Learning, Social Creativity, and Cultures of Participation

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Abstract

Social Creativity is based on the assumption that the power of the unaided individual mind is fundamentally limited. Although creative individuals are often thought of as working in isolation, much human creativity arises from activities that take place in a social context in which interaction with other people and the artifacts that embody collective knowledge are important contributors to the process. Because the fundamental problems of the 21st century are systemic, complex, and open-ended, they require the ongoing contributions of many minds, particularly from the people who own problems and are directly affected by them.

Unique new opportunities and challenges to enhance social creativity are facilitated by *cultures of participation.* The rise in social computing (based on social production and mass collaboration) has facilitated a shift from *consumer cultures* (specialized in producing finished goods to be consumed passively) to *cultures of participation* (in which all people are provided with the means to participate actively in personally meaningful problems).

Our research in the Center for LifeLong Learning & Design (L3D) (1) has explored a *conceptual framework* integrating perspectives from learning, social creativity, and cultures of participation such as meta-design and long-tail based approaches, (2) has designed, developed, and assessed *socio-technical environments* addressing important societal problems grounded in this framework, and (3) has articulated *implications* as challenges for future research.

Keywords

social creativity, cultures of participation, socio-technical environments, systemic problems, meta-design, distances, diversity, new media, motivation

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Most interesting design problems are systemic, ill-defined, and unique. Systemic problems require stakeholders from different disciplines; ill-defined problems require that the owners of problems are involved, because these problems can not be delegated); and unique problems require learning and the construction of new knowledge.

Over the last two decades, the research and education activities in our Center for Lifelong Learning & Design (L3D) at the University of Colorado, Boulder have been focused on three major objectives: (1) to make learning a part of life; (2) to engage in design of socio-technical environments in different application areas; and (3) to explore and exploit the power of new media in these contexts. Our methodology was grounded in the aspiration to do *"basic research on real problems."* Learning and creativity research in such contexts is fundamentally different from traditional research in these areas. Traditionally learning is focused on schools and formal learning environments, conceptualized by a transmission model in which the students learn what the teacher knows (Engeström, 2001). Traditionally creativity is analyzed in the context of well-defined problems which may require non-standard and non-obvious solution methods, a prominent example being the 9-dot problems (Sternberg, 1999).

This article first describes components of our evolving conceptual framework relating learning, creativity, and cultures of participation. It then describes *socio-technical environments* addressing different societal challenges grounded in the conceptual framework. It concludes by articulating implications for future developments by exploring the unique synergy between learning, creativity, and cultures of participation.

A Conceptual Framework for Exploring Relationships between Learning, Social Creativity, and Cultures of Participation

Most interesting and important societal problems of today are complex systemic problems that require more knowledge than any single person can possess (Arias, Eden, Fischer, Gorman, and Scharff, 2000). In addition, design problems are unique requiring new aspects to be explored. Social creativity and cultures of participation offer important and interesting possibilities to cope with major problems our societies are facing today. These problems include the following:

- Problems for which *expertise and knowledge is widely distributed*, for example, synthesizing the knowledge about the topic "Creativity and Information Technology" in the CreativeIT wiki;
- Problems of a *magnitude* such that individuals and even large teams cannot solve, for example, modeling all buildings in the world in 3-D as addressed by "Goggle SketchUp and 3D Warehouse");
- Problems of a *systemic nature* requiring the collaboration of many different minds from a variety of background, for example, urban planning problems as addressed by the Envisionment and Discovery Collaboratory.;
- Problems supporting participation as a *community of learners*, for example, courses-as-seeds engaging learners to become active contributors.

Most current practices and research activities about learning are focused on formal learning environments (schools and universities) and they are dominated by a transmission model in which the teachers "knows the answer" and the students should learn what the teacher knows.

But in the problem domain explored by our research these assumption do not hold and the fundamental challenges can be characterized as follows:

> *In important transformations of our personal lives and organizational practices, we must learn new forms of activity which are not there yet. They are literally learned as they are being created. There is no competent teacher. Standard learning theories have little to offer if one wants to understand these processes* (Engeström, 2001, p. 138).

Coping with problems where "the answer is not known" requires learning from each other and synthesizing new knowledge creatively by bringing different views and experiences together and exploiting the "symmetry of ignorance" as a source of creativity (Fischer, Ehn, Engeström, and Virkkunen, 2002).

