevent them from enculturation in case they do not see any reason to strongly engage in a company's projects:

> *At the core I would look upon our three* [*students*] *group as a team. With the project running, the relationship to the* {*company's*} *members became better and closer. That made us becoming a team all together. ... But the ties between us and them are not as strong as between us three students. The core is the three of us and around this core there are the members of* {*company*}. [*a student*]

- A history of more than one CiP with a local company (or another form of an earlier cooperation between university and company) typically offers better opportunities for students to enculturate because companies suggest projects that are closer to their core business. The first cooperation project between the university and a local company needs to build trust, and in case of success, provides a very good basis for future cooperation.
- Mutual learning is full of conflicts because students act as boundary spanners between CoPs in academia and industries. When students are enculturated in both CoPs, conflicts come up (with regard to identity and practice). However, mutual learning (between universities and industry) and regional innovation are typically happening at these points:

> *Yes, the* {*company's*} *supervisor, at the beginning I wasn't sure whether we would get problems with him, whether there would be conflicts. I didn't know because he seemed to be a strange guy, I mean, very nice but sometimes I asked myself 'Did he mean that serious or is he joking on us? Is he thinking: There are three students from university and they try to make a show?' I wasn't able to get a right picture of him. Therefore, I kept a bit of distance at first. But* [*then it turned and*] *the* {*company's*} *supervisor is really great because he is really supporting and spends a lot of time for us.* [*another student]*

- Social capital and mutual reliability are core to all of these processes: At the beginning of the cooperation within the projects, very often a lot of trust-building communication was necessary to enable cooperative structures and the motivation for cooperation at all:

> *I have conducted one of the early interviews alone because {the other student} had to stay at university and the {company's} member with whom I was talking said to me: 'No, I don't want to talk to you.' 'Why?' Then he said: 'Because I dislike that students come to my company to sort people out'— It took me ... about one hour to make clear that this was not my intention. It was rather difficult to make that clear. I noticed that there were rumors around at the beginning and that was a big problem.* [*another student*]

- The enculturation of students into the university research CoP depends on the match between the students' anticipation of the utility of their project task with regard to their professional career expectations. Some of the students developed the topic of their diploma thesis out of their project experience. Other students who started working on projects were enculturated even for a longer period of time by being employed as research assistants or, after their graduation, as research associates.

Regional networks of practice (NoPs)

Concerning the specific local situation in Siegen, the fostering of regional NoPs between university and local companies revealed several critical factors:

- In the Siegen region, the density of software and media companies is not very high. Therefore, networks of practice focusing on specific aspects of software techniques are difficult to establish. Thus, NoPs fostered between university and companies and among different companies needed to be understood covering a broader range of practices, or a rather broad understanding of common practices.
- Because the regional market for IT services is limited as well, there is strong competition among those software and media companies that target this market. This competition limits the chances to foster NoPs for regional learning, at least on the CEO level.
- With regard to the size (especially of small companies) and the strong competition between the local companies, cooperation in regional NoPs is rather weakly developed. The exchange of practical experiences in NoPs seems to be more likely and perform better within larger companies (e.g., local software company clusters in Silicon Valley). Within and between these NoPs of larger companies, a fluctuation of employees takes place, and people change from one local company to another one. Contrary to that, in the Siegen region, competition and the risk of "takeovers" of employees is considered one of the central problems.

Issues to be aware of: Our experiences and observations with establishing regional networks lead to the following conclusions:

- One needs a lot of patience to successfully establish mutual relationships of trust.
- As a new player in a region, one needs a regionally well-known "door opener" to help introduce new players in the regional network structures.
- The organizational reputation of a university (in its regional context) can be enforced significantly by strategic partnerships with other well-known scientific institutions. In our case, we set up an institutional cooperation arrangement between the university and the Fraunhofer Society. In Germany, Fraunhofer has a strong reputation for transferring

innovation toward industries. This alliance proved to be one of the important success factors for the fostering of regional NoPs.

- With regard to certain existing institutional and personal conflicts in a regions' networks of practice, one needs to become aware of them and should try to act carefully, being neutral and as fair as possible toward all actors.

Discussion

Residential, research-based universities are facing new challenges from computer-supported and web-based offers of distance or tele-learning and -teaching, such as online universities and even free educational course material on the Internet (e.g., the OpenCourseWare program of MIT and similar programs at approximately 50 universities worldwide, planned for roll out within the next several years). The OpenCourseWare concept seems to suggest that knowledge creation is based on consumptive processes of individual learning, facilitated by filling in knowledge relevant to web surfers, in written or multimedia formats.