Creativity is often associated with ideas and discoveries that are fundamentally novel with respect to the whole of human history (*historical creativity*). Creativity, however, also happens daily in real problem-solving activities, and not only in research labs or art studios as exceptional events. We are primarily concerned here with ideas and discoveries in everyday work practice that are novel with respect to an individual human mind or social community (*psychological creativity*) (Boden, 1991)—a capacity inherent to varying degrees in all people, and needed in most problem-solving situations.

Analyzing the contributions of outstanding creative people (Gardner, 1993) helps to establish a framework for creativity, but understanding creativity in the context of everyday activities is equally important for people to create better work products. The analysis of everyday design practices (Rogoff,and Lave, 1984) has shown that knowledge workers and designers have to engage in creative activities to cope with the unforeseen complexities of real-world tasks.

The power of the unaided individual mind is highly overrated (Salomon, 1993; John-Steiner, 2000). As argued above, although creative individuals (Sternberg, 1988; Gardner, 1995) are often thought of as working in isolation, much of our intelligence and creativity results from interaction and collaboration with other individuals (Csikszentmihalyi and Sawyer, 1995). Creative activity grows out of the relationship between an individual and the world of his or her work, as well as from the ties between an individual and other human beings (Gardner, 1995; Fischer, Nakakoji, Ostwald, Stahl, and Sumner, 1998). Much human creativity arises from activities that take place in a social context in which interactions with other people and the artifacts that embody group knowledge are important contributors to the process. Creativity does not happen inside a person’s head, but in the interaction between a person's thoughts and a socio-cultural context (Engeström, 2001).

To support social creativity, situations need to be sufficiently open-ended and complex that users will encounter new, unpredictable conditions, and will eventually experience breakdowns (Schön, 1983). As any professional designer knows, breakdowns—although at times costly and painful—offer unique opportunities for reflection and learning, underscoring the importance of the back-talk of situations (Fischer et al., 1998).

Cultures are defined in part by their media and their tools for thinking, working, learning, and collaborating. In the past, the design of most media emphasized a clear distinction between producers and consumers (Benkler, 2006). Television is the medium that most obviously exhibits this orientation and has contributed to the degeneration of humans into *“couch potatoes”* (Fischer, 2002) for whom remote controls are the most important instruments of their cognitive activities. In a similar manner, our current educational institutions often treat learners as consumers, fostering a mindset in students of “consumerism” rather than “ownership of problems" for the rest of their lives. As a result, learners, workers, and citizens often feel left out of decisions by teachers, managers, and policymakers, denying them opportunities to take active roles.

The rise in *social computing* represents unique and fundamental opportunities, challenges, and transformative changes for innovative research and practice in supporting *cultures of participation* (Jenkins, 2009; Fischer, 2011) as we move away from a world in which a small number of people define rules, create artifacts, make decisions for many consumers towards a world in which everyone has interests and possibilities to actively participate. In cultures of participation, not every participant must contribute, but all participants must have opportunities to contribute when they want to. For cultures of participation to become viable and be successful, it is critical that a sufficient number of participants take on the more active and more demanding roles. To encourage and support *migration paths towards more demanding roles*, mechanisms are needed that lead to more involvement, motivation, and facilitate the acquisition of the additional knowledge required by the more demanding and involved roles (Porter, 2008; Preece, and Shneiderman, 2009).

Where do new ideas come from in cultures of participation? The creativity potential is grounded in user-driven innovations supported by *meta-design environments*, in taking advantage of *breakdowns* as sources for creativity, and in exploiting the *symmetry of ignorance*-meaning that all stakeholders are knowledgeable in some domains and ignorant in others (Arias et al., 2000). To increase the creativity potential of cultures of participation requires *diversity*, *independence*, *decentralization*, and *aggregation*. Each participant should have some unique information or perspective (*diversity*). Participants' opinions are not determined by the opinions of those around them (*independence*). Participants are able to specialize and draw on local knowledge (*decentralization*). Mechanisms exist for turning individual contributions into collections, and private judgments into collective decisions (*aggregation*). In addition, participants must be able to express themselves, requiring technical knowledge how to contribute; they must be willing to contribute, and must be allowed to have their voices heard.

Cultures of participation are related to other conceptual frameworks, specifically to *communities of practice* (Lave, 1991; Wenger, 1998) and *expansive learning* (Engeström, 2001; Engeström, and Sannino, 2010). Cultures of participation complement and transcend communities of practice with their focus to exploit the creativity potential of communities of interest (Fischer, 2001) by supporting the integration of multi-dimensional expertise. They address new frontiers for expansive learning as postulated by Engeström:

> *Perhaps the biggest challenge for future studies and theorizing in expansive learning comes from the emergence of what is commonly characterized as social production or peer production (Benkler, 2006). In social production or peer production, activities take the shape of expansive swarming and multidirectional pulsation, with emphasis on sideways transitions and boundary-crossing* (Engeström, and Sannino, 2010, p. 21).

Social creativity and cultures of participation require *active contributors*—people acting as designers in personally meaningful activities—not just consumers (Fischer, 2002). The necessity of involving and empowering users and allowing them to act as designers requires the expansion of the creative process from the individual to the group (National-Research-Council, 2003). The sharing of products of individual creativity enables other people to work on them as a continuous activity without repeating unnecessary work. For example, the open-source movement (Raymond, and Young, 2001) demonstrates that the sharing of source code makes it possible for others to go forward when the original developers stop for various reasons, such as loss of interest or lack of time or new ideas.

Meta-Design (Fischer, and Giaccardi, 2006) is focused on “design for designers.” Meta-designers create the social and technical prerequisites for cultures of participation by sharing control over the design process among all stakeholders. Users are empowered with opportunities, tools, and social rewards to extend a system to fit their needs, rather than being forced to use closed systems designed beforehand by software engineers. As owners of problems, users can be active contributors engaged in creating knowledge rather than passive consumers restricted to the consumption of existing knowledge.

Existing design methodologies are insufficient to cope with the emergence of situated and unintended requirements (Winograd and Flores, 1986; Suchman, 1987). Socio-technical environments for which the design does not end at the time of deployment and whose success hinges on continued user participation (Henderson and Kyng, 1991) are needed. Meta-design (1) *extends boundaries* by supporting users as active contributors who can transcend the functionality and content of existing systems in *personally meaningful activities*; (2) creates artifacts that can be subjected to critical reflection, open to adjustment and tweaking; (3) supports unintended and subversive uses (not just anticipated ones); (4) allows learners to engage in personally meaningful activities; and (5) distributes *control* among all stakeholders in design processes.

Social creativity and cultures of participation thrives on the diversity of perspectives by making all voices heard. They require constructive dialogs between individuals negotiating their differences while creating their shared voice and vision. In the following, I shall describe the need for multiple voices by exploring different dimensions of diversity and distances (Fischer, 2005).

Voices from Different Places: Spatial Distance. Bringing spatially distributed people together with the support of computer-mediated communication allows the prominent defining feature of a group of people interacting with each other to become shared concerns rather than shared location. It further allows more people to be included, thus exploiting local knowledge. Whereas communication technologies enable profoundly new forms of collaborative work, research has found that closely coupled work can still be difficult to support at a distance (Olson and Olson, 2001). In addition, critical stages of collaborative work, such as establishing mutual trust, appear to require some level of face-to-face interaction. Brown and Duguid present a similar argument: *"Digital technologies are adept at maintaining communities already formed. They are less good at making them"* (2000, p. 226).

Voices from the Past: Temporal Distance. Design processes often take place over many years, with initial design followed by extended periods of evolution and redesign. The idea of exploiting and building on the voices of the past to enhance social creativity is important not only for software reuse but for our overall cultural heritage. In cultural evolution there are no mechanisms equivalent to genes and chromosomes (Csikszentmihalyi, 1996). Therefore, new ideas or inventions are not automatically passed on to the next generation, and education becomes a critical challenge to learn from the past (Bruner, 1996). Many creativity researchers have pointed out that the discoveries of many famous people (e.g., Einstein, who could build on the work of Newton) would have been inconceivable without the prior knowledge, without the intellectual and social network that simulated their thinking, and without the social mechanisms that recognized and spread their innovations.