Based on socio-cultural theories of learning, the idea of instructionist teaching and consumptive learning does not represent a comprehensive model of knowledge creation in a social world. Furthermore, if concepts of "knowledge" not only include *cognitive* or *intellectual* competencies, but social, emotional, motivational, and practical competencies as well, learning (and of course university education as one core component of knowledge building) is confronted with new challenges for teachers and students.

Therefore, social and collaborative processes of learning—as well of individuals as of collectives—and the (culturally mediated) social construction of knowledge (Vygotsky, 1986) are emphasized. Specifically, the following aspects of knowledge building are focused on in a new paradigm of university education:

- Knowledge building seen as a process of construction instead of instruction;
- Knowledge building seen as a result of interaction with others instead of individual consumption;
- Knowledge building seen as a function of practical experiences rather than as a function of theoretical readings;
- Knowledge building seen as a challenge for lifelong learning rather than as a matter of a "once upon a lifetime" experience; and
- Knowledge building being influenced by the social and situational context.

Based on these assumptions, *community-based learning* seems to be a quite relevant concept for learning and teaching at the university level: Lifelong learning, learning in practice, cross-cultural learning, collaborative learning, and learning in a regional context are promising concepts for residential universities to cope with the new challenges of online universities (and the emerging web-based education programs) mentioned above.

Community-based learning has different needs for computer support than content-delivery-oriented approaches, such as the OpenCourseWare initiative. Due to the distributed nature of the actors, we rely heavily on tools such as email, community systems such as BSCW, and distributed software development environments such as CVS. These tools support cooperation, coordination, and shared knowledge building among the different actors involved, in contrast to the delivery of well-defined content from academics to students (Ackermann, Pipek, Wulf, 2003; Huysman & Wulf, 2004a). Community-based approaches to learning therefore ask for a different IT infrastructure at the university level, which needs to reach out into the relevant NoPs of the region.

Besides the question of appropriate technical support, the didactical concepts and education programs of residential, research-based universities are challenged. As far as lifelong, community-based, and practice-oriented learning is concerned, finding the right selection of CoPs and CoIs is one of the most important challenges to define a stable curriculum for students:

- A teaching curriculum could become a description of different practices a student could enculturate into (plus other forms of education);
- An appropriate mixture between traditional and community-based forms of learning needs to be found; and
- A one-semester (four-month) course is often too short to create a community.

Compared to approaches that try to extract the epistemology of CoPs and bring it into the classroom (Shaffer, 2004), the Siegen experiences indicate that educational institutions should cross the boundary toward industrial practice to an even wider extent. Supporting the enculturation of students into CoPs of companies offers occasions for mutual learning among residential universities and regional industries. So, besides students, regional industries and universities can learn while engaging in CiPs.

With regard to these suggestions, one has to concede that career patterns in academia that force professors to change university affiliations frequently are counterproductive to these (often long-term) types of learning. However, scientific competition still needs to be encouraged.

Moreover, professors need to develop new sets of skills. First, they need to be suitable facilitators to support the teambuilding and enculturation processes of the student (teams). Second, to find appropriate CoPs for their students to enculturate, they need to have networking skills to enter existing regional networks of practice or even to set them up. Third, their research work needs to be, at least partly, applicable in practice. And fourth, the professors themselves, or at least the institutions with which they are involved, need to have a certain reputation to attract companies and students and bring them together.

From the point of view of necessary personal resources, it should be noted that community-based strategies of learning are labor- and qualification-intense on the part of the universities. They require coaching students intensively, particularly if these strategies are taking place in cooperation with practice (Rohde et al., 2005).

Our findings also suggest that the relationship between universities and regional industries will have to develop to a new level of intensity. Saxenian (1994) and other scholars in regional studies have already hinted at the importance of leading research universities for development in the high-tech domain (e.g., by educating a highly skilled workforce and attracting the support of high-tech companies). We stress the bi-directionality of this relationship in particular. Under a community-oriented learning paradigm, a university depends very much on its region to provide appropriate practices to nurture its different programs. In the Siegen region, however, the software and media industry lacks density, thus limiting the opportunity to address specific practices.

With regard to political agendas for regional development, community-based learning offers interesting perspectives. The policy followed by the Siegen business development council points in an interesting direction. By supporting networks of practices that include the relevant actors of the university, the potentials of community-based learning are well exploited.