Voices from Different Communities: Conceptual Distances. Design communities are social structures that enable groups of people to share knowledge and resources in support of collaborative design. Different communities grow around different types of design practice. Each design community is unique, but for the purposes of this discussion communities of practice (CoPs) and communities of interest (CoIs) will be differentiated. *Communities of Practice (CoPs)* (Wenger, 1998) consist of practitioners who work as a community in a certain domain undertaking similar work. Examples of CoPs are architects, urban planners, research groups, software developers, and end-users. CoPs gain their strength from shared knowledge and experience. However they face the danger of *group-think* (Janis, 1972): the boundaries of domain-specific ontologies and tools that are empowering to insiders are often barriers for outsiders and newcomers. *Communities of Interest (CoIs)* (Fischer, 2001) bring together stakeholders from different CoPs to solve a particular (design) problem of common concern. They can be thought of as "communities-of-communities" (Brown, and Duguid, 2000). Examples of CoIs are described in the following section. Fundamental challenges facing CoIs are found in building a shared understanding (Resnick, Levine, and Teasley, 1991) 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 to describe their ideas and to establish a common ground (Clark, and Brennan, 1991).

In a world in which solutions are neither given nor confined in one single mind (Bennis, and Biederman, 1997), we need not only new models of collaboration, but also effective creativity support tools (Shneiderman, 2007). These tools have the potential (1) to provide time on task by eliminating prerequisite skills and by automating "low-level" skills (e.g.. the use of spelling correctors, compilers, spreadsheets, etc.); (2) to make information relevant to the task at hand (by employing task and user models); (3) to support emerging insights by synthesizing, visualizing, and simulating information from different sources; and (4) to make all voices heard by exploiting the symmetry of ignorance and conceptual collisions.

Fostering Learning and Social Creativity with Socio-Technical Environments

Grounded in our conceptual framework described in the previous section, we have developed over the last two decades a variety of socio-technical environments which will be briefly described in this section indicating their contribution to learning, social creativity, and cultures of participation (Shneiderman, 2002). Table 1 provides on overview of the socio-technical environments described in this section.

CreativeIT Wiki

Conventional wikis (Tapscott, and Williams, 2006) have proven to be usable and useful to support communities, but one of their main limitations is their *lack of support for different media*

Table 1: Overview of Socio-Technical Environments Described in this section

Socio-Technical Environment	**Application Domain**	**Creativity Dimension**	**Cultures of Participation**
CreativeIT Wiki	Research Community in Creativity	Supporting the creations of mind maps, videos, anecdotes, and stories	Engaging the community by supporting *processes and activities* surrounding the creation of content
SketchUp + 3D-Warehouse + Google Earth	3D Modeling	Creating unique artifacts and collections	Engaging the Talent Pool of the Whole World
Envisionment and Discovery Collaboratory (EDC)	Urban Planning	Supporting Communities of Interest	Putting Owners of Problems in Charge
Courses-as-Seeds	Communities of Learners	Knowledge Creating and Sharing by Learners	Supporting Community of Learners

types as they are applied to research in Creativity and Information Technology (IT) as explored and supported by the NSF program CreativeIT (*http://www.nsf.gov/pubs/2007/nsf07562/nsf07562.htm*). A consequence of this limitation is that communities (particularly those not focused on text) have only limited means to describe the research contributions. In our NSF supported research projects (Dick, Eden, and Fischer, 2009), we have explored the following factors in understanding and designing new wikis that can be used to support collaborative design and social creativity:

- Wikis have always had the goal of being *open, simple, and low-threshold environments*; this creates the challenge of increasing the expressiveness (the "high ceiling") required for creative activities in a wiki while retaining the low threshold;
- Most wikis have been used as *content management systems* in which individual contributions are accumulated; this raises the demand to improve support for dialogue, interpretation, interactions, and reflection;
- Current wikis present only the current versions of content, and minority opinions are often lost in the rewriting of wiki items; this creates the challenge of making *minority voices heard* to avoid the pitfall of average mediocre products and ideas (Lanier, 2006);
- Many wikis suffer from a lack of participation; they are *"systems built but users never come."*

We have investigated these requirements in the CreativeIT Wiki (*http://swiki.cs.colorado.edu/CreativeIT*) serving as a socio-technical environment supporting the diverse communities interested in creativity and IT (National-Research-Council, 2003). Our *assessment studies* have provided indications for the following challenges: (1) current wiki-like environments are limited (we need to analyze and create additional objects such as mind maps, videos, anecdotes, and stories); (2) different modes of interacting with wikis need to be supported (including: face-to-face, virtual, synchronous, and asynchronous activities); and (3) the right balance between supporting more complex interactions and more varied objects and avoiding the loss of a low threshold for participation needs to be found.

A research team at Google in Boulder, CO is working on the objective of having all buildings in the world modeled in 3D. Google Earth is being used to explore this virtual 3D world. This desirable objective cannot be achieved solely by a development team at Google due to the sheer amount of work it requires. The team at Google has chosen to create a socio-technical environment (supporting meta-design and wiki-style environments for sharing artifacts) by integrating SketchUp, 3D Warehouse, and Google Earth to support everyone motivated enough to participate in this effort. This project represents a unique, large-scale example in evaluating the conceptual framework for social creativity and collaborative design.

SketchUp (*http://sketchup.google.com/*) is an interactive 3D modeling environment. Although SketchUp is a high-functionality environment with a reasonably low threshold and a high ceiling, developing sophisticated models with SketchUp requires a *nontrivial learning effort*. In order to motivate enough people and make them independent of “high-tech scribes,” powerful learning mechanisms for SketchUp are critical to allow everyone who wants to contribute to learn how to do so.

The 3D Warehouse (*http://sketchup.google.com/3dwarehouse/*) is an information repository for the collection of models created by all users who are willing to share the models they created with SketchUp. The 3D Warehouse contains thousands of models from different domains, including buildings, houses, bridges, sculptures, cars, and people. It supports collection mechanisms to organize models and supports ratings and reviews from community members.

Google Earth has the capability to show 3D objects consisting of users' submissions that were developed using SketchUp. Figure 1 shows downtown Denver modeled in 3D and displayed in Google Earth.

Figure 1: Downtown Denver modeled in Google Earth using SketchUp

The assessment of this large-scale effort has shown that extensive support for learning to become a contributor (in this case: to be able to develop models with SketchUp) is critically important to foster a culture of participation. As the 3D Warehouse grows, support is not only needed for the contribution of additional 3D models, but the rich information stores needs to be organized and *new curatorial mechanisms* need to be explored, designed, and implemented.

The Envisionment and Discovery Collaboratory (EDC)

The EDC (Arias et al., 2000) is a long-term research platform exploring conceptual frameworks for collaborative design and social creativity in the context of complex design problems. It brings together participants from various backgrounds to frame and solve ill-defined, open-ended design problems. The knowledge to understand, frame, and solve these problems does not already exist (Engeström, 2001), but is constructed and evolves during the solution process—an ideal environment to study social creativity. The EDC represents a *socio-technical environment* incorporating a number of technologies, including table-top computing, the integration of physical and computational components supporting new interaction techniques, and an open architecture supporting meta-design activities. The vision of the EDC is to provide contextualized support for *reflection-in-action* (Schön, 1983) within collaborative design activities.

Figure 2 shows a design session exploring a urban planning problems involving different stakeholders. The EDC supports face-to-face problem-solving activities by allowing the participants to discuss and explore problems while taking advantage of a shared construction space facilitated by a table-top computing environment. As participants interact with physical objects that are used to represent the situation currently being discussed and create design situation by sketching, corresponding computational representations are created and

Figure 2: A community of interest using the EDC for a design session

incrementally updated by using technologies that recognize these actions. Computer-generated information is projected back onto the horizontal physical construction area, creating an augmented reality environment. This physical construction is coupled with information relevant to the problem currently being discussed.

Grounded in a meta-design perspective, we have included mechanisms within the EDC to allow participants to inject content into the simulations and adapt the environment to new scenarios. Also, we have created ways to link to existing data and tools so that participants can draw on information from their own areas of expertise to contribute to the emerging, shared model. By exploring and supporting these activities, the EDC has given us insights into collaborative design that draw on both individual and social aspects of creativity.

Evaluations showed (Warr, 2007) that the EDC empowers users in personally meaningful tasks to engage as active contributors, externalizing ideas and thereby allowing knowledge to be created, integrated, and disseminated. It supports users to interact and communicate with boundary objects leading to the generation of new ideas through the combination and improvement of existing ideas (for example: participants considered the sketching function allowing the creation of external representations to be crucial for the generation of objects "to-think-with" and "to-negotiate-about.")