Implementing community-based strategies for learning requires changes on the personal as well as on the institutional level. Compared to the Colorado case, Siegen found much less resistance toward change among its IS students. This may be due to the fact that Siegen's IS students selected the course by themselves from a bundle of other options.

Some students needed to understand their new role inside companies, and companies needed to develop mechanisms that allowed students to enculturate. Conflicts occurred when expectations of the university advisors and the companies did not match within this process. Our experiences indicate that the implementation of community-based educational programs requires personal and organizational development strategies on the parts of all participating actors.

Concepts such as communities of practice (Lave & Wenger, 1991; Wenger, 1998) and networks of practice (Duguid, 2003, 2005) as well as social capital (Bourdieu, 1985; Putnam, 1993) and social creativity (Fischer et al., 2005) guided us in developing a variety of didactical approaches for community-based learning. However, all of these concepts are analytical and do not easily provide guidelines for didactical practice in the context of residential universities.

With regard to the concept of common practice, it is especially difficult to define suitable boundaries when trying to foster NoPs or CoPs. The theories do not provide criteria of what should still be assumed as common practice and where boundaries must be expected. For instance, there was a lack of common practice among the different software and media companies with regard to their development practices. Therefore, we decided to focus our networking activities at managerial practices (e.g., process management, product innovation, and marketing). The same applies for CiPs. One needs to find sufficient common practice between university and industries to enable enculturation in a limited period of time, and to allow for the border-spanning activities of the students. When setting up practice-oriented courses, we had to rely on our "gut-feeling" rather than on well-defined criteria. So the analytic conceptualizations offer a framework of orientation but do not provide concrete guidelines for an appropriate course design, the successful establishment of CoPs, or the evaluation of networking processes.

Conclusion

New media and new technology provide us with exciting possibilities to rethink teaching, learning, and university courses-specifically, community-based learning. Almost all serious educational reformers believe that new media and new technology on their own cannot transform universities to meet the demands of the future. Technology is only one part of the necessary cultural change. Cultural change implies that all stakeholders participating in the process of change have to reflect and change their behaviors, their objectives, and their values.

We have learned from our experiences at the University of Colorado and the University of Siegen that students are strongly influenced by the values they have learned from their previous educational experiences, which are reinforced by the current university culture. Attempts to install new values cannot be conceived in isolation, but instead must take this cultural clash very seriously.

In the days where the future of universities is seen by many to lie in the virtual world, and where education is often reduced to a commodity, we need to understand the *core competencies of residential, research-based universities*. Community-based learning (e.g., as explored in the courses-as-seeds model) is a promising approach to evolve and enrich courses by allowing students to act as *active contributors* and not just as passive consumers.

Cultural change, beyond the adoption of new technologies, is required in our current system in which students have been taught to take on the role of consumers of education. This change will require innovation and risk taking by faculty members.

Community-based learning approaches in university education provide learning opportunities for academics and companies. While enculturation into the companies' communities of practice is seen as the main mechanism for student learning, students often mediate between university and company practice. Because the students are coached by their advisors during their experience in the company, students carry ideas back and forth between the communities of practice within companies and academia. Companies get glimpses of innovative ideas from academia, and researchers get feedback on the applicability of their concepts. This boundary-spanning activity is specifically intense when the students have been enculturated before in academia.

Considerable theoretical and practical problems still exist, however, when implementing community-based learning approaches at a residential research university. On a theoretical level, the different concepts discussed in "Conceptual frameworks" need to be better integrated and elaborated. By comparing practice theories with the concept of social capital, Duguid (2003, 2005) offers interesting theoretical insights. On a practical level, we need to gain more experiences and develop guidelines for an appropriate course design. A still-open question is under which circumstances CoPs/NoPs theories offer a better framework for community-based learning compared to CoI-inspired approaches to span the boundaries between the university's and companies' practices on the one hand, and among different companies' practices on the other.

Even though these theoretical and practical problems still exist, we already can draw some conclusions from our experiences. The establishment of community-based approaches to university education are based on (academic) visibility and a sufficient level of social capital. The enculturation processes require substantial efforts from companies as well as from students. Companies feel rewarded only when their proposed project turns out to be successful. Mutual trust between companies and academia needs to be built over time through cooperation in successful projects. A certain reputation built through various regional activities is instrumental in getting the process started. Regional networking activities and the joint acquisition of research projects have turned out to be important means of building social capital. In the future, we will extend this community-building effort, including our network of alumni. To offer appropriate learning opportunities to their students, therefore, academics will have to build and maintain a dense web of social relationships.

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