More specifically, we have observed that more creative solutions to urban planning problems can emerge from the collective interactions with the environment by *heterogeneous communities of interests* compared to *homogeneous communities of practice* (Fischer, 2001). We have observed also that participants are more readily engaged if they perceive the design activities as *personally meaningful* by associating a purpose with their involvement (Fischer, 2002), and participants must be able to *naturally express* what they want to say (Eden, 2002).

Courses-as-Seeds

Courses-as-seeds (dePaula, Fischer, and Ostwald, 2001) is an educational model that explores meta-design and social creativity in the context of fundamentally changing the nature of courses taught in universities. Its goal is to create a culture of informed participation (Fischer, and Ostwald, 2005) that is situated in the context of university courses transcending the temporal boundaries of semester-based classes. The major role for new media and new technologies from a culture-of-participation perspective is not to deliver predigested information and non-changeable artifacts and tools to individuals, but rather to provide the opportunity and resources for engaging them in authentic activities, for participating in social debates and discussions, for creating shared understanding among diverse stakeholders, and for framing and solving personally meaningful problems.

Over the last decade, our teaching objectives and practices have increasingly tried to reconceptualize learning in courses from a cultures-of-participation perspective. Our courses are using wikis as course information environments (for examples see: *http://l3d.cs.colorado.edu/~gerhard/courses*). Traditionally, the content of a course is defined by the resources provided by instructors (such as lectures, readings, and assignments), but, in courses-as-seeds, the instructor provides the initial seed rather than a finished product. By involving students as active contributors, courses do not have to rely only on the intellectual capital provided by the instructors but they are enriched on an ongoing basis by the contribution of all participants.

Courses-as-seeds represent a *community-of-learners* model (Rogoff, Matsuov, and White, 1998) and explores new middle ground between *adult-run* and *children-run* education. All participants are active and the more skilled partners (experienced teachers and coaches) can provide leadership and guidance. The learners have opportunities to become responsible and organize their own learning, exploit their previous interests, and sustain their motivation to learn by having some control over their contributions.

The courses-as-seeds model represents a system of values, attitudes, and behaviors that differ radically from the traditional educational culture in which courses are conceived as finished products and students are viewed as consumers. Courses-as-seeds create a culture based on a *designer mindset* that emphasizes habits and tools that empower students to actively contribute to the design of their education (and eventually to the design of their lives and communities).

Implications: Lessons Learned and Challenges Ahead

The developments of the socio-technical environments described briefly in the previous section have explored our basic assumptions that learning, social creativity, and cultures of participation can be enhanced by making all voices heard, harnessing diversity, and enabling people to be aware of and to access each other's work and ideas, relate them to their own, and contribute the results back to the community. Whereas social creativity seen from this perspective is essential for framing and solving complex design problems, it contributes also to the invention and transformation of our social and cultural environments. With modern decentralization of knowledge into highly specialized niches, no single person is likely to have sufficient knowledge to solve a complex problem in any given field, and collaboration is therefore necessary.

Our studies have provided evidence for our basic assumption that innovative socio-technical environments create feasibility spaces for new social practice. We have articulated some initial success factors from our research including *promises*-new perspectives with potential that should be pursued, and *pitfalls*-problematic insights which should not be overlooked and misconceptions that must be exposed and examined. These factors were derived from the assessment studies of the specific application contexts but are more broadly applicable to study design creativity and they contribute to an enrichment of the conceptual framework articulated in this chapter.

Our basic assumption is that collaborative design and social creativity are necessities rather than luxuries for most interesting and important design problems in today's world. But there is ample evidence that there should be a "and" and not a "versus" relationship between individual and social creativity as aptly expressed by Rudyard Kipling *"The strength of the pack is in the wolf, and the strength of the wolf is in the pack."* This claim is strongly supported by other studies (Bennis, and Biederman, 1997; Csikszentmihalyi, 1996) and other conceptual frameworks such as the fish-scale model (Campbell, 2005) which postulates that we should achieve *"collective comprehensiveness through overlapping patterns of unique narrowness" (p. 3*). Meta-design supports social creativity by democratizing design allowing all users to become participants in personally meaningful problems.

An important objective of meta-design is to create important foundations for collaborative design and social creativity by encouraging and supporting owners of problems to contribute user-generated content. Underdesign (Brand, 1995), which is negotiated rather than planned in advance, allows owners of problems to adapt a system to local contingencies and conditions.

Underdesign is a defining activity for meta-design aimed at creating design spaces for others. It assumes that the meaning, functionality, and content of a system are not fully defined by designers and user-representatives alone at design time, but are socially constructed throughout the entire design, deployment, and use cycles of the system. Emphasizing underdesign as an important objective of meta-design creates important foundations for social creativity and cultures of participation by encouraging and supporting owners of problems in contributing user-generated content in Web 2.0 environments, such as: Wikipedia, Second Life, Flickr, YouTube, and open source (von Hippel, 2005; Benkler, 2006; Tapscott, and Williams, 2006).

In cultures of participation there is no clear distinction between developers and users: all users are potential developers. Being a consumer or being a designer is a not binary choice: it is rather a continuum ranging from passive consumer, to well-informed consumer, to end-user, to power user, to domain designer all the way to meta-designer (Preece, and Shneiderman, 2009).

People will decide on the worthiness of doing something by relating the perceived value of an activity to the perceived effort of doing it (Fischer, and Giaccardi, 2006). Experiences with systems developed by cultures of participation have exposed the following barriers: individuals must perceive a value in contributing to an activity that is large enough to outweigh the effort and the effort required to contribute to this activity must be low enough to avoid interfering with the work at hand. From a meta-design perspective, major efforts at design time are needed to create the structures that will empower users at use time and greatly reduce their cost of participation. *Value considerations* can be influenced by allowing people to engage in personally meaningful tasks. People are willing to spend considerable effort on things that are important to them. The *effort* can be reduced by lowering the threshold required to learn and make a contribution and by taking advantage of derived information from the actions of participants, e.g., personalizing environments by creating task and user models of their behavior.

Without active contributions and participation from motivated users, learning and social creativity will not succeed. Important motivational dimensions (Csikszentmihalyi, 1996) to be considered are: *generalized reciprocity, social recognition, rewards, and social capital*.

Although participants in community-based efforts, as exemplified by our application contexts, typically do not get paid for their contribution, there are other forms of external compensation contributing to extrinsic motivation. Reputation in these communities is an external motivator governed by what you contribute to the community (Raymond, and Young, 2001). More important and more interesting than extrinsic motivation is intrinsic motivation that is positively influenced by the fact that participants find their engagement intellectually stimulating and personally enriching. Participating in these projects may be a way to learn about a new technology that may be useful to further professional development of technically inclined participants.

The theory of the *Long Tail* (Anderson, 2006) conveys that our culture and economy is increasingly shifting away from a focus on a relatively small number of "hits" (mainstream products and markets) at the head of the demand curve and toward a huge number of niches in the tail. As the costs of production and distribution fall, especially online, there is now less need to lump products and consumers into one-size-fits-all containers.

While the Long Tail is most often discussed as a phenomenon of interest for web-based businesses, it has implications for learning and social creativity. By empowering stakeholders with unique interest and knowledge to be active contributors, the networked information economy has unleashed a flowering of creativity across all fields of human endeavor and has created a Long Tail of niche communities engaging in very large number of idiosyncratic topics in learning and social creativity (Collins, Fischer, Barron, Liu, and Spada, 2009).

Learning and social creativity require the co-design of social and technical systems. They need to use models and concepts that focus not only on the artifact but exploit the social context in which the systems will be used Creativity flourishes best in a unique kind of social environment: one that is stable enough to allow continuity of effort, yet diverse and broad-minded enough to nourish creativity in all its subversive forms. Practice without process becomes unmanageable, but process without practice damps out the creativity required for innovation; the two sides exist in perpetual tension.

By studying design activities in specific application contexts addressing specific societal challenges of our world, our research lays the groundwork for an enriched conceptual framework for social creativity and cultures of participation. Achieving these objectives is not only a technical problem; it requires new cultures, new mindsets, and innovative socio-technical environments that provide people with powerful media to express themselves and engage in personally meaningful activities. Research activities have only scratched the surface of exploiting the power of collective minds equipped with new media. The challenges of the complex problems that we all face make this approach not a luxury, but a necessity.

